August 1997 www.nasatech.com Vol. 21 No. 8

TECH BRIEFS

THE DESIGN/ENGINEERING TECHNOLOGY DIGEST

Technology 2007 Exhibits Preview

Graphics & Simulation Advances

Laser Tech Briefs

DAQ Made Simple

with DAQ Wizards in LabVIEW® 4.1

NEW

Today, thousands of users are successfully using LabVIEW, the world's leading instrumentation software package, in their data acquisition (DAQ) systems. Now, with the **new DAQ Wizards in LabVIEW 4.1** successful DAQ applications are easier than ever. From the time you open the LabVIEW package you are only a few minutes and a few mouse clicks away from a custom solution designed for you. Whether you are looking for a temperature monitoring system, a PC-based multimeter, oscilloscope, or waveform generator, or countless other applications, LabVIEW 4.1 has you up and running in a fraction of the time it takes with other software. Discover how the new DAQ Wizards bring you instant success.

LabVIEW – It's Just That Easy

For a free LabVIEW 4.1 Evaluation Package, call

(800) 661-6063

(U.S. and Canada)

www.natinst.com/mags/labview41.htm

NATIONAL INSTRUMENTS®

The Software is the Instrument®

U.S. Corporate Headquarters
Tel: (512) 794-0100 • Fax: (512) 794-8411
info@natinst.com
Worldwide network of direct offices and distributors.

For More Information Circle No. 601

omega.com™

OMEGA®
One Omega Drive, P.O. Box 4047
Stamford, CT 06907-0047

http://www.omega.com
e-mail: info@omega.com

Collection Series #2-117018

To Request Your DILBERT® Deck Card Pack, Dial: 1-(203)-329-1266

DILBERT® by Scott Adams

Get Your Dilbert® Card Deck Circle No. 516

Laugh When You Receive Dilbert® Card Deck #2 !

Where Do I Find Infrared Instruments?
OMEGA...Of Course!

Pocket Infrared Pyrometer

OS681 Series $149 Basic Unit

Document #1709 OMEGAfax™

omega.com™ OMEGA®

Infrared Thermocouple

As Seen In...

Model OS39 $225 Basic Unit

Document #1666 OMEGAfax™

©COPYRIGHT 1997 OMEGA ENGINEERING, INC. ALL RIGHTS RESERVED
Patent Applied For

Handheld Infrared Thermometers Optional Laser Sight

OS520 Series $345 Basic Unit

Document #1538 OMEGAfax™

OS522 Unit with Standard Laser Sight, $1295. U.S. and Int'l. Patents Pending

OS520 units supplied standard with soft carrying case, wrist strap, batteries, ac adaptor and complete operator's manual.

For more information, call OMEGAfax℠ on-line publishing service at 1-800-848-4271 and request desired document numbers.

Digital Infrared Temperature Scanner

OS91 $699

Document #1426 OMEGAfax™

For Sales and Service, Call:
1-800-82-66342™
1-800-TC-OMEGA

See Dilbert® On The Reverse Side Of This Card!

Where Do I Find Handheld Multimeters/Thermometers?
OMEGA...Of Course!

http://www.omega.com

Audible Multimeter

Model HHM1 $349

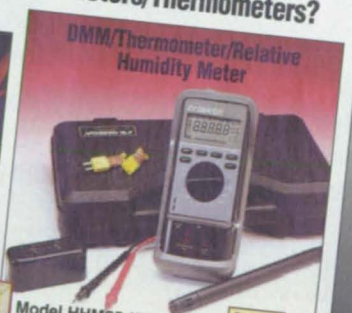
Choice of 5 Languages! Units supplied standard with carry case, ear piece, and sensing probes.

omega.com™ OMEGA®

Document #1031 OMEGAfax™

e-mail: info@omega

DMM/Thermometer/Relative Humidity Meter



Model HHM25-KIT $259

Document #1372 OMEGAfax™

©COPYRIGHT 1997 OMEGA ENGINEERING, INC. ALL RIGHTS RESERVED
Patent Applied For

Large Display DMM/Thermometer

Model HHM57B Series $109

Document #1699 OMEGAfax™

For more information, call OMEGAfax℠ on-line publishing service at 1-800-848-4271 and request desired document numbers.

Low Cost Digital Multimeters

HHM10 Series from $49

Document #1515 OMEGAfax™

For Sales and Service, Call:
1-800-82-66342™
1-800-TC-OMEGA

NEW! FREE!

Vol. MM™
21st Century™ Preview Edition

YOUR SOURCE FOR

- Temperature
- Flow & Level
- Pressure, Strain & Force
- Data Acquisition
- pH & Conductivity
- Electric Heaters
- Environmental

Request The Vol. MM™ 21st Century™ Preview Edition
Circle No. 517 or Dial 1-800-848-4271 for OMEGAfax℠ Service and Request Doc. #9983.

http://www.omega.com
e-mail: info@omega.com

OMEGAfax℠

OMEGA's 24-Hour-a-Day, On-Demand Publishing Service

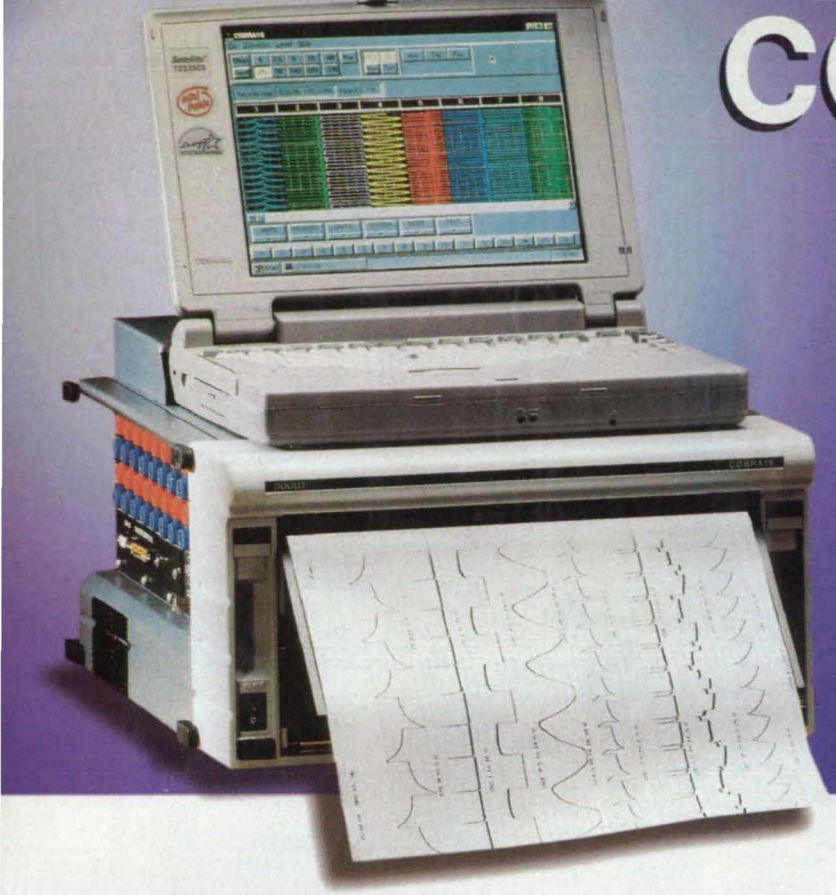
DIAL 1-800-848-4271

For Sales and Service Call: 1-800-82-66342℠ 1-800-TC-OMEGA

ISO 9001 CERTIFIED CORPORATE QUALITY

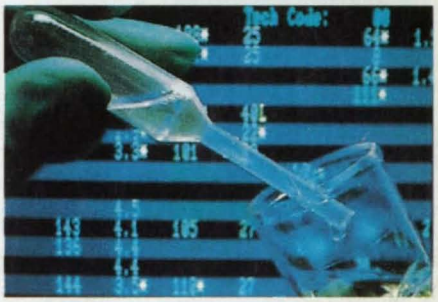
omega.com™ OMEGA®

OMEGA ENGINEERING, INC., ONE OMEGA DRIVE, P.O. BOX 4047, STAMFORD, CT. 06907-0047



COBRA 16

...It Will Test Everything, But Your Patience.



Analyze Data While You're Collecting It!

Now you can turn raw data into solid information, **faster and more efficiently** than ever before...with the COBRA 16 Data Acquisition System.

The COBRA 16 features a built-in-controller that **utilizes your PC,** and a host of **Microsoft® Windows® based data acquisition software packages.** You get powerful signal monitoring, signal conditioning, signal capture, chart output, and signal playback and analysis capabilities...all in one affordable system.

The COBRA 16 is ideal for quality assurance, maintenance, or process monitoring applications. Any way you use it, the COBRA 16 will help **make the most of your time...your talent...and your test cell resources.**

FEATURES AND CAPABILITIES

- ***Real Time analysis software**--Make decisions while your tests are running.*
- ***View II software**--For detailed post-acquisition analysis on site.*
- ***Microsoft® Windows® based setup and control software.***
- ***High quality printer**--Features extended head performance, low power consumption, high contrast printing.*
- ***Signal monitoring**--Color display of signals. Four acquisition modes. Signals displayed at all times, monitoring only, recording to chart, and acquiring.*
- ***Integral or external signal conditioners.***
- ***Standard industrial or isolated power supply.***
- ***8 Channel model**--1-250k samples/second*
- ***16 Channel model**--1-125k samples/second*

Visit our Website
www.gouldis.com

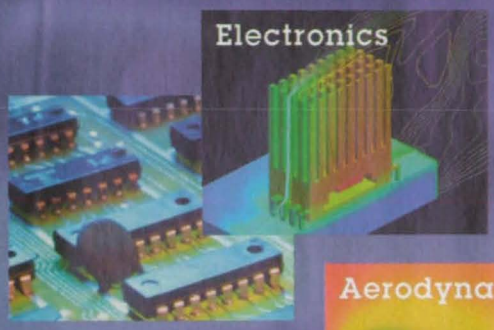
COBRA 16 signals a new era in PC-based data acquisition systems.
For a **FREE COBRA 16 Brochure,** call **1-800-468-5365.**
8333 Rockside Road, Valley View, Ohio 44125 • (216) 328-7000 • Fax: (216) 328-7400

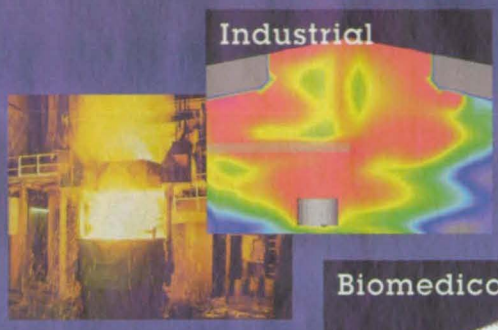
GOULD
Instrument Systems
A ThermoSpectra Company

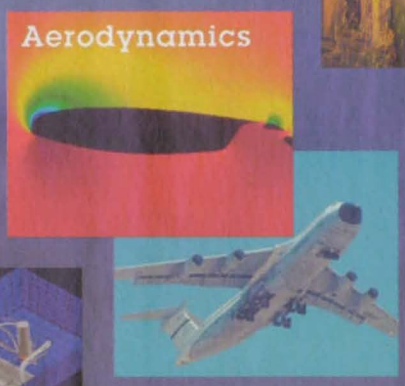
For More Information Circle No. 606

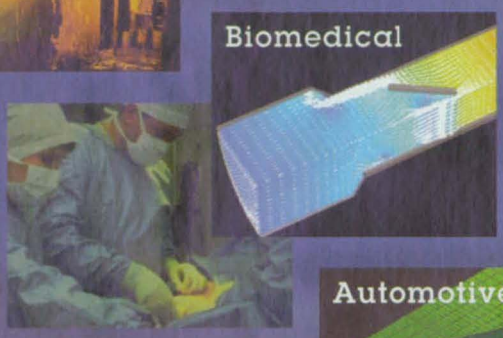
CFD2000®

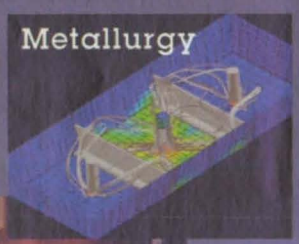
generating real results...

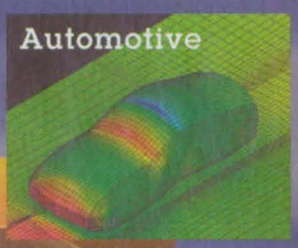












www.adaptive-research.com

sales@adaptive-research.com

Trying to solve real-world fluid flow and heat transfer problems?

The solution...CFD2000. The most powerful and cost-effective CFD/CAD software system available to engineers. Period. With CFD2000, you can analyze and improve your designs without the cost of real-world testing. This means a more cost-effective design cycle. CFD2000 helps you identify design flaws early, resulting in a better product and shorter time-to-market. Adaptive Research is dedicated to building strong relationships with clients and ensuring their success by providing quality software and expert technical support. Adaptive Research has the solution for you...CFD2000.

CALL FOR FREE DEMO CD OF CFD2000

adaptive RESEARCH
a Division of Pacific-Sierra Research Corporation

2901 28th Street, Suite 300
Santa Monica, California 90405
(800) 326-5155

4960 Corporate Drive, Suite 100
Huntsville, Alabama 35805
(800) 321-2426

Why do more mechanical design engineers choose SolidWorks™?

Results. Our production solid modeling solutions help thousands of customers worldwide operate more efficiently with faster time-to-market – from Alcoa in the US to Sindo-Ricoh in Asia. With this kind of success, it should come as no suprise that SolidWorks experienced the best first year of any CAD company in history, with more first year revenue than PTC and Autodesk – combined.

Why the move to SolidWorks? We provide the highest quality solid modeling and mechanical design solutions in the market. Bar none. Our products are consistently released on time. They move our customers quickly into production. And offer Windows®-native ease-of-use, 100% editability for design flexibility, and productivity gains up to 60%. All for only $3,995 (USD)*.

Experience the power of SolidWorks today.

SolidWorks

For a FREE interactive CD and the location of a reseller near you, call **800-693-9000, ext. 304**. Or visit our Web site to learn more about upcoming SolidWorks seminars . . .

www.solidworks.com/304

*Internationally, SolidWorks is priced locally.

No Distributor Turns Your Order Faster!

SAME-DAY SHIPMENT

On orders entered by 5:00p.m. central time

Quality Electronic Components
Superior Service!

Rated #1 for On-Time Delivery!
...5 Years in a Row!

Call, write, fax or visit us on the Internet for your FREE CATALOG today!

Digi-Key®

Digi-Key Corporation
701 Brooks Ave. South
Thief River Falls, MN 56701
Toll-Free: 1-800-344-4539 • Fax: 218-681-3380
Order Online www.digikey.com

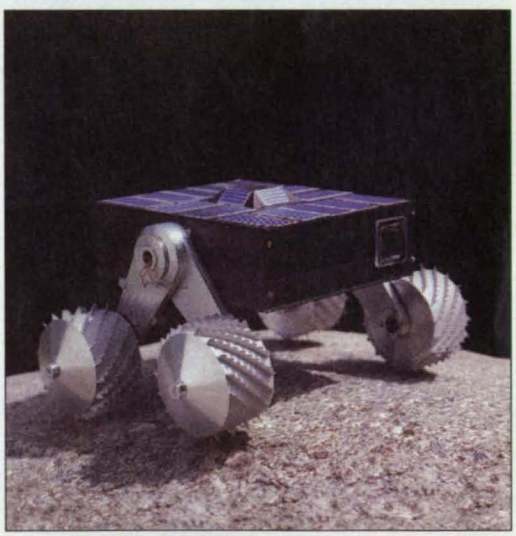
NASA TECH BRIEFS

August 1997 • Vol.21 No.8

Features

Briefs

Departments

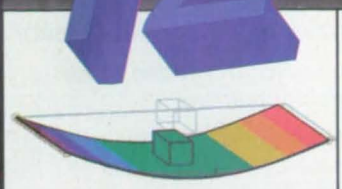


NASA's Jet Propulsion Laboratory (JPL) and Japan's Institute of Space and Astronautical Science plan to launch the first NASA/Japan joint asteroid mission in January 2002. A 2.2-pound rover, designed and built by JPL, will collect samples of the asteroid Nereus and return them to Earth for study. JPL engineers used Working Model® 2D and 3D software from Working Model, Inc., a division of Knowledge Revolution, San Mateo, CA, to analyze the rover's dynamics and visualize its mechanical performance through motion simulation. For more on this application, see Application Briefs on page 16.

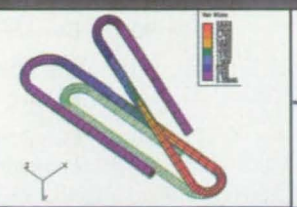
Photo courtesy of Knowledge Revolution

Now: NONLINEAR that's EASY

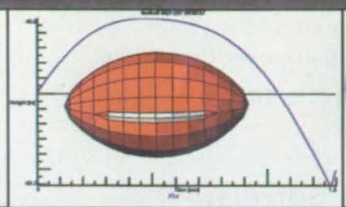
12 EASY things you can do with Nonlinear that you can't do with regular linear stress analysis



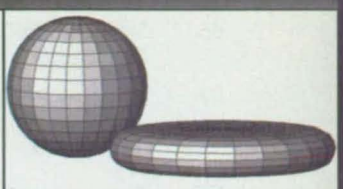
Out of plane bending - Use nonlinear analysis to determine whether this plate will foreshorten and fall out of its support. Linear cannot predict geometry changes perpendicular to a load.



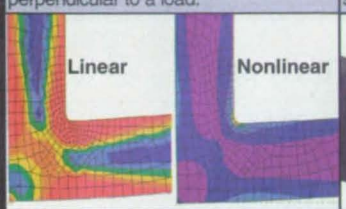
Permanent deformation - Algor's nonlinear analysis can predict the permanent deformation when the predicted stress exceeds the yield stress. Linear analysis can't do this.



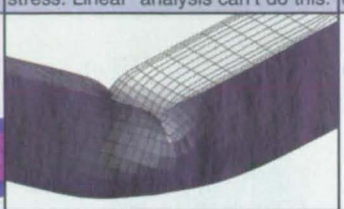
Trajectory - Basic motion, such as the trajectory of this rotating football is easily done using Algor's nonlinear analysis. Linear analysis cannot predict motion.



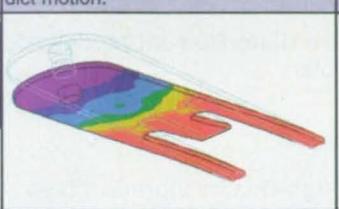
Squashing - Squashing this rubber ball in a vice using linear analysis cannot predict the final shape like this nonlinear analysis.



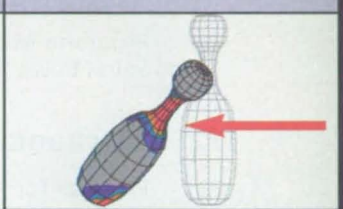
Stress concentration - Linear stress analysis will misrepresent both the stress and the deformation of this hanger due to minute changes in the fillet. Nonlinear analysis gets it right.



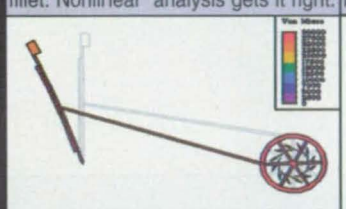
Local buckling - When failure is due to local buckling, the geometry fails at stresses much, much lower than the yield stress. Linear cannot detect local buckling.



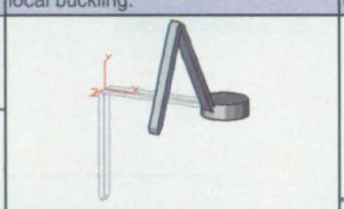
Snap-through - Any time you have a snap-through effect, your part is in motion until it stops on the other side. You need nonlinear analysis to predict this effect.



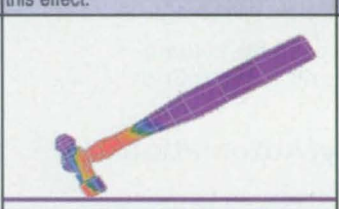
Impact - Nonlinear dynamic response predicts the stress in an object when it goes into motion as a result of impact by another object. Linear analysis cannot analyze for impact and motion.



4-bar link - Linear dynamic analysis cannot predict the forces and stresses due to periodic loading. Accupak/VE simulates the loading and stresses in one analysis.



3-D mechanism - When a moving object is a 3-D mechanism, high inertia forces can occur. You need Accupak/VE to predict the stresses caused by motion.



Contact impact - Kinematic motion and the stresses due to the shock of impact cannot be predicted by either linear stress analysis or kinematics analysis software. Accupak/VE does it in one shot..

Elastic large deformation - Nonlinear analysis predicts the stressed geometry when the deformation is significant, even if the material properties remain linear. Linear analysis fails at this.

Nonlinear Dynamic Analysis for Virtual Engineering that's:

1. **As EASY as Linear Static Stress Analysis**
2. **At Linear Stress Pricing Levels**
3. **Fully Integrated with your CAD Station**

Accupak/VE from Algor is the nonlinear dynamic analysis software that's as easy to use as regular linear stress analysis while providing advanced solution technology. Its ease-of-use, affordability, and compatibility with Pentium computers and mainstream CAD systems make Accupak/VE ideal for everyday engineering. Engineers can learn it quickly and easily with the help of Docutech-Technical Documentation On-line Information Resource.

Get your free Video and CD-ROM to see Algor Software in action

Video includes 18 action packed minutes of real-world examples combined with Algor FEA demonstrations. See Accupak/VE in action. CD includes a complete version of Algor's website with detailed information and software you can try.

Visit Algor at:
WWW.ALGOR.COM

Products

Services

Download Superdraw III

You have 4 ways to get your free demo video and CD-ROM:

1) Call: +1 (412) 967-2700
2) WWW.ALGOR.COM
3) E-mail to: info@algor.com
4) Complete this form and fax to: +1 (412) 967-2781

Name _____ Company _____

Address _____

City _____ State/Prov. _____ Zip/Postal Code _____

Country _____ Telephone _____

Fax _____ E-mail _____

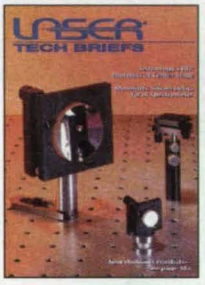
♦ALGOR®

When the Engineering Has to be Right

Algor, Inc.
150 Beta Drive, Pittsburgh, PA 15238-2932
USA
Phone: +1 (412) 967-2700
Fax: +1 (412) 967-2781
California: +1 (714) 564-0844
Europe (UK): +44 (1) (784) 442 246
E-mail: info@algor.com

Contents *continued*

Special Supplement



Laser Tech Briefs

Follows page 64 in selected editions only.

On the cover:

Models of three parts of a high-performance air intake manifold for Ford Motor Co.'s latest V-8 engine were used by Ford's Special Vehicle Operations group to test the performance of the manifold design. The models were generated from an SGC 5600 rapid prototyping machine form Cubital America, Troy, MI, running Cubital's Data Front End (DFE) rapid prototyping software. For more information on this and other Graphics & Simulation software, see the Special Focus on page 34.

Photo courtesy of Cubital America

NASA Tech Briefs, ISSN 0145-319X, USPS 750-070, copyright © 1997 in U.S. is published monthly by Associated Business Publications Co., Ltd., 317 Madison Ave., New York, NY 10017-5391. The copyright information does not include the (U.S. rights to) individual tech briefs that are supplied by NASA. Editorial, sales, production, and circulation offices at 317 Madison Ave., New York, NY 10017-5391. Subscription for non-qualified subscribers in the U.S., Panama Canal Zone, and Puerto Rico, $75.00 for 1 year; $125 for 2 years; $200.00 for 3 years. Single copies $10.00. Foreign subscriptions one-year U.S. Funds $195.00. Remit by check, draft, postal, express orders or VISA, MasterCard, and American Express. Other remittances at sender's risk. Address all communications for subscriptions or circulation to *NASA Tech Briefs*, 317 Madison Ave., New York, NY 10017-5391. Second-class postage paid at New York, NY and additional mailing offices.

New ModelServer Publisher makes it easy to collaborate across hallways, platforms, time zones and disciplines.

"We see ModelServer Publisher as a useful tool in moving beyond personal productivity applications to an enterprise work flow solution."
Dave Weisberg
Engineering Automation Report

For every project and everyone involved, ModelServer Publisher™ enables you to dynamically access design or engineering data in real time, all the time, via the Internet or Intranet using any standard Web browser.

NETSCAPE Enterprise Server Included

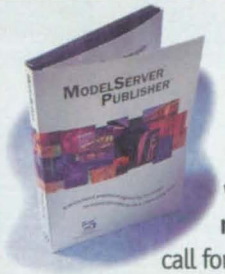
First in Bentley's family of ModelServer™ products, it allows you to review and distribute design or engineering documents in a variety of published formats on demand. So no matter how big the project or how widespread the team, everyone works with the most up-to-date information.

MicroStation® and AutoCAD® compatible.

ModelServer Publisher converts standard file formats (.DGN, .DWG, .DXF and .CEL) to public, web-based formats "on the fly," providing access between organizations and the public.

Experience ModelServer Publisher in action.

You absolutely, positively must see all that Bentley's family of ModelServer products can do for you; and look for soon to be released ModelServer Continuum™ for storing engineering maps and drawings in standard relational databases, and ModelServer TeamMate™ for web-centric document and work flow management.



Try it today! Publish your own files **LIVE** now by visiting **www.bentley.com/modelserver/**, or call for more information.

ModelServer Publisher

1-800-BENTLEY

In Europe call +31 23 556 0560
In Asia-Pacific call +61 3 9699 8699

BENTLEY
Engineering the future together

610-458-5000 • Fax: 610-458-1060
e-mail: family@bentley.com

For More Information Circle No. 554

NASA TECH BRIEFS

BPA ABP

Published by ..... Associated Business Publications
Chairman/Chief Executive Officer ..... Bill Schnirring
Publisher ..... Joseph T. Pramberger
Chief Editor ..... Linda L. Bell
Editor, Market Focus Editions ..... Robert Clark
Production Manager ..... Margery Koen
Assistant Production Manager ..... John Iwanciw
Art Director ..... Lois Erlacher
Production Artist ..... Christopher Coleman
Circulation Manager ..... Hugh J. Dowling
Circulation Assistant ..... Damiana Garcia

BRIEFS & SUPPORTING LITERATURE: Written and produced for NASA by **Advanced Testing Technologies, Inc.,** Hauppauge, NY 11788
Technical/Managing Editor ..... Ted Selinsky
Sr. Technical Analyst ..... Dr. Larry Grunberger
Art Manager ..... Eric Starstrom
Staff Writers/Editors ..... Dr. Theron Cole, George Watson, Howard Falk, Gail Pyke
Graphics ..... Robert Simons
Editorial & Production ..... Joan Schmiemann, Caroline Weaver, Becky D. Bentley

NASA:
NASA Tech Briefs are provided by the National Aeronautics and Space Administration, Technology Transfer Division, Washington, DC:
Administrator ..... Daniel S. Goldin
Director, Commercial Technology ..... Dr. Robert Norwood
Publications Director ..... Carl Ray

ASSOCIATED BUSINESS PUBLICATIONS
317 Madison Avenue, New York, NY 10017-5391
(212) 490-3999 FAX (212) 986-7864
Chairman/Chief Executive Officer ..... Bill Schnirring
President/Chief Operating Officer ..... Domenic A. Mucchetti
Treasurer ..... Joseph T. Pramberger
Credit/Collection ..... Felecia Lahey
Staff Accountant ..... Larry Duze
Budget Analyst ..... Mark Stanovic
Accounting Assistant ..... Alfredo Vasquez
Director of Marketing/New Business Development ..... George L. DeFeis
Exhibition Sales Manager ..... Wayne Pierce
Exhibition Sales Representative ..... Joanna Lipton
Human Resources Manager ..... Lourdes Del Valle
MIS Manager ..... Ted Morawski
Webmaster ..... Albert Sunseri
Assistant MIS Manager ..... Pak Tong
Network Administrator ..... Dmitry Master
Office Manager ..... Sylvia Valentin
Mailroom Operations ..... John Torres, Rose D'Addozio
Administrative Assistant ..... Christine Saluzzi

***NASA TECH BRIEFS* ADVERTISING ACCOUNT EXECUTIVES**
Headquarters ..... (212) 490-3999
NY, NJ (Area Code 201), Eastern Canada ..... John Waddell at (212) 490-3999
PA, DE, NJ (Area Code 908, 609), VA, DC, MD, WV ..... Tara Morie at (610) 640-3118
Eastern MA, NH, ME, RI ..... Paul Gillespie at (508) 429-8907
Bill Doucette at (508) 429-9861
Western MA, CT, VT ..... George Watts at (802) 824-5546
Southeast, South Central ..... Thomas E. Duffy at (770) 844-7996
OH, MI, IN, KY ..... Louise Clemens at (216) 397-7477
IL, WI, MO, IA, MN, ND, SD, NE, KS, Central Canada ..... Paul Tucker at (847) 397-7084
N. Calif., CO ..... Bill Hague at (408) 492-9292
WA, OR, ID, MT, WY, UT, Western Canada ..... Bill Madden; Bill Hague at (253) 858-7575
S. Calif., AZ, NM, NV (For *NASA Tech Briefs*) ..... Blake Dahlgren at (310) 288-0391
S. Calif., AZ, NM, NV (For *Electronics and Laser Tech Briefs*) ..... Richard Ayer, Jane Hayward at (714) 366-9089
TechDeck Postcard Sales ..... Janet Krebs at (847) 397-7084

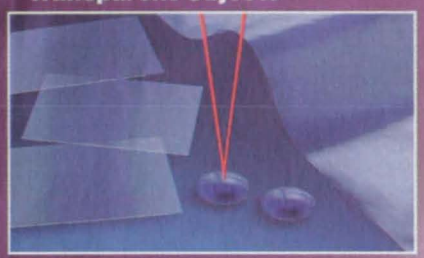
How To Reach Us On Line

NASA Tech Briefs home page: http://www.nasatech.com
Letters to the editor: ntb_edit@mindspring.com
To find out about advertising opportunities: ntb_advertise@mindspring.com

"Confocal"... a Breakthrough in LASER Measurement Technology!

0.1-µm resolution of height, depth, thickness and profiles – regardless of surface conditions

Thickness and Profiles of Transparent Objects



A single LT sensor head traces the curves of contact lenses and measures the thickness of glass and plastic (poly) film.

Depth of Metal Stampings and Scorings on Rough Surfaces

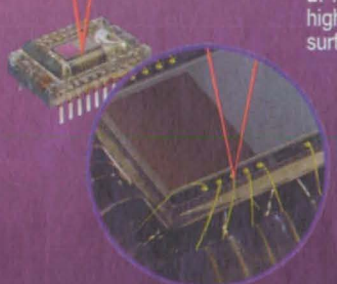
Scoring depths of 100 -150 µm are accurately measured by the new LT.

Thickness of Conformal Coatings on Colored Surfaces

LT accuracy is unaffected by surface color, luster, texture and even wet surfaces.

Flatness and Profiles of Mirrored Surfaces

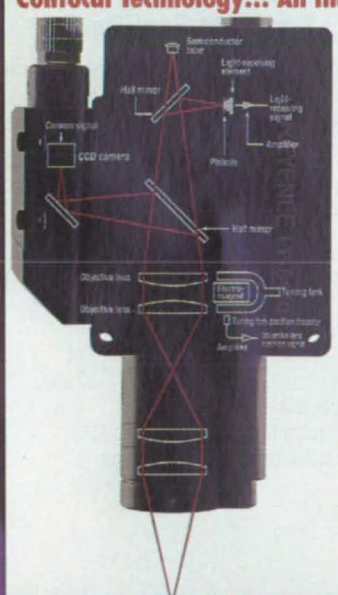
LT measurement of height and profiles of highly mirrored surfaces is unaffected by surface reflections.



Height of Very Small Objects

The height of 20-µm diameter IC leads with reflective surfaces is easily measured using confocal technology.

Confocal Technology... An Industry First!



A laser beam passes through a lens coupled to a vibrating tuning fork which moves the beam in and out of focus.

The beam reflects off the target through a system of mirrors and converges on a pinhole aperture. It passes through the aperature onto a photodiode only when perfectly focused.

The vertical position of the fork is then used to calculate the distance to the target's surface.

A Breakthrough in LASER Displacement Meter Performance

- 2-µm beam diameter with 0.1-µm resolution.
- Built-in CCD camera for viewing target surfaces.
- Autofocus beam technology insures measurement precision regardless of surface characteristics.
- Surface profile display increases measurement versatility.

Keyence Corporation of America
50 Tice Boulevard, Woodcliff Lake, New Jersey 07675
KEYENCE on the Internet... http://www.keyence.com

FREE
15-day trial
Call today

KEYENCE
SENSORS FOR FACTORY AUTOMATION

Atlanta Office:	Tel: 770-499-5390 • Fax: 770-499-5391
Chicago Office:	Tel: 630-775-1110 • Fax: 630-775-1169
Los Angeles Office:	Tel: 310-540-2254 • Fax: 310-316-1032
New Jersey Office:	Tel: 201-930-1400 • Fax: 201-930-0088
No. California Office:	Tel: 510-225-1550 • Fax: 510-225-1440

NASA Commercial Technology Team

NASA's R&D efforts produce a robust supply of promising technologies with applications in many industries. A key mechanism in identifying commercial applications for this technology is NASA's national network of commercial technology organizations. The network includes ten NASA field centers, six Regional Technology Transfer Centers (RTTCs), the National Technology Transfer Center (NTTC), business support organizations, and a full tie-in with the Federal Laboratory Consortium (FLC) for Technology Transfer. Call (206) 683-1005 for the FLC coordinator in your area.

NASA's Technology Sources

If you need further information about new technologies presented in *NASA Tech Briefs*, request the Technical Support Package (TSP) indicated at the end of the brief. If a TSP is not available, the Commercial Technology Office at the NASA field center that sponsored the research can provide you with additional information and, if applicable, refer you to the innovator(s). These centers are the source of all NASA-developed technology.

Ames Research Center
Selected technological strengths: Fluid Dynamics; Life Sciences; Earth and Atmospheric Sciences; Information, Communications, and Intelligent Systems; Human Factors.
Bruce Webbon
(415) 604-6646
bwebbon@mail.arc.nasa.gov

Dryden Flight Research Center
Selected technological strengths: Aerodynamics; Aeronautics Flight Testing; Aeropropulsion; Flight Systems; Thermal Testing; Integrated Systems Test and Validation.
Lee Duke
(805) 258-3802
duke@louie.dfrf.nasa.gov

Goddard Space Flight Center
Selected technological strengths: Earth and Planetary Science Missions; LIDAR; Cryogenic Systems; Tracking; Telemetry; Command.
George Alcorn
(301) 286-5810
galcorn@gsfc.nasa.gov

Jet Propulsion Laboratory
Selected technological strengths: Near/Deep-Space Mission Engineering; Microspacecraft; Space Communications; Information Systems; Remote Sensing; Robotics.
Merle McKenzie
(818) 354-2577
merle.mckenzie@ccmail.jpl.nasa.gov

Johnson Space Center
Selected technological strengths: Artificial Intelligence and Human Computer Interface; Life Sciences; Human Space Flight Operations; Avionics; Sensors; Communications.
Hank Davis
(713) 483-0474
hdavis@gp101.jsc.nasa.gov

Kennedy Space Center
Selected technological strengths: Environmental Monitoring; Sensors; Corrosion Protection; Bio-Sciences; Process Modeling; Work Planning/Control; Meteorology.
Gale Allen
(407) 867-8035
galeallen-1@ksc.nasa.gov

Langley Research Center
Selected technological strengths: Aerodynamics; Flight Systems; Materials; Structures; Sensors; Measurements; Information Sciences.
Dr. Joseph S. Heyman
(804) 864-6006
j.s.heyman@larc.nasa.gov

Lewis Research Center
Selected technological strengths: Aeropropulsion; Communications; Energy Technology; High Temperature Materials Research.
Ann Heyward
(216) 433-3484
ann.o.heyward@lerc.nasa.gov

Marshall Space Flight Center
Selected technological strengths: Materials; Manufacturing; Nondestructive Evaluation; Biotechnology; Space Propulsion; Controls and Dynamics; Structures; Microgravity Processing.
Harry Craft
(205) 544-5419
harry.craft@msfc.nasa.gov

Stennis Space Center
Selected technological strengths: Propulsion Systems; Test/Monitoring; Remote Sensing; Nonintrusive Instrumentation.
Kirk Sharp
(601) 688-1929
ksharp@ssc.nasa.gov

NASA-Sponsored Commercial Technology Organizations

These organizations were established to provide rapid access to NASA and other federal R&D and foster collaboration between public and private sector organizations. They also can direct you to the appropriate point of contact within the Federal Laboratory Consortium. To reach the Regional Technology Transfer Center nearest you, call (800) 472-6785.

Dr. David Moran
National Technology Transfer Center
(800) 678-6882

Ken Dozier
Far-West Technology Transfer Center
University of Southern California
(213) 743-2353

Dr. William Gasko
Center for Technology Commercialization
Massachusetts Technology Park
(508) 870-0042

J. Ronald Thornton
Southern Technology Applications Center
University of Florida
(904) 462-3913

Gary Sera
Mid-Continent Technology Transfer Center
Texas A&M University
(409) 845-8762

Lani S. Hummel
Mid-Atlantic Technology Applications Center
University of Pittsburgh
(412) 383-2500

Chris Coburn
Great Lakes Industrial Technology Transfer Center
Battelle Memorial Institute
(216) 734-0094

NASA ON-LINE: Go to NASA's Commercial Technology Network (CTN) on the World Wide Web at **http://nctn.hq.nasa.gov** to search NASA technology resources, find commercialization opportunities, and learn about NASA's national network of programs, organizations, and services dedicated to technology transfer and commercialization.

NASA Program Offices

At NASA Headquarters there are seven major program offices that develop and oversee technology projects of potential interest to industry. The street address for these strategic business units is: NASA Headquarters, 300 E St. SW, Washington, DC 20546.

Carl Ray
Small Business Innovation Research Program (SBIR) & Small Business Technology Transfer Program (STTR)
(202) 358-4652
cray@mail.hq.nasa.gov

Dr. Robert Norwood
Office of Aeronautics and Space Transportation Technology (Code R)
(202) 358-2320
rnorwood@mail.hq.nasa.gov

Philip Hodge
Office of Space Flight (Code M)
(202) 358-1417
phodge@osfms1.hq.nasa.gov

Gerald Johnson
Office of Aeronautics (Code R)
(202) 358-4711
g_johnson@aeromail.hq.nasa.gov

Bill Smith
Office of Space Sciences (Code S)
(202) 358-2473
wsmith@sm.ms.ossa.hq.nasa.gov

Bert Hansen
Office of Microgravity Science Applications (Code U)
(202) 358-1958
bhansen@gm.olmsa.hq.nasa.gov

Granville Paules
Office of Mission to Planet Earth (Code Y)
(202) 358-0706
gpaules@mtpe.hq.nasa.gov

NASA's Business Facilitators

NASA has established several organizations whose objectives are to establish joint sponsored research agreements and incubate small start-up companies with significant business promise.

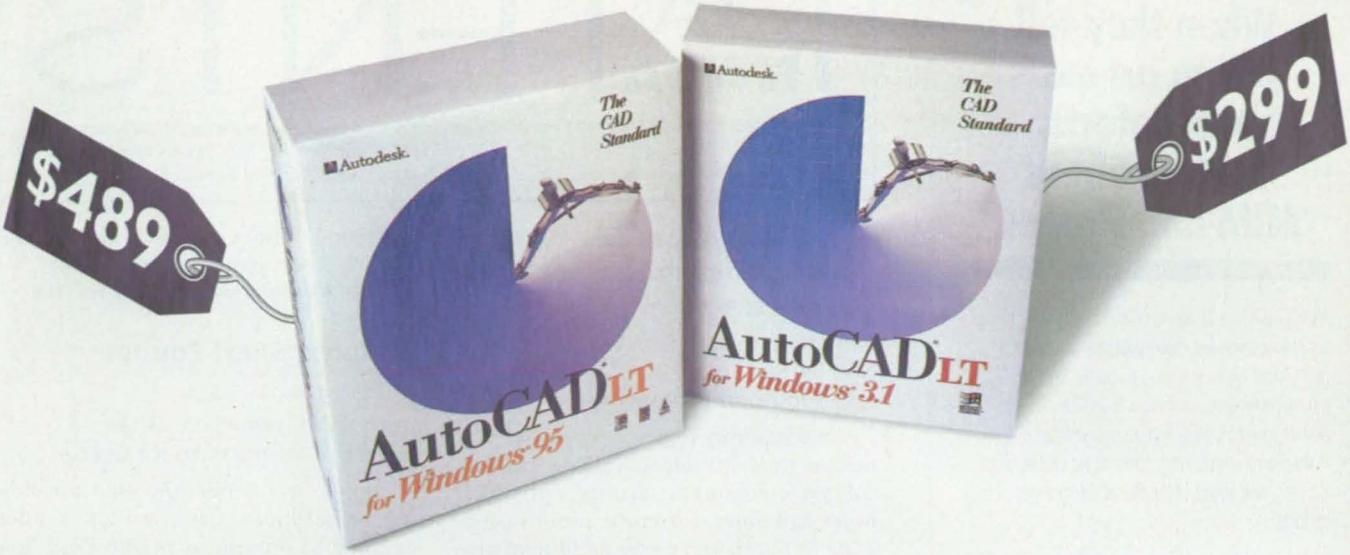
Karen Robbins
American Technology Initiative
Menlo Park, CA
(415) 325-5353

Dr. Jill Fabricant
Johnson Technology Commercialization Center
Houston, TX
(713) 335-1250

Joe Boeddeker
Ames Technology Commercialization Center
San Jose, CA
(408) 557-6799

Dan Morrison
Mississippi Enterprise for Technology
Stennis Space Center, MS
(800) 746-4699

If you are interested in information, applications, and services relating to satellite and aerial data for Earth resources, contact: Dr. Stan Morain, **Earth Analysis Center,** (505) 277-3622. For software developed with NASA funding, contact the **Computer Software Management and Information Center (COSMIC)** at phone: (706) 542-3265; Fax: (706) 542-4807; E-mail: http://www.cosmic.uga.edu or service@cosmic.uga.edu.



Prices include extras money can't buy.

What makes AutoCAD® LT so attractive isn't just the price, it's that it comes with peace of mind built in. Based on the industry standard, AutoCAD,® it's the only one of its kind that allows you to share files quickly and accurately with nearly 1.8 million AutoCAD and AutoCAD LT users worldwide. That means you can communicate ideas and iterations with just about anyone in the industry, whether they're clients, contractors or partners. You can't buy that kind of access, but you can get it free with AutoCAD LT. And when you do, you can rest assured you're investing in a product line that will grow as your business grows. So don't wait. The sooner you put AutoCAD LT to work for you, the sooner you'll see just how invaluable our extras really are.

New AutoCAD LT for Windows® 95

Designed for Microsoft® Windows®95

Provides all the benefits of Windows 95 and Office™ 95 compliance, including Windows NT™ support. Based on AutoCAD R13. Powerful CAD tools such as NURBS curves, advanced geometry and complex linetypes. Plus set-up wizards, a property painter and real-time pan and zoom make it easier than ever to use.

Microsoft® OFFICE Compatible

AutoCAD LT for Windows® 3.1

If you're not yet ready for the move to Windows 95, you can still reap the benefits of AutoCAD LT for Windows 3.1 (formerly known as AutoCAD LT Release 2) at a new low price. Based on AutoCAD R11 and R12.

True AutoCAD Compatibility

AutoCAD® COMPATIBLE

Other CAD packages claim to read and write .DWG, but in reality they can only translate it. AutoCAD LT's native .DWG file format means that you can share files without worry. No long waits as your files load, no ballooning file sizes and no translation errors.

VISIT YOUR LOCAL RETAILER TODAY, OR TO RECEIVE YOUR FREE DEMOPAK, CALL 1-800-228-3601* AND ASK FOR DEMOPAK A142. TO UPGRADE CALL 1-800-435-7771 AND ASK FOR OFFER J28.

Autodesk. DESIGN YOUR WORLD™

Visit our web site for more information about Autodesk products, http://www.autodesk.com. *Outside the U.S. and Canada, fax 206-860-2196. Pricing in U.S. dollars, estimated street price. Certain restrictions may apply. © Autodesk, Inc. Autodesk, the Autodesk logo and AutoCAD are registered trademarks, and Design Your World is a trademark of Autodesk, Inc. Windows 95 and Windows 3.1 are registered trademarks and Office Compatible and Windows NT are trademarks of Microsoft Corporation.

NASA PATENTS

Over the past three decades, NASA has granted more than 1000 patent licenses in virtually every area of technology. The agency has a portfolio of 3000 patents and pending applications available now for license by businesses and individuals, including these recently patented inventions:

Catalytic Ignitor for Regenerative Propellant Gun

(U.S. Patent No. 5,608,179)

Inventors: Gerald E. Voecks and Ned W. Ferraro,
Jet Propulsion Laboratory

Contemporary regenerative liquid propellant guns typically comprise a variable-volume combustion chamber in which inner and outer concentric pistons cooperate to pump and meter additional propellant into the chamber as the combustion proceeds. These guns need a more reliable and consistent means of ignition of the liquid propellant that also mitigates the occurrence of undesirable combustion oscillations that occur in the current four-step process. This ignitor incorporates a catalyst onto which the propellant, such as hydroxylammonium nitrate (HAN) and triethanolammonium nitrate (TEAN), is sprayed, and a heater for heating the catalyst. The catalyst is formed on a substrate that defines an electrical resistance heater, which heats the crystallites on its surface to the activation energy necessary for initiating the combustion.

For More Information Circle No. 787

Polarization Perception Device

(U.S. Patent No. 5,598,298)

Inventors: Victor S. Whitehead and Kinsell L. Coulson,
Lyndon B. Johnson Space Center

The invention is a means whereby a human observer can visually perceive the relative polarization of various objects in a given scene in real time, and/or delayed time if the scene is filmed, taped, or photographed. A polarizing filter having opposite broad sides and a centerline perpendicular to those sides is mounted on a base for relative rotation with respect thereto. Automatic drive means move the filter angularly about its centerline at a speed slow enough to permit changes in light transmission to be perceived as light-dark pulses by an observer, but fast enough so that the light phase of each pulse occurs prior to fading of the image of the preceding pulse. Thus speed is coordinated with the visual sensory memory so that the precise location and shape of objects polarizing the light can be perceived as if it were continuous. In a prototype, one revolution per second was found to work well for both real-time human observation and video taping.

For More Information Circle No. 788

Flexured Shaft Poppet

(U.S. Patent No. 5,577,533)

Inventor: Joseph S. Cook, Jr.,
Lyndon B. Johnson Space Center

Poppets are commonly used for closing or seating a valve seat on a valve opening to prevent or permit fluid flow through the opening. In conventional designs contaminants or components can build up as a residue on sliding surfaces as a result of surface wear and other factors. In the invention a tubular poppet stem or valve is constructed from a spring material, and the wall of the stem has a longitudinal section with a spiral configuration. The tubular section and the spiral provide a radial, relatively stiff support along the longitudinal axis yet permit the stem to have a longitudinal spring action. The flexible wall construction allows a sealing valve head to flex relative to the longitudinal axis, so that seating surfaces on the valve head and opening can align themselves.

For More Information Circle No. 790

Method of Implementing Digital Phase-Locked Loops

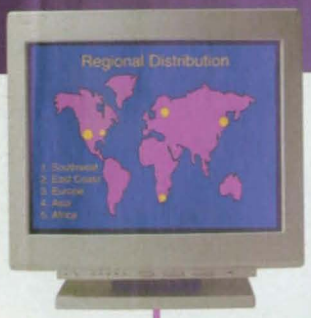
(U.S. Patent No. 5,602,883)

Inventors: Scott A. Stephens and Brooks Thomas,
Jet Propulsion Laboratory

Previous analyses of digital phase-locked loops (DPLLs) are based on analog loop traditions and introduce into the calculations unnecessary analog considerations such as loop-filter time constants and uncontrolled gain variations. This new approach reverses the conventional design procedure for obtaining loop filter constants. Loop roots are first placed in the s-plane on the basis of new root-specific damping and root-specific-decay-rate parameters. Loop constants are then calculated on the basis of these roots. With an appropriately formulated "digital analysis," DPLL theory and design become more straightforward, particularly for third- and fourth-order loops, and loop performance is more accurately controlled for "high-gain" loops.

For More Information Circle No. 791

TO CONVERT REAL-TIME COMPUTER GRAPHICS TO VIDEO...



...and get the best possible image, you will need the Model 9400JR or Model 9700XL from Folsom Research.

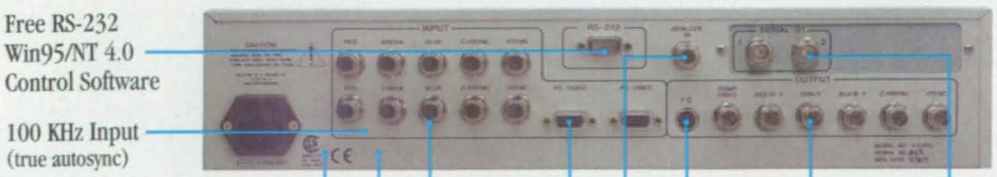
1280x1024 Computer Display

NTSC/PAL Monitor

You're looking at the two best autosync video scan converters available anywhere. Both can turn your high-resolution desktop workstation, PC or Mac presentations into broadcast-quality videos. The 9400JR is built for the same top performance and excellent picture quality as our top-of-the-line unit. It is the most affordable true broadcast-quality scan converter made. The 9700XL, built for absolute control and flexibility, is the most powerful scan converter made. Period.

9400JR

9700XL



To see all of the powerful features, call for your free demo today.

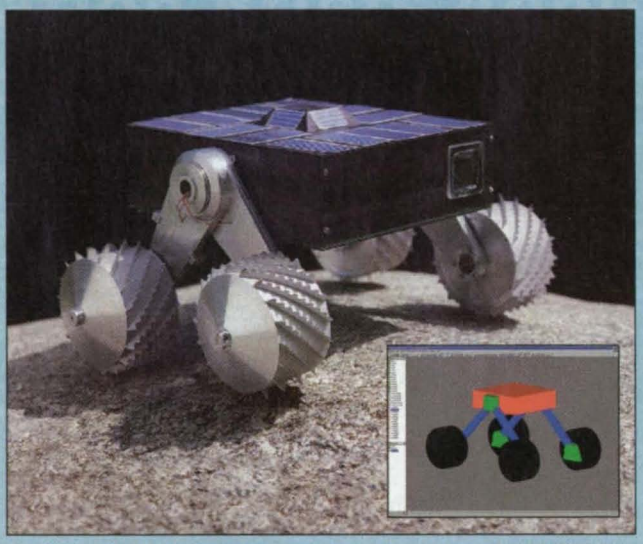
Folsom™ RESEARCH

526 East Bidwell Street
Folsom, CA 95630-3119
Tel (916)983-1500
Fax (916)983-7236
Email: sales@folsom.com
http://www.folsom.com

SEE US AT SIGGRAPH BOOTH #1757

Simulation Software Aids Asteroid Exploration

Working Model® 2D/3D virtual prototyping and design software
Working Model, Inc., div. of Knowledge Revolution
San Mateo, CA
415-574-7777
http://www.krev.com



Working Model 2D software was used to analyze the MUSES-C rover (inset); Working Model 3D was used to visualize the mechanical performance of the rover on the asteroid's surface.

NASA's Jet Propulsion Laboratory (JPL) is working with Japan's Institute of Space and Astronautical Science (ISAS) on the first NASA/Japan joint asteroid mission. Known as MUSES-C, the mission will be launched on a Japanese M-5 spacecraft in January 2002 from Kagoshima Space Center, Japan. It is scheduled for touchdown on the asteroid Nereus in September 2003, and should return to Earth in 2006. The goal of the mission is to collect samples from the asteroid's surface and bring them back to Earth for in-depth study. Scientists want to study Nereus because its composition, rotations, and length of days and nights remain a mystery.

JPL will design and build the rover, which will be the smallest ever flown in space. Its physical dimensions are 6" x 6" x 4" with a mass of less than 500 grams (2.2 pounds). The four-wheeled rover will carry two scientific instruments: a visible spectrum imaging camera and a near-infrared point spectrometer.

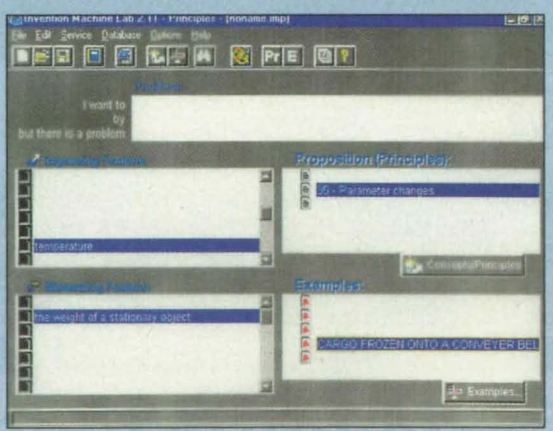
Space missions present considerable challenges because of the many unfamiliar or unknown factors. In this case, the asteroid's extremely low gravity field will greatly affect the rover's mission. Dr. Eric T. Baumgartner, Ph.D., of JPL's Science and Technology Development Section in the Mechanical Engineering Department, has been using Working Model® 2D and Working Model® 3D motion simulation software from Working Model, Inc. to visualize the mechanical performance of the rover on the asteroid's surface.

Dr. Baumgartner first used Working Model 2D version 4.0 to analyze the rover's dynamics. As a result, he clearly saw that the asteroid's minuscule level of gravity sufficiently provided traction for the wheels of the rover. According to Dr. Baumgartner, using Working Model 2D helped determine what the rover can do, which led to investigating ways to command the vehicle.

For the next stage, Working Model 3D version 2.0 will be used to develop navigation strategies for the rover. Directing the rover's movements - both in simulation and on Nereus - will ensure that the rover can conduct a thorough study of the asteroid surface. Said Dr. Baumgartner, "We expect Working Model 3D to help us handle the unpredictable dynamics by allowing accurate testing of the rover's movements within a simulation environment."

"Inventing" Solutions to Power Problems

Invention Machine™ Lab™/TechOptimizer™ problem-solving software
Invention Machine Corp.
Boston, MA
800-595-5500
http://www.invention-machine.com



The Invention Machine Lab software solves problems based on the criteria entered, including the problem, improving features, and worsening features. The solutions are generated as concepts or principles.

Many of NASA's future space missions are geared towards exploring planets and moons that are plagued with very-low-temperature environments. Temperatures on Mars, for example, can dip to -100°C. Space vehicles designed for such exploration require high-energy batteries that can operate at those low temperatures. Currently available batteries are unable to deliver electrical power under severe conditions below -40°C, and rechargeable batteries cannot be used because the electrolyte inside will become either very viscous or frozen. NASA's Jet Propulsion Laboratory (JPL) investigated ways to develop a battery that would operate in such harsh environments. Researchers looked into the chemistry of batteries already in existence, hoping to modify some of those characteristics into a new design.

Dr. Julian O. Blosiu, senior multidisciplinary engineer at JPL's Avionic Systems and Technology Div., used Invention Machine Lab and TechOptimizer software from Invention Machine Corp. to generate concepts of how a battery could be made to operate at very low temperatures. The software provided a structured, functional analysis of a component (the battery), as well as its environment (the low temperature). It took into consideration any constrictions and limitations, and generated suggested solutions based on a database of proven concepts. Invention Machine Lab produced over 166 concepts and ideas for solving the battery problem. Dr. Blosiu reduced that number to four concepts that turned out to be fairly simplistic, but were substantiated by a number of previously discovered theories. Those four concepts are being further investigated.

The software also was used in JPL's development of a penetrator to land on Mars as part of the New Millenium Program's Deep Space 2 mission scheduled for January 1999. The device has a spike-shaped, bullet-like penetrator designed to bore about two meters deep into the Martian soil. Connected with a wire, a portion of the unit remains on the surface and contains the batteries, electronics, and an antenna to communicate with the spacecraft. The problem was that in order to reach a depth of two meters, the penetrator must hit the soil at a force of 80,000 Gs, or at a speed of 200 meters per second. The portion that must stay on the surface would be damaged severely from the impact. The required criteria were entered into the software, which generated eight concepts — from mechanical to pneumatic — including the one idea that is being developed further: using airbags similar to those in passenger cars.

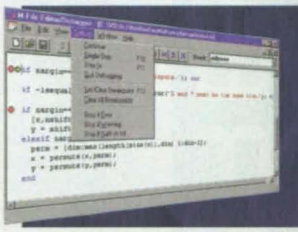
New release!

MATLAB® 5

The Language of Technical Computing

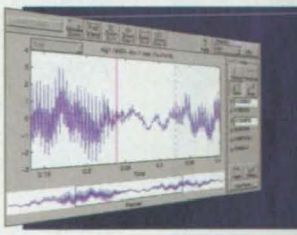
New features include:

- Data structures and types, including multidimensional arrays and user-definable objects
- Programming environment with visual debugging, interactive performance optimization, and online references
- Interactive graphical interface (GUI) layout and development
- Fast, accurate advanced visualization and 3-D modeling
- Visual interfaces for Signal Processing and Control System Toolboxes and a new release of SIMULINK®



New editor/debugger simplifies MATLAB code development for analysis, algorithm design, and system prototyping.

MATLAB lets you model complex data graphically. Here, lighting effects highlight topography data. Source: NOAA.



New GUIs in Signal Processing Toolbox 4.0 make signal analysis faster and easier.

Available Now!

Call 508-647-7000

To find out more about MATLAB 5, SIMULINK 2, and the new toolbox updates, call now and request KP167 to receive your free edition of *MATLAB 5 News & Notes*.

http://www.mathworks.com/ntb

For more information on our Connections OEM/VAR program, visit our Web site at http://www.mathworks.com/oem, or call us at 508-647-7253.

The MATH WORKS Inc.

The MathWorks, Inc. • 24 Prime Park Way, Natick, MA 01760-1500 USA • tel: (508) 647-7000 • fax: (508) 647-7101 • e-mail: info@mathworks.com • http://www.mathworks.com

Employment opportunities: http://www.mathworks.com/newjobs.html • MATLAB in Education: http://education.mathworks.com

The MathWorks is represented in: **Australia:** + 61-2-9922-6311 • **Benelux:** + 31 (0) 182-53-7644 • **Brazil:** + 55-11-816-3144 • **Czech Republic:** + 42-2-68-44-174 • **France:** + 33 (0) 41-14-67-14 • **Germany/Austria:** + 49-241-470750 **India:** + 91-80-5-549338 • **Israel:** + 972-3-561-5151 • **Italy:** +39-11-24-85-332 • **Japan:** + 81-3-5978-5410 • **Korea:** + 82-2-556-1257 • **New Zealand:** + 64-7-839-9102 • **Poland:** + 48-12-17-33-48 • **Scandinavia:** + 46-8-15-30-22 **Singapore/Malaysia:** + 65-842-4222 • **South Africa:** + 27-11-325-6238 • **Spain/Portugal:** + 34-(9)3-415-49-04 • **Switzerland:** + 41-31-954-2020 • **Taiwan:** + 886-2-501-8787 • **United Kingdom:** + 44-1223-423-200

Technology 2007 Exhibits Preview

The industry's premier new technology showcase, Technology 2007, will be held in the northeast for the first time from September 22-24 at the Hynes Convention Center in Boston. This year, the show will be joining forces with SPIE's Photonics East and Electronic Imaging Intl. conferences to offer more than 80,000 square feet of exhibits featuring new inventions and products from universities, federal labs, and leading OEMs. Following is information on this year's exhibitors (as of July 1).

Adina R&D.....NETS
Watertown, MA

The company will display ADINA, a finite element system for stress analysis of structures and fluid flows (CFD) with heat transfer and seamless connections to CAD programs such as Pro/ENGINEER, I-DEAS, AutoCAD, and PATRAN.

Argonne National Laboratory 206
Argonne, IL

Argonne is an R&D laboratory located 25 miles southwest of Chicago with more than 200 programs in basic and applied sciences. Highlighted will be capabilities in the areas of energy and the environment, transportation, materials, and manufacturing.

Armstrong Lab (US Air Force) 216
Brooks AFB, TX

Armstrong Laboratory combines physical and behavioral sciences, engineering disciplines, and research facilities to address human roles in Air Force operations. Cooperative ventures with the private sector emphasize skills training and assistive technologies.

Austrian Trade Commission 208
New York, NY

The Austrian Trade Commission promotes trade and mutual cooperation between the U.S. and Austria, and helps in identifying market opportunities, technology transfers, and similar arrangements.

Aztech 330
Amherst, NY

Products and technology evaluation and transfer services for people with disabilities.

Belt Technologies 120
Agawam, MA

The company manufactures metal belts, drive tapes, and pulleys used for indexing, conveying, power transmission, and timing, as well as related engineering and design services.

Berkeley Laboratory 204
Berkeley, CA

A major national laboratory, Berkeley Lab - with 3000+ employees and an annual budget exceeding $300 million - conducts leading-edge research in energy, environment, materials, computing, and biotechnology.

Best Manufacturing Practices 702
College Park, MD

BF Goodrich Aerospace 221
Vergennes, VT

Supporting aviation with advanced products since 1909, the company provides fluid measurement/management, health monitoring, proximity sensing, system integration, and development using simulation and emulation.

Brookhaven National Laboratory 320
Upton, NY

Brookhaven's booth will feature their new planar optic display using laser light; and examples of basic and applied research in the physical, biomedical, and environmental sciences, and in selected energy technologies for commercialization.

BRTRC 307
(Army SBIR Program & Advanced Concepts & Technology II - ACT II - Program)
Fairfax, VA

Carbolite.....117
Watertown, WI

Carbolite offers a range of standard and custom-designed laboratory furnace, oven, and incubator products. Furnaces are available to 180°C, ovens to 600°C, and incubators to 80°C.

Centro Estero Camere Commercio 310
Torino, Italy

Chain Reactions Inc. 713
Gold River, CA

Smart sex now with technology from the future: See the PFT 1-2-3 Fertility Test System, a handheld, non-toxic, reusable device. Simply lick and look to know when.

Concepts ETI.....817
White River Junction, VT

CETI provides fully integrated engineering design software, turbomachinery (pumps, compressors, turbines) design and development services, performance testing services, troubleshooting and design audit services, educational courses, and publications.

COSMIC 1013
Athens, GA

Computer Software Management and Information Center (COSMIC) is an independent business partner of NASA that maintains an inventory of over 800 programs representing a wide range of software applications.

Derwent Information 102
McLean,VA

Derwent's international patent products are designed for anyone involved in the engineering process, from identifying new research areas and monitoring competition, through improving manufacturing processes.

Dexter Magnetic Materials 212
Fremont, CA

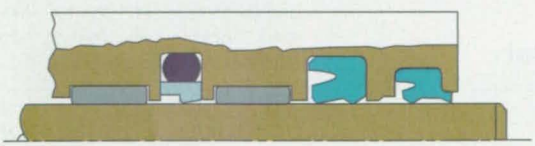
The company provides magnets and magnetic component design, fabrication, and assembly service, from prototype to production quantities. Dexter maintains a comprehensive inventory of materials and components.

Federal Aviation Administration Technology Transfer Office 224
Atlantic City, NJ

Aviation-related products and technologies.

A PERFECT FIT OFF THE SHELF

With the expansion of our North American Logistics Center, you now have immediate off-the-shelf access to Turcon® and Zurcon® seals. Only available from Busak+Shamban, our Preferred Design products, such as



Busak+Shamban Rod Sealing System
Turcon® Stepseal® K/Zurcon® U-Cup/Zurcon® DA22 Scraper

the Turcon® Stepseal® K and Turcon® Glyd Ring® T, Zurcon® B+S U-Cup, and Turcite® Slydring®, are well known as the industry's best engineered thermoplastic components. We also offer Standard Products, such as O-Rings and V-Seals.

Call your nearest Busak+Shamban sales office to discuss how we can help you reduce inventories and shorten lead times for significant time and cost savings. Let us show you how we can become your *Single Source for Superior Service* with solutions for all your seal and bearing applications.

Busak+Shamban®

Midwest
270 Tubeway Dr.
Carol Stream, IL
60188
P 630-682-8855
F 630-682-3860

South
5151 S. Royal Atlanta Dr.
Tucker, GA
30084
P 770-908-1100
F 770-908-1188

East/Central
Direct Sales
2531 Bremer Dr.
Fort Wayne, IN
46803
P 219-749-9631
F 219-749-0066

West
3904 Del Amo
Blvd., Suite 805
Torrance, CA
90503
P 310-371-1025
F 310-371-3135

Texas
2313 W. Sam
Houston Pkwy,
Suite 119
Houston, TX 77043
P 713-461-3495
F 713-461-1677

Canada
43 Voyager Ct. N.
Etobicoke, Ontario
M9W 4Y2
P 416-213-9444
F 416-213-9462

Federal Highway Administration 503

Washington, DC

Federal Laboratory Consortium 116

Sequim, WA

The FLC offers access to federal laboratory expertise and capabilities. Those seeking new federal technology, unique facilities, or assistance with technical problems can contact the FLC regional coordinator in their area.

Fisher Space Pen Co. 106

Boulder City, NV

Fisher Space Pens are used on all NASA space flights. They are sealed and pressurized to write in a vacuum, under water, upside down, and from -20°F to +250°F.

FLC State and Local Government Committee 227

Idaho Falls, ID

This Committee of the Federal Laboratory Consortium promotes productive interaction among the federal laboratories with state and local governments and industries to include the exchange of information, technical assistance, and advice to help sustainable development.

Geophysics Directorate (Air Force Phillips Lab).....1012

Hanscom AFB, MA

The Geophysics Directorate's cutting-edge air and space technology enables the warfighter to operate successfully in the challenging environment between the Earth and the Sun.

GIDEP 308

Norco, CA

The company will exhibit its technical document distribution system with information on discontinued or non-conforming parts or processes. Documents on engineering design, reliability, and test measurement will be displayed.

Gulf Coast Alliance for Technology Transfer (GCATT) 302

Shalimar, FL

GCATT's 11 federal laboratories and four research universities offer unique technology and test facility assets in fields including environmental, electronics, optics, magnetics, sensors, materials, and human performance.

IGS Systems 406

Kingston, MA

Imi-Tech Corporation.....203

Plano, NY

Imi-Tech's SOLIMIDE® polyimide foams provide thermal and acoustical insulating properties in combination with fire resistance, light weight, and thermal stability from -300°F to +600°F.

Ingenieurschule Biel 305

Biel, Switzerland

INPEX 809

Pittsburgh, PA

INPEX, the Invention Show, is an international trade show that showcases all types of inventions, new products, and innovations that are available to business and industry.

Institute for Physical Research and Technology 220

Ames, IA

IPRT will feature technological developments from research centers at Iowa State University, including advanced nondestructive evaluation technology, microelectronic systems, materials science technology, and microanalytical devices.

Invention Machine 210

Boston, MA

Invention MachineLab™, TechOptimizer and IM-Phenomena software packages help engineers in the conceptual stage of design of a product or process.

InVironmental Integrity 1008

Minneapolis, MN

The company develops environmental conditioning systems using patented electrostatic liquid vaporization methods. Applications include disinfection, odor control, environmental aroma, agricultural, and industrial process vapor systems.

Marcorsyscom....700

Quantico, VA

Marcorsyscom is the S&T acquisition agent for the Marine Corps. Technology being showcased will be core body cooling for NBC protective clothing, and land, sea, air, and space technologies.

Melcor Corp.....1003

Trenton, NJ

On display will be thermoelectric coolers, which are environmentally friendly because they are solid-state devices (no CFC). Applications include electro-optics, temperature stabilization, enclosure cooling, and power generation from waste heat.

MicroPatent.....232

East Haven, CT

MicroPatent is a leading publisher of patent information on CD-ROM and via the Internet. The company offers three distinct product categories: CD-ROM, Internet, and Marketing Support.

MVE.....422

New Prague, MN

NASA....313, 512, 612

Washington, DC

Did you know that your company has access to the most formidable, cutting-edge technology ever developed? NASA's 7,000 scientists and engineers already have partnered with thousands of U.S. companies to develop new products. NASA can work with your company in areas ranging from sensors and photonics research, to technologies for monitoring the environment. By contacting NASA, you can talk to some of our most talented people about specific technology challenges, improving existing products or new product development.

NASA Tech Briefs 111

New York, NY

NASA Tech Briefs, the world's largest BPA-audited design engineering magazine, has first publishing rights to new innovations and inventions by NASA and its contractors. High-tech fields covered include electronics, software, mechanics, and materials.

National Center for Toxicological Research 705

Jefferson, AR

NCTR research is aimed at understanding critical biological events in the expression of toxicity and developing methods to improve assessment of human exposure, susceptibility, and risk. The Center encourages collaborative research with government, industry, and academia.

continued on page 24

Call GMR or visit our web site for information on how we can take your career into the 21st Century

Which Global Integrator Will Take Your Enterprise Into The 21st Century?

Software Engineering Services

Groupware/Internet Solutions

Contract Manufacturing

Calendar Year 2000 Solutions & Services

Integrated Telecommunications Solutions (CTI)

Government Contract Specialists:
- GSA Schedules: 70 A, B/C, 58
- GWAC
  - FEDSIM
  - Dept. of Justice
  - NASA SEWP II
- Agency Specific Contracts

Integration & Maintenance Provider
- Commercial
- Government
- Subcontracting

Acquisition, Operations, Resource Services Assistance Available

800-232-4671
www.gmri.com

We're Government Micro Resources, Inc. (GMR), but there's nothing micro about us.

Leading edge solutions, complete services, and best-of-breed products are hallmarks of our success. For fifteen years, GMR has been addressing customer's Information Technology needs. From laptop to mainframe and everything in between, around the beltway or around the world, GMR is the integrator with global vision.

Call us today for more information on how we can take your enterprise into the 21st Century.

GMR

NASA Langley - NAS1-97101
NASA Ames - NAS2-14352

GSA Schedule B/C - GS-35F-4566G
GSA Schedule A - GS-35F-0097D
GSA Schedule 58 - GS-35F-1083D

Government Micro Resources, Inc.

Sunnyvale, CA • Norfolk, VA • Mannington, WV • San Antonio, TX • Denver, CO
7203 Gateway Court • Manassas, VA 20109
(703) 330-1199 • (703) 330-1722 Fax

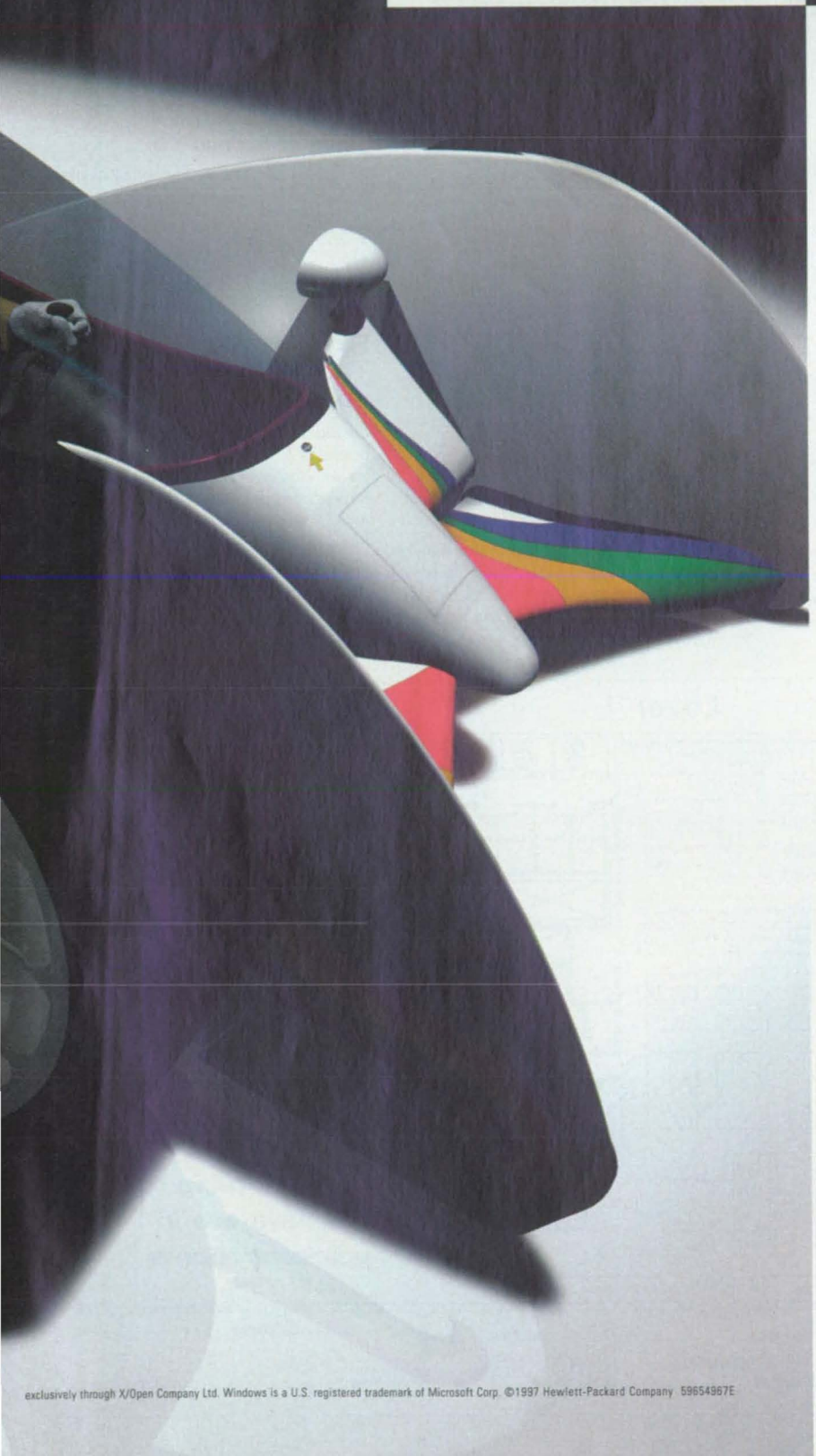
SEWP II - NAS5-32898

For More Information Circle No. 690

HP Technical Computing

NO BOUNDARIES

Andy Saunders of Benetton Formula 1 on an HP Workstation. What's Your Vision?



You've got ideas. But in today's highly competitive and chaotic environment, do you have the tools to realize them? Benetton does. Between every Formula 1 racing season, Benetton engineers design, construct and test an entirely new racing machine. Aerodynamics. Stress analysis. Kinematics. Thanks to HP Technical Computing Systems, this happens in under five months. HP provides the tools, solutions and expertise to give Benetton's design, manufacturing and race teams easy access to data across UNIX® and Windows® NT. So they in turn have the powerful graphics capabilities to make their vision a reality. Or, in this case, a 210-mph blur. Please call us today at 1-888-844-6547 or visit

www.hp.com/go/hpbenettonf1

HEWLETT® PACKARD

continued from page 20

National Security Agency 1009

Ft. Meade, MD

National Space Society 225

Washington, DC

NSS will showcase its Space Leadership Campaign, a grassroots effort to maintain America's leadership position in space. Handouts, merchandise, and copies of the Society's publications will be available.

National Technology Transfer Center 709

Wheeling, WV

A full-service technology commercialization center, NTTC maintains the nation's largest database of federally-funded technologies and provides technology assessment, licensing, and marketing support.

Novespace 326

Paris, France

Nuclear Metals 315

Concord, MA

NMI is a technology/materials development company that has invented an investment castable beryllium aluminum alloy, Beralcast®, that is being used in satellites.

Oak Ridge National Laboratory - Hybrid Lighting 703

Oak Ridge, TN

Hybrid Lighting combines natural and artificial light sources with advanced light distribution systems. This new generation of lighting systems offers improved light quality and efficiency.

Olympus America 1014

Melville, NY

Olympus America will display remote visual inspection equipment such as rigid borescopes, flexible fiberscopes, and video imagescopes.

Panasonic Factory Automation 1007

Franklin Park, IL

The Micro EDM machine, capable of boring holes as small as 5μm in diameter and producing 20μm shafts in diameter, will be displayed.

Proto Mfg. 222

Old Castle, Ontario, Canada

Romer 707

Agawam, MA

Romer manufactures and distributes the Romer portable CMM. The Romer is a unique, six-axis articulated arm CMM that is designed to fit you and the parts you measure.

Russian Tech Transfer Center 237

(Russian Space Agency)

Moscow, Russia

Several technologies from Russian aerospace companies will be displayed.

Seanergy 1005

Mexico City, Mexico

The company's product produces means of movement of sea level, unlimited low-cost, "gree" kinetic energy transformable into any kind of energy.

Silicon Mountain Design 309

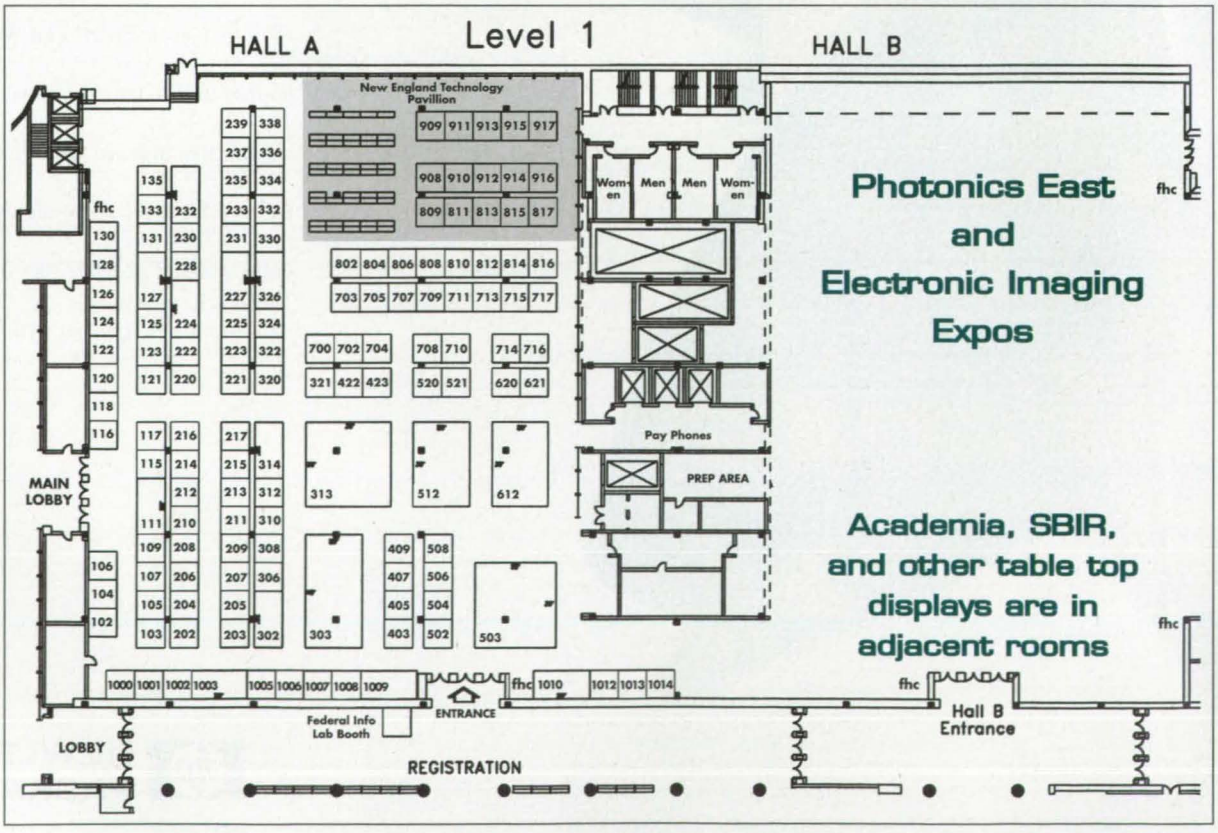
Colorado Springs, CO

SMD will display its line of ultra-high-speed digital cameras, ranging from 2048 x 2048 at 15 frames/sec, to 256 x 256 at 1 million frames/sec. All of SMD's products are a result of SBIR developments.

Simula Technologies 103

Phoenix, AZ

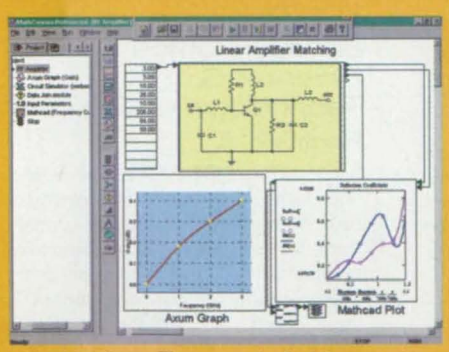
Simula Technologies performs R&D and operates a technology business incubator with the goal of protecting human life through transportation safety technologies. Areas of expertise include: polymers, composites, biomechanics, computerized modeling, occupant restraints, and armor systems.



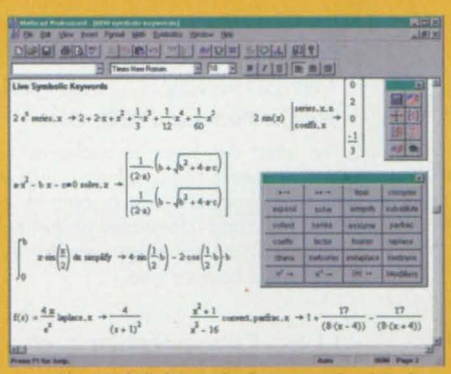
What makes new Mathcad® 7 the world's most innovative calculation software? Let's talk addition.

MORE POWER + EASIER TO USE + TOTALLY WIRED

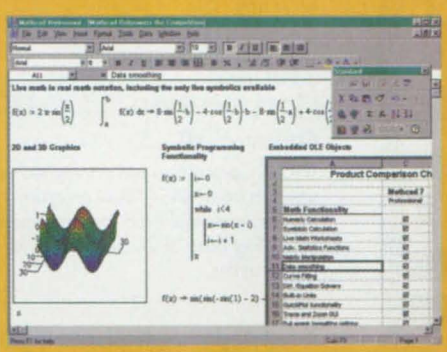
How did simple addition make Mathcad 7 exponentially better? Consider what was added. Like increased power. A more refined interface. Easier equation editing. A richer programming environment. Greater access to deep technical content. And full Web integration — with Microsoft® Internet Explorer built right in. All these additions let corporate workgroups increase productivity — so it's no wonder Mathcad continues to be the world's best-selling calculation software for technical professionals. Looks like the best just got better.



New MathConnex™ gives you the flexibility to combine components from several applications, such as Excel or MATLAB™, in a fully functional system. Feed the frequency output to a Mathcad plot or the gain curve to Axum®. Wire them together and show your entire model working in one window.



New symbolic keywords allow you to descriptively show the operations you perform. Convert an expression to a partial fraction and Mathcad's self-documenting nature explains what you're doing. As always, Mathcad's calculations are live: make a change and your answers are recalculated instantly.



Full support for OLE 2 including automation allows you to drag-and-drop Excel objects into Mathcad and make them functional components, or embed Mathcad objects in your spreadsheet.

To upgrade call **1-888-568-0951**. To order Mathcad 7, visit us at **www.mathsoft.com/mathcad** or see one of these fine retailers.

For corporate licensing, call **1-800-MATHCAD.**

SciTech SOFTWARE FOR SCIENCE · COMPUSA · COMPUTER CITY · ADEPT SCIENTIFIC · MICRO CENTER · EGGHEAD SOFTWARE

Includes Microsoft® Internet Explorer · Designed for Microsoft® Windows NT™ Windows™ 95

MathSoft, Inc., 101 Main Street, Cambridge, MA 02142 USA • Phone: 617-577-1017 • Fax: 617-577-8829 MathSoft International, Knightway House, Park Street, Bagshot, Surrey GU19 5AQ UK Tel: +44(0)1276 452299 • Fax: +44(0)1276 451224 • Mathcad 7 Professional and Mathcad 7 Standard are available for Windows 95 and Windows NT 3.51 and higher.

Sunlux Enterprises 520

Tottenham, Ontario, Canada

Sunlux provides services to industry and investors.

Team Technologies 312

Newton Upper Falls, MA

The SCAEP Air Sampler/Concentrator collects and concentrates the contaminants in large volumes of air into small quantities of sample liquid at high capture efficiencies, combining the principles of air scrubbing and electrostatic precipitation.

Techni-Products 314

East Longmeadow, MA

Techni-Products is a precision machined parts manufacturer with a modern manufacturing facility of 30,000 sq. ft. MorTech Inc., a sister company, offers SLS and LOM rapid prototyping.

Technology & Management Services 127

(U.S. Dept. of Energy, Office of Coal and Power Systems)

Gaithersburg, MD

Technology Access 118

Novato, CA

Thiokol Corporation.....205

Corimme, UT

Thiokol Corporation will display technology spin-offs from NASA/DoD programs resulting in commercial products that expand the marketing base of Thiokol and small business partners.

Thoughtventions Unlimited 1006

Glastonbury, CT

The company offers a high-temperature transparent furnace.

Tiodize Co. 402

Huntington Beach, CA

Composite fastener products, composite self-lubricating bearing material, dry film lubricants, Teflon coatings, mold releases, degreasers, aluminum anodize, and anodize of titanium with no dimensional change.

Tokue Rubber Industrial Co. (Mitsui USA) 1010

Southfield, MI

The company's superior seal fastening system uses special springs to make a tight joint that is flexible, air-tight, and easy to install.

Toroidal Power Systems Co. 321

Billerica, MA

A transmission which employs a three-dimensional kinematic toroidal path to convey torque and power to the output shaft will be exhibited.

TRI/Austin 408

Austin, TX

Texas Research Institute/Austin conducts research, development, and testing in the field of material science. Specialties include composites, adhesives, coatings, foams, and polymer systems; services include accelerated life testing, reliability engineering, failure analysis, and non-destructive testing.

U.S. Air Force Phillips Lab 711

Kirtland AFB, NM

USAF Phillips Laboratory will focus on the tech transfer tools used in fulfilling its mission to apply its technologies to meet both military and non-military needs.

U.S. Air Force - Science & Technology 403

Wright-Patterson AFB, OH

The latest Air Force technologies with applications in human systems, information management, space, aircraft and structures; and information on technology transition/technology transfer programs will be displayed.

U.S. Department of Agriculture - Agricultural Research Service 217

(Office of Technology Transfer)

Beltsville, MD

A wide range of patented technologies available for license and business opportunities will be exhibited from USDA's Office of Technology Transfer.

U.S. Department of Commerce - National Institute of Standards & Technology (NIST).....704

Gaithersburg, MD

NIST promotes U.S. economic growth by working with industry to develop and apply technology, measurements, and standards through the Advanced Technology Program, Manufacturing Extension Partnership, lab research and services, and the Malcolm Baldrige National Quality Award Program.

U.S. Department of Commerce - Office of Export Promotion Coordination.....215

Washington, DC

Information on how to export or expand exports will be provided. The Department of Commerce is the leading Federal Export Promotion Agency.

U.S. Department of Energy - Kansas City Plant (AlliedSignal) 202

Kansas City, MO

Manufacturing process capabilities include electronic, mechanical, engineered materials, test and evaluation, and services associated with product development.

U.S Department of Energy - Office of Science & Technology....322, 324

Northfield, IL

Since 1989, DOE's Office of Science and Technology has been developing new technologies to process, destroy, store, recycle, and/or reuse radioactive and hazardous waste. Safety, efficiency, and cost-effectiveness are central to these efforts. A CD-ROM presentation will highlight several DOE sites and technologies.

U.S. Department of the Interior 620

Reston, VA

Technologies related to earth and life sciences including geology, hydrology, biological sciences, and environmental sciences will be featured.

U.S. Navy - SBIR Program.....306

Fairfax, VA

SBIR PAVILION

The following companies have received Small Business Innovation Research (SBIR) program grants from federal labs or government agencies to support the development of their technological innovations. These companies will be featured in a special area of the exhibit hall.

Advanced Modular Power Systems

Ann Arbor, MI

The company has developed the Alkali Metal Thermal to Electric Conversion (AMTEC) technology to produce compact, lightweight, self-reliant devices that can generate electricity for years, as long as heat is provided by any 800° to 900°C source. AMTEC cells have been selected by DOE and NASA for new design advanced radioisotope power systems.

Advanced Refractory Technologies

Buffalo, NY

Dylyn® is a thin-film, "diamond-like" coating engineered at the atomic scale, with a unique suite of properties that can alter surface properties of a broad range of materials and components.

Aerodyne Research

Billerica, MA

The company's Chlorophyll Fluorescence sensor is a passive spectral line discriminator that directly measures chlorophyll fluorescence (photosynthetic activity in plants) by exploiting the Fraunhofer A & B "lines" in oxygen.

Alternative System Concepts

Windham, NH

The JTAG Test Synthesis Tool accepts Verilog and VHDL, and automatically generates technology-independent boundary scan implementation at the RT level, thus promoting design reuse.

Analysis and Simulation

Buffalo, NY

The Human Memory Extension Technology (HMETECH) distributed information retrieval system uses Internet sockets to meet the needs of medical researchers looking for various digitized medical libraries. A robot accesses web sites and seeks out information for inclusion in the HME server database.

Applied Science & Technology (ASTEX)

Woburn, MA

A microwave reactor that grows high-quality diamond and films at a fast rate and lower cost than earlier equipment will be displayed.

Benova

Farmington, CT

The interactive touchscreen Choice Card Kiosk helps Medicaid recipients navigate varied levels of information to select the managed care health plan which best meets their needs.

Eltron Research Co.

Boulder, CO

Developed for NASA's Johnson Space Center, the Membrane for Selective Removal of Ammonium Ions from Spacecraft Recycled Water addresses removal of ammonium ions from aqueous streams in the absence of co-produced expendables by utilizing ammonium ion selective membranes in electrodialysis flow cells.

EXHIBITS PREVIEW

Faraday Technology (Faratech)

Clayton, OH

The Electrochange™ In-Process Recycling system provides cost-effective in-process recycling capabilities for contaminated rinse water, metals, and acids for various plating applications. This patented technology has been engineered into a completely automated, standalone system.

Foster-Miller

Waltham, MA

Z-fiber™ is a low-cost, easy-to-use method for through-thickness reinforcement of fiber-reinforced composites. It increases delamination/disbond resistance (the major weakness of these materials) by 10-30x. The company also will display a low-cost, mid-IR probe and spectrum analyzer for in-situ, non-contact determination of surface cleanliness, coating chemistry, and degree of cure.

General Reality Co.

San Jose, CA

The Automated Site Model Generator automatically generates 3D computer graphics models from video imagery of real-world scenes.

KSE

Amherst, MA

The Adsorption-Integrated-Reaction (AIR) process for photocatalytic air pollution control economically destroys air contaminants for spacecraft air revitalization and environmental pollution control. Commercial AIR systems utilize ambient temperatures and UV light.

Lionhearth Technologies

Los Gatos, CA

Online VR will allow people to put on virtual reality gear, plug themselves into a telephone or video cable, and teleport their presence into common, simulated, virtual environments wherein different forms of teleconferencing, teletraining, entertainment, and commerce are possible.

Lynntech

College Station, TX

The company's 524 Electrochemical Ozone Generator forms ozone by the electrolysis of water. It is used in treating hazardous waste water, in food processing and medical sterilization, for potable water, in aquariums, and in semiconductor processing.

Manufacturing and Technology Conversion Intl.

Columbia, MD

A novel, feedstock flexible, indirectly heated, steam-reforming process for chemical and energy recovery and/or waste treatment operates in an efficient, cost-effective, and environmentally friendly manner.

Metalforming

Allentown, PA

Combining the processes of hydrostatic extrusion and wire drawing for the manufacture of ultrafine wire - finer than economically feasible by conventional methods - becomes a reality with the Augmented Hydrostatic Extrusion (HYDRAW) process.

Physical Optics Corp.

Torrance, CA

Raven

Alexandria, VA

The Bird/Aircraft Collision Reduction System uses a special microwave signal that can be detected audibly by birds in the flight path of approaching aircraft, alerting the birds to imminent danger of collision.

Rohini International

Beavercreek, OH

The company has developed a vibration controller for the U.S. Air Force.

Scientific Solutions

Hollis, NH

The Intelligent Sensor Protection System (ISPS) houses and protects sensors, allowing them to be deployed in harsh polar and marine environments such as the Arctic.

SPEC

Austin, TX

Spectra Research

Dayton, OH

Integrated Reengineering and Porting software provides a Windows-NT-based tool set to recast FORTRAN and C legacy applications into an Intranet/Internet-enabled application.

Street Smarts

Duluth, GA

The company develops intelligent data collection tools for transportation applications using handheld computers.

Stress Photonics

Madison, WI

The DeltaTherm 1000 stress measurement system uses Thermoelastic Stress Analysis (TSA) technology to provide near-instantaneous stress images under most common structural loading.

Tao of Systems Integration

Hampton, VA

The technology measures true airspeed and flow direction for helicopters using stagnation flow oscillations.

Theseus Logic

St. Paul, MN

Null Convention Logic™ is a symbolically complete logic expression that integrates data transformation and control, and thus yields inherently clockless, delay-insensitive circuits and systems.

TSI

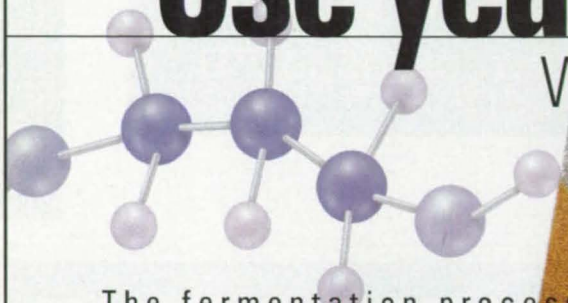
St. Paul, MN

The company is developing a unique particle sizing probe for in situ measurements. The instrument incorporates an interferometric laser technique for sizing and velocimetry of irregular and/or inhomogeneous particles.

For more information on Technology 2007, see pages 77-79. Plan NOW to attend - use the registration form on page 79.

Use yeast to turn sugar

Why not, Egyptians have been



The fermentation process is being redesigned by DuPont scientists to create new chemicals efficiently, precisely and with less environmental impact.

Yeast, grain and water can be used to make really fine beer. Or, for that matter, really fine trimethylene glycol.

into other molecules?

doing it for 4,000 years.

The transformation of sugars into alcohol by microscopic organisms has been known for a very long time. But only since the advent of genetic engineering is it feasible to think about harnessing the sophistication of biological systems to create molecules that are difficult to synthesize by traditional chemical methods.

For example, the polymer polytrimethylene terephthalate (3GT) has enhanced properties as compared to traditional polyester (2GT). Yet commercialization has been slow to come because of the high cost of making trimethylene glycol (3G), one of 3GT's monomers.

Working the bugs in

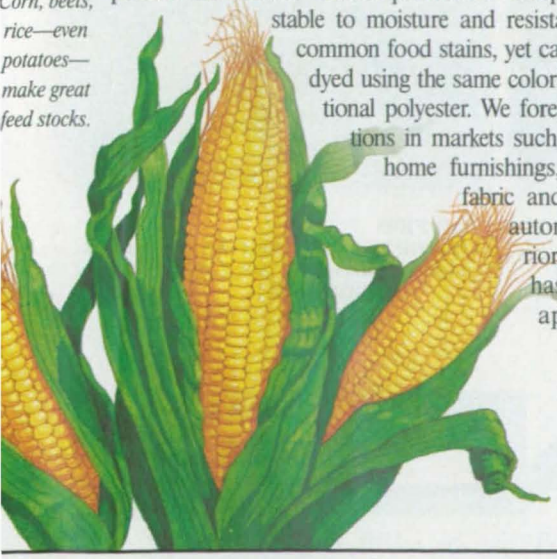
The secret to producing 3G can be found in the cellular machinery of certain unrelated microorganisms. Some naturally occurring yeasts convert sugar to glycerol, while a few bacteria can change glycerol to 3G. The rub is that no single natural organism has been able to do both.

Through recombinant DNA technology, an alliance of scientists from DuPont and Genencor International has created a single microorganism with all of the enzymes required to turn sugar into 3G. This breakthrough is opening the door to low-cost, environmentally sound, large-scale production of 3G. The eventual cost of 3G by this process is expected to approach that of ethylene glycol (2G).

t is no longer necessary to start with a barrel of il to produce chemicals. Corn, beets, rice—even potatoes—make great feed stocks.

A polymer for your thoughts

The 3GT polymer produced using our biosynthesized monomer has properties that exceed those of normal polyester. It is resilient and can be molded or extruded into fibers. The fibers are heat-settable and can be stretched at least 15 percent and recover without permanent "creep." They are stable to moisture and resistant to most common food stains, yet can be readily dyed using the same colors as conventional polyester. We foresee applications in markets such as apparel, home furnishings, upholstery fabric and carpet for automobile interiors. Even 3G has numerous applications.



Comfortable, easy-care apparel may soon be made with fibers spun from chemicals that have been fermented from sugar.

By combining it with various organic acids, polyols can be made as precursors to polyurethane elastomers and synthetic leathers.

A break for the environment

The 3G fermentation process requires no heavy metals, petroleum or toxic chemicals. In fact, the primary material comes from agriculture—glucose from cornstarch. Rather than releasing carbon dioxide to the atmosphere, the process actually captures it because corn absorbs CO_2 as it grows. All liquid effluent is easily and harmlessly biodegradable. What's more, 3GT can readily undergo methanolysis, a process that reduces polyesters to their original monomers. Post-consumer polyesters can thus be repolymerized and recycled indefinitely.

Can you play a role?

Throughout DuPont's history, many of our biggest contributions have come to market through collaboration with other companies. Development of 3GT could involve partnering with companies active in traditional polymer processing, separations technologies, recombinant DNA techniques, corn wet-milling and fermentation. If you possess these skills, or have ideas for end-use applications, we'd like to hear from you. Fax us on company letterhead with an indication of your interests to: DuPont, Dept. NT, 302-695-7615. Please limit your correspondence to nonproprietary, public-domain information only.

DUPONT

Better things for better living

Commercialization Opportunities

Gas-Sensor Test Chip

A small printed-circuit chip measures chemoresistive properties of polymer films. These films are examined as candidate transducer elements for miniature gas-sensor circuits. Changes in resistance as small as parts per million can be detected.

(See page 46.)

Compact Instrumentation Package for Remote Medical Diagnosis

A suitcase-sized telemedicine instrumentation pack instantly brings top medical assistance to patients in remote locations. The pack transmits video, audio, and other data signals from patient to specialist at a major medical center, who in turn advises the patient's caretakers how to handle or treat the condition, often without a trip to the hospital.

(See page 50.)

Digital Receiver for Mobile Use in an Urban Environment

This receiver uses concatenated coding and interleaving to correct errors and mitigate loss of signal, and an equalizer to synchronize multiple received signals. The unit is intended to receive signals from repeater stations retransmitting signals in an urban environment from a satellite in orbit.

(See page 50.)

Miniature Gas Chromatograph/ Mass-Spectrometer

This proposed hand-held instrument could be carried into the field to measure concentrations of volatile compounds, e.g., pollutants found in air, water, soil, industrial environments, and other areas impractical for laboratory analysis. The instrument would also consume much less power than conventional laboratory apparatuses.

(See page 56.)

Microwedge Optical Concentrators for Image Sensors

Proposed as optical concentrators on image-sensing devices, these reflective microwedges would offer a number of advantages over microlenses. The microwedges would be easier to produce and would eliminate cross talk encountered in microlens designs.

(See page 60.)

Small, High-Torque Reaction/Inertia/ Momentum Wheel

High torque is obtained with no increase in weight or size. Developed as part of an attitude-control system on spacecraft, the unit can be used for precise aiming and steadying of optical instruments, such as cameras, aboard moving vehicles and aircraft. Special lubricant in this wheel simplifies the bearing design.

(See page 66.)

TRUE WORKSTATION PERFORMANCE ...

... WITHOUT THE RISC.

The Micron™ Powerdigm.™

Workstation performance you can really sink your teeth into.

Meet the Micron Powerdigm.

A powerful, processor based workstation, the Powerdigm executes demanding business and technical tasks with command, yet has the flexibility to run popular PC programs. The Powerdigm delivers excellence in graphic design, digital imaging, financial analyses, CAD, and more. Optional Diamond Fire GL video cards make 3D imaging an affordable reality. You also get Micron's unrivaled customer service and support. So go ahead. Meet the Powerdigm. And see why our competition has met its match.

POWERDIGM XLI

- Dual Intel® 200MHz Pentium® Pro processors
- 64MB EDO ECC RAM
- Number Nine Imagine 128 series II video card, 4MB VRAM
- 4GB Ultra Wide SCSI-3 hard drive
- 12/20X variable speed SCSI CD-ROM drive
- 19" Hitachi SuperScan CM751 (18" display) .26dp color monitor

$4,999

Bus. lease $170/mo.

AVAILABLE POWERDIGM FEATURES & OPTIONS

- Support for Dual Pentium Pro 200MHz processors
- Memory upgradable to 512MB ECC EDO RAM
- Supports multiple Ultra Wide SCSI-3 hard drives
- Supports dual monitors
- Diamond Fire GL series of Open GL professional 3D accelerators
- Iomega Jaz SCSI drive with 1GB removable cartridge
- 32 voice wavetable stereo sound with speakers
- Fast Ethernet 10/100 PCI network adapter
- Tool-free minitower
- Microsoft® Intellimouse™
- 104-key keyboard
- Microsoft Windows NT® Workstation
- 5-year/3-year Micron Power℠ limited warranty

Micron Sales Hours: Mon-Fri 6am-10pm, Sat 7am-5pm (MT) Technical Support Available 24 Hours A Day-7 Days A Week Tollfree from Mexico: 95-800-708-1755 Tollfree from Canada: 800-708-1758 • Tollfree from Puerto Rico: 800-708-1756 International Sales: 208-893-8970 International Fax: 208-893-7393

MICROSOFT WINDOWS NT READY-TO-RUN

MICRON ELECTRONICS™

800•626•5628

www.micronpc.com

For More Information Circle No. 518

Web Interface for Telescience

Scientists at their home institutions plan and control the actions of remote scientific robots.

NASA's Jet Propulsion Laboratory, Pasadena, California

The Web Interface for Telescience (WITS) is a computer-software system that enables scientists, located at computer terminals connected to the World Wide Web, to control remote instrumented robotic vehicles. The WITS is designed specifically to enable scientists at their home institutions to control robotic vehicles (called "rovers") in exploration of planets other than Earth, making it unnecessary for the scientists to travel to a central control station at NASA's Jet Propulsion Laboratory (see Figure 1). The WITS also has obvious potential for adaptation to purely terrestrial use in telescience, telemedicine, telerobotics, and other applications that involve remote monitoring, supervision, control, and planning.

The WITS software provides an interactive display and is accessible via a Java-enabled web browser such as Netscape Navigator. The display (see Figure 2) includes an overhead plan view with a color-coded elevation map and the rover path and science targets drawn on it; a wedge view showing an actual downlink image in the panorama around the rover, where the rover path and science targets and commands are specified; a wedge strip showing all the images in a panorama side by side; and a descent view (not shown in the figure) showing an image taken by a descending rover with the overall mission rover paths drawn on it. A scientist can, for example, use the WITS display to enter such command data as science targets for the rover to visit and science commands to perform at those targets. The scientist can also view data transmitted back to Earth from the rover. A group of scientists at various locations can use the WITS to jointly plan rover activities.

The WITS software can be used on all major computer platforms, including Sun, SGI, and Windows 95. There are two versions of the WITS software; a mission version accessible by authorized scientists only, and a public version accessible by the general public. The WITS public version is accessible at http://robotics.jpl.nasa.gov/tasks/scirover/operator/wits/homepage.htm.

This work was done by Paul G. Backes, Kam Sing Tso and Gregory K. Tharp of Caltech for **NASA's Jet Propulsion Laboratory.** *For further information, access the Technical Support Package (TSP)* ***free on-line at www.nasatech.com*** *under the Electronic Systems category,* ***or circle no. 121*** *on the TSP Order Card in this issue to receive a copy by mail ($5 charge).*

NPO-19934

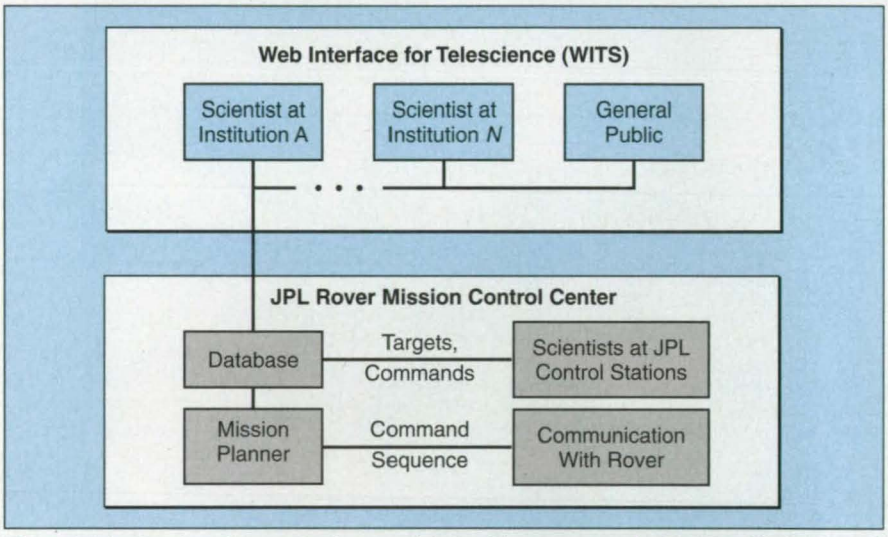


Figure 1. **Scientists Anywhere on Earth** can act jointly with operators at the JPL Rover Mission Control Center via the World Wide Web.

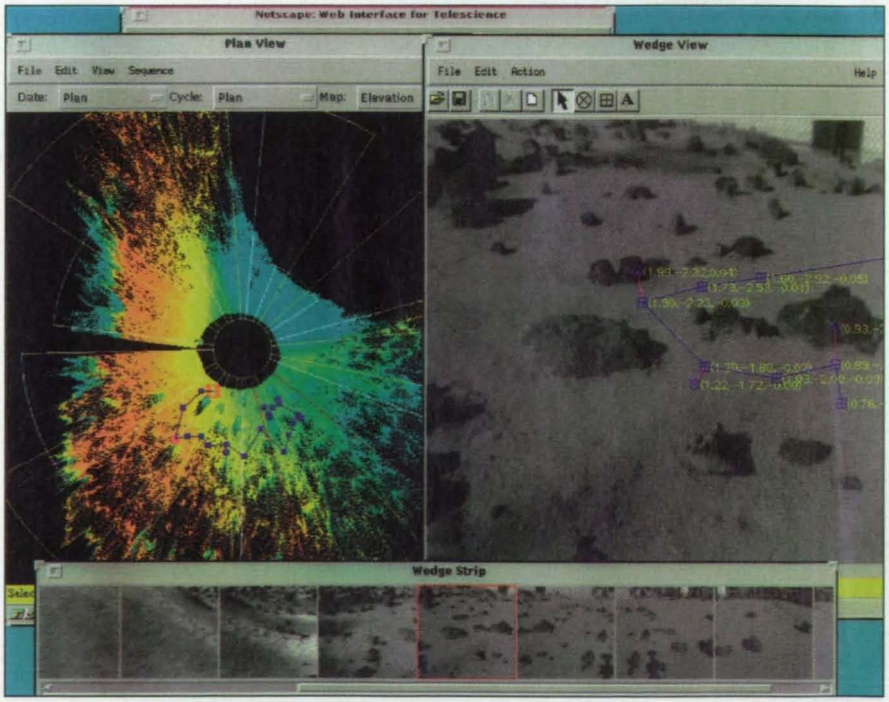


Figure 2. The **Interactive Display** provided by the WITS software includes an elevation map and views returned by the rover camera.

Simply OUTSTANDING

Vector illustration created exclusively with CorelDRAW by John Corkery, U.S.A.

Includes . . .

COREL DRAW™ 7

Productivity, Power and Precision!

Also included:

- Eight powerful utilities
- 32,000 clipart images and symbols
- 1,000 photos
- 1,000 TrueType® and Type 1 fonts
- Over 450 CorelDRAW™ templates
- Over 250 3D models
- Over 750 floating objects

CorelDRAW SERIES
OVER 250 FIRST-PLACE AWARDS

$227.39* Upgrade from CorelDRAW 3,4,5 or 6

$434.69* Full CD-ROM version

Producing outstanding illustrations is an incredibly smooth process with the revolutionary performance and power of CorelDRAW™ 7. This precision software lets you transform the masterpieces in your imagination into breathtaking reality. With Corel PHOTO-PAINT™ 7 for photo editing and bitmap creation, and CorelDREAM 3D 7 for 3D modeling and rendering, this award-winning graphics suite helps you tap into new creative worlds. It's the software of choice for the illustration professional.

1997 PCG-V WINNER

PC WORLD WORLD CLASS

To find out how to enter visit our Web site at: www.corel.com/contests

CDW COMPUTER DISCOUNT WAREHOUSE™ 800-279-4CDW

*CDW prices in US$ plus applicable taxes and shipping.

KUR-0451-US

COREL WTA TOUR
Corel, Official World Title Sponsor of the COREL WTA TOUR

COREL TRAINING PARTNER
For more information call Corel's Fax on Demand Service at 1-613-728-0826 ext. 3080 Doc. # 1020 (U.S.) or # 1021 (Can.)

COREL®
www.corel.com
Call now for faxed literature!
1-613-728-0826 ext. 3080
Document # 1085

For More Information Circle No. 561

Predicting Off-Design Performances of Fans and Compressors

This program helps to minimize costly testing.

Lewis Research Center, Cleveland, Ohio

The OFFCDC (Compressor Off-Design Code) computer program uses the output of the Aerodynamic and Blading Design of Multistage Axial Flow Compressors computer program (COSMIC program LEW-13505) to predict aerodynamic-performance maps of fans and compressors. In so doing, OFFCDC helps to minimize costly and time-consuming testing of compressor designs. OFFCDC also offers a capability for making reliable predictions of flow properties at off-design speeds; such predictions can be used as starting points for full three-dimensional flow analyses, thereby reducing long computing times.

To be able to use OFFCDC successfully, one must first use a compressor-design code to generate a blade-geometry block of data that must be part of the input. In a case in which the compressor-blade design is an old design or obtained from an outside source, one must use the compressor-design code to duplicate the design data and put them into a form suitable for input to OFFCDC.

OFFCDC is based partly on the assumption of steady flow. It is also assumed that the flow is axisymmetric; OFFCDC solves for an axisymmetric flow field in the meridional plane. A streamline-curvature method is used for calculating the flow field outside the blade rows. OFFCDC allows for bleed flow, and the first five stators can be reset for each rotational speed; these capabilities are necessary for analyzing large multistage compressors.

The accuracy of off-design-performance predictions depends on the validity of flow-loss and -deviation mathematical models included in the code. These models incorporate real flow effects via empirical correlations. The code also computes through small reverse-flow regions.

OFFCDC is written in FORTRAN 77 for use on UNIX-based computers. It has been successfully executed on a Sun Sparc workstation running SunOS 4.1.3, a Sun Sparc Workstation running Solaris 2.4, an HP9000/700 computer running HP-UX 9.03, and an SGI Indigo 2 computer running IRIX 6.2 The standard distribution medium for OFFCDC is one 0.25-in. (6.35-mm) streaming-magnetic-tape cartridge (Sun QIC-24) in UNIX tar format. Alternative distribution media are available on request. OFFCDC was released to COSMIC in 1996.

This program was written by J. F. Schmidt of NYMA, Inc., for **Lewis Research Center.** *For further information, access the Technical Support Package (TSP)* ***free on-line at www.nasatech.com*** *under the Computer Software category,* ***or circle no. 134*** *on the TSP Order Card in this issue to receive a copy by mail ($5 charge).*

Inquiries concerning rights for the commercial use of this invention should be addressed to NASA Lewis Research Center, Commercial Technology Office, Attn: Tech Brief Patent Status, Mail Stop 7–3, 21000 Brookpark Road, Cleveland, Ohio 44135. Refer to LEW-16176.

Software Predicts Damage by High-Velocity Debris Impacts

These programs can help in designing efficient shields.

Marshall Space Flight Center, Alabama

SD_SURF is a unique collection of computer codes developed to assist in the design and analysis of systems to protect spacecraft against spaceborne debris. SD_SURF calculates and summarizes the vulnerability of a spacecraft to debris as a function of impact velocity and its obliquity.

An SD_SURF analysis shows which velocities and obliquities are most likely to cause penetration. This determination can help an analyst select a design best suited to the predominant penetration mechanism. The analysis indicates the parameters most suitable for development or verification testing.

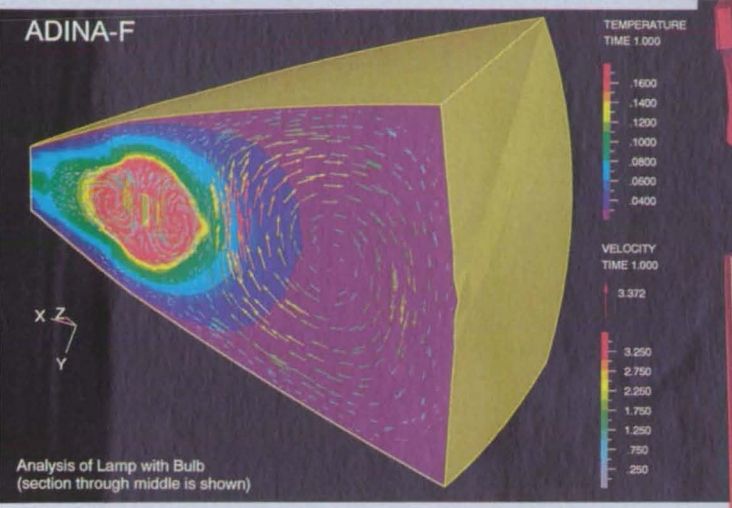
Prior space-debris-analysis codes told designers which areas were most vulnerable, but gave no information to help select the most efficient shield design for a given area. In the newer approach implemented in SD_SURF, one first summarizes the information about an exposed area of a spacecraft in a table of velocity and obliquity. The table can be generated from a description of simple geometry (plane, sphere, or cylinder), or the code can read the GEOM output from the BUMPERII code, which is included with SD_SURF. This makes it possible to process data (this includes performing calculations of self-shielding) pertaining to a spacecraft of complex geometry and to store the resulting data in a small file for further trade studies or optimization.

SD_SURF is written in FORTRAN for Macintosh-compatible computers. A VAX

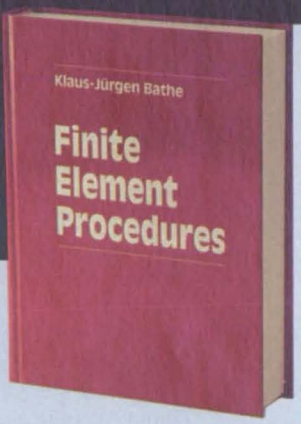
ADINA

Structures & CFD

Crush analysis, static solution



Fluid flow with specular radiation



Theory & Practice

Prentice Hall 1996

- Solids and structures
- CFD, incompressible and compressible flows
- CFD with structural interactions
- Parallel processing
- Seamless connection to Pro/E, I-DEAS and PATRAN
- Automatic meshing

ADINA R & D, Inc.

71 Elton Avenue ▪ Watertown, MA 02172 ▪ U.S.A. ▪ Telephone: (617) 926-5199 ▪ Telefax: (617) 926-0238
email: info@adina.com ▪ www.adina.com

FOCUSED ON EXCELLENCE

For More Information Circle No. 628

version of BUMPERII with manuals is available from COSMIC (program MFS-28565). SD_SURF has been successfully executed on a Macintosh Quadra 800 computer running System 7.5. Sample executable codes are included on the distribution medium. Version 3.0 of Language Systems FORTRAN is necessary for creating new executable codes. The distribution also includes a set of SD_SURF macros and spreadsheets for Microsoft Excel; these can be used independently or with selected output from the SD_SURF FORTRAN programs. The standard distribution medium for SD_SURF is a set of four 3.5-in. (8.89-cm) Macintosh-format diskettes. SD_SURF was last updated in 1995 and released to COSMIC in 1996.

This program was written by Norman C. Elfer and Robert Meibaum of Lockheed Martin for **Marshall Space Flight Center.** *For further information, access the Technical Support Package (TSP)* ***free on-line at www.nasatech.com*** *under the Computer Software category,* ***or circle no. 140*** *on the TSP Order Card in this issue to receive a copy by mail ($5 charge).*
MFS-31172

Software for Processing ScanSAR Data Into Images

NASA's Jet Propulsion Laboratory, Pasadena, California

The SSP1 processes measurement data acquired by scan-mode synthetic aperture radar (scanSAR) into terrain image data. More specifically, SSP1 was developed for processing data acquired by the Radarsat, which is an Earth-observing SAR mission led by the Canadian Space Administration. SSP1 can be regarded as performing four major functions; pointing refinement, generation of processing parameters, SAR processing, and post-SAR processing. "Pointing refinement" denotes, in essence, refinement of estimates of how far and in what direction the radar apparatus was looking when acquiring a given set of data. Pointing refinement is based on estimation of Doppler and range centroids, as described previously in "Optimal Estimation of Range and Doppler Centroid in ScanSAR" (NPO-19519), *NASA Tech Briefs*, Vol. 19, No. 12 (December 1995), page 82. "Processing parameters" signifies mainly Doppler-profile and mapping parameters that express the relationships between (a) three-dimensional coordinates of points on Earth and (b) range and Doppler values of measurement data acquired from those points. "SAR processing" denotes all the processing involved in converting raw scanSAR data sets into multilook, multibeam image data registered with along- and across-track coordinates. "Post-SAR processing" includes averaging, normalization, scaling, mapping from along/across-track coordinates to standard map coordinates, and resampling to produce low-resolution image data in the chosen map coordinates.

This work was done by Michael Y. Jin of Caltech for **NASA's Jet Propulsion Laboratory.** *For further information, access the Technical Support Package (TSP)* ***free on-line at www.nasatech.com*** *under the Computer Software category,* ***or circle no. 131*** *on the TSP Order Card in this issue to receive a copy by mail ($5 charge). NPO-19867*

Software for Calibration of Computer-Generated Images

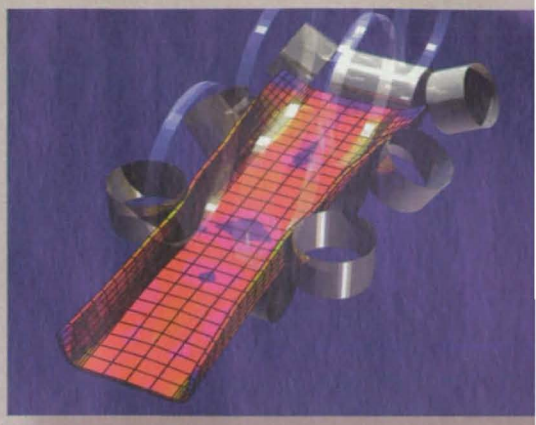
NASA's Jet Propulsion Laboratory, Pasadena, California

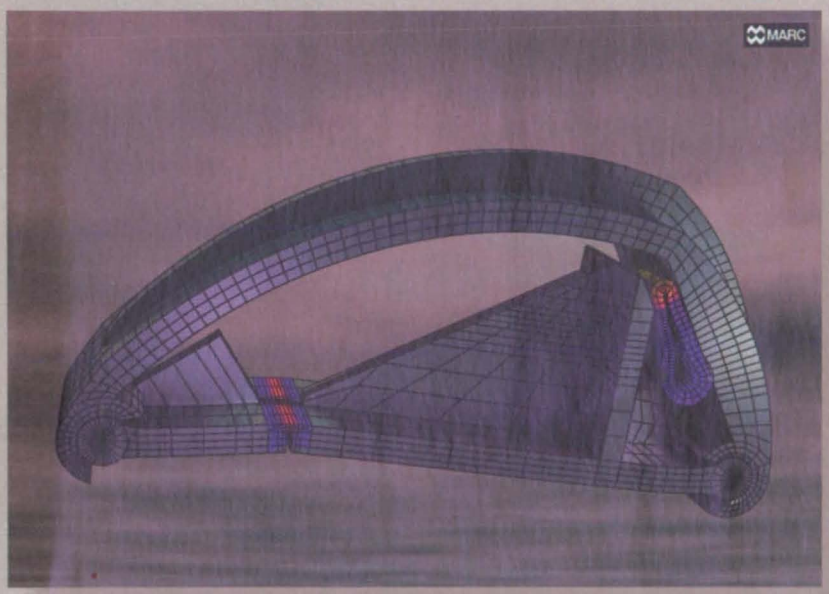
A software system provides for semiautomated calibration of three-dimensional computer-generated images (e.g., "virtual reality" images) from digitized video images of real scenes. Three-dimensional graphic models are intermittently updated through this virtual-reality calibration, which determines the camera calibration parameters and object locations semiautomatically by using model-based, edge-matching computer-vision algorithms. The algorithms utilize the known geometric-object models and their salient edges and do not specifically require arrays of accurately positioned vision targets.

This software continues to undergo development in an effort to extend telerobotic capabilities beyond manually controlled teleoperation to enable semiautomatic (supervisory) telerobotic performance of such diverse tasks as nuclear-waste remediation, mining, painting bridges, and operating cranes. The software implements the following:

1. an edge-based weighted-least-squares algorithm for determining the positions and orientations of objects,
2. a robust matching algorithm for removal of data outliers that would otherwise degrade least-squares solutions,

There's a world of difference waiting. The competition isn't.





Nonlinear analysis.
Virtual manufacturing.
Product simulation.
Parallel processing.
Multiphysics.

The cutting edge solutions you need are here today.

MARC, the world's leading supplier of advanced finite element analysis software, has become the analysis methodology of choice in aeronautics, automotive, biomechanics, consumer products.... In **your** industry.

Our products give you the ability to benefit from the use of new materials, to extract more performance from less weight at less cost, to see how your products will perform in the real world — before they're manufactured.

Powered by Sun Microsystem's Ultra™ Enterprise™ Servers, MARC gives you the **competitive advantage**.

Analysis for the new millennium.

Find out what the world's leading manufacturing companies have already discovered. Visit us at **www.MARC.com**. Or contact us directly at **800-548-4665**. Find out what MARC can do for you.

Order our free CD-ROM. See what the industry's talking about.
Order at the website or call MARC today!

MARC

MARC Analysis Research Corporation
260 Sheridan Avenue, Suite 309
Palo Alto, CA 94306

Sun microsystems

For More Information Circle No. 659

3. an algorithm that updates both the video-camera calibration and the object localization simultaneously to reduce initial camera-calibration errors, and
4. semiautomatic intermittent model update to increase the alignment precision as the mating part gets closer for insertion.

An interface is provided to enable the operator to intervene, by use of a mouse, to align camera and object model positions, and to select and deselect model and image edges interactively for removal of false matches. Thus, the operator can guide the automatic matching when necessary. This calibration software has been successfully utilized to demonstrate an Orbital Replacement Unit (ORU) insertion task, with a 1/4-in. and 1-1/2 degree precision using two camera views.

This program was written by Won S. Kim of Caltech for **NASA's Jet Propulsion Laboratory.** *For further information, access the Technical Support Package (TSP)* ***free on-line at www.nasatech.com*** *under the Computer Software category,* ***or circle no. 152*** *on the TSP Order Card in this issue to receive a copy by mail ($5 charge).*

This software is available for commercial licensing. Please contact Don Hart of the California Institute of Technology at (818) 393-3425. Refer to NPO-20007.

The DARE Software System

NASA's Jet Propulsion Laboratory, Pasadena, California

The Data Archival Retrieval Enhancement (DARE) software system stores, catalogs, retrieves, displays, and delivers multimedia data via an intranet, using the World Wide Web (WWW) client-server architecture. The data can be in the forms of documents, engineering drawings, photographs, videos, tables, scientific numerical data, and software. DARE was developed to enhance the preservation and utilization of archives of information pertaining to special weapons effects. However, the software is readily adapted to other domains; for example, a scientific and educational version called "WebCat" was described in "Program Organizes Data for the Internet" (NPO-19830), *NASA Tech Briefs*, Vol. 20, No. 11 (November 1996), page 71. DARE pulls information from various sources and builds a computational environment for searching and presentation of data via familiar, consistent Hypertext Markup Language (HTML) documents accessible to users of WWW browser software. Once users find data of interest, they may download it or order it for delivery on various physical media. Consistent with the unique nature of its intended application, DARE also controls access to all data on the basis of classification, distribution statements, caveats, and need-to-know.

This program was written by Carol Miller, Ann Bernath, Oscar DeMartino, Susan Hess, Kristy Kawasaki, Rosana Borgen, David Bernath, Keevin Fisher, Jason Hyon, James Krueziger, Michael Martin, Patrick Murphy, and Mark Takacs of Caltech for **NASA's Jet Propulsion Laboratory.** *For further information, access the Technical Support Package (TSP)* ***free on-line at www.nasatech.com*** *under the Computer Software category,* ***or circle no. 153*** *on the TSP Order Card in this issue to receive a copy by mail ($5 charge).*

This software is available for commercial licensing. Please contact Don Hart of the California Institute of Technology at (818) 393-3425. Refer to NPO-20034.

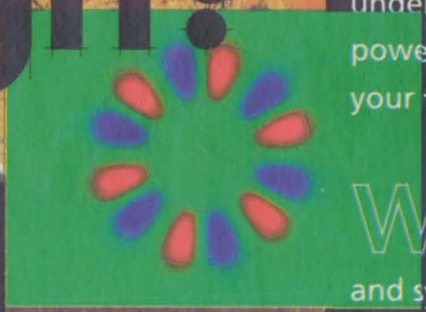
what drives your design?

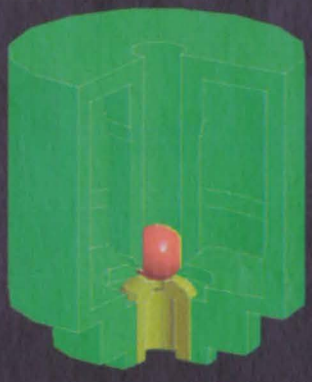
Is it a sensor? Maybe a transformer or a motor. How about a permanent magnet or actuator?

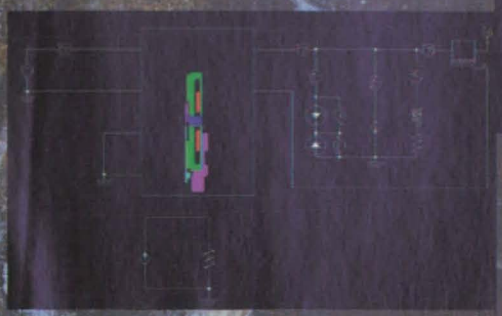
Applications vary, but the need to account for electromagnetic effects remains a critical factor in design performance. Today more than ever before, the demand for high-yield, high-performance, and smaller devices compel engineers to understand electromagnetic fields.

Not every engineer is an expert in electromagnetics - Ansoft knows this. Our easy-to-use and understand software puts the power of Maxwell's equations at your fingertips.

With features like adaptive meshing, parametric analysis, and system-level simulation, it's not difficult to see why Ansoft is the world leader in electromagnetic design tools. Our EM product family provides a wide range of solutions for your particular design needs.







ANSOFT

Desktop solutions for what drives design.

Telephone: 412.261.3200
Facsimile: 412.471.9427
Internet: EMinfo@ansoft.com
World Wide Web: www.ansoft.com

WinVN: Improved News-Reader Software

This program implements a visual, intuitive approach to communication via the Usenet.

John F. Kennedy Space Center, Florida

Windows Visual Newsreader (Win VN) is a user-friendly computer program that facilitates communication via the Usenet, which is a worldwide distributed-"bulletin-board" network that resides on millions of computers linked by local-area networks and by wide-area networks, including the Internet. Users of the Usenet exchange news and opinions by writing articles and posting them on the network, where they are transmitted automatically to other interested users. In Usenet news, articles are organized into a hierarchy of newsgroups, which are subject-matter and geographical groups — approximately equivalent to specialized magazines, journals, and discussion groups.

WinVN is among the first Usenet news-reader programs developed specifically for the Microsoft Windows operating system. Prior to WinVN, the only such programs usable with Windows were character-cell (DOS)-based. Those programs did not provide for mouse-driven user interfaces. Because those programs did not support the XOVER or REFERENCES news-reader commands, they could not handle heavy traffic and could not cross-reference the traffic. Moreover, because those programs were not based on the Windows Socket standard, they were not compatible with networking software from multiple vendors.

Like other news-reader computer programs, WinVN can be used to select, view, write, sort, and print articles. Articles can be saved locally, cut into the Windows clipboard, or forwarded to other individuals via electronic mail. In comparison with other news-reader software, WinVN implements a more visual and intuitive approach to Usenet news. WinVN enables the user to navigate easily between newsgroups and articles by means of a graphical, mouse-driven, point-and-click interface. It enables the simultaneous viewing of multiple articles. When used with multitasking operating systems like Windows/NT, WinVN can even provide for simultaneous connection to multiple news servers.

In normal operation, WinVN generates three types of windows (see figure):

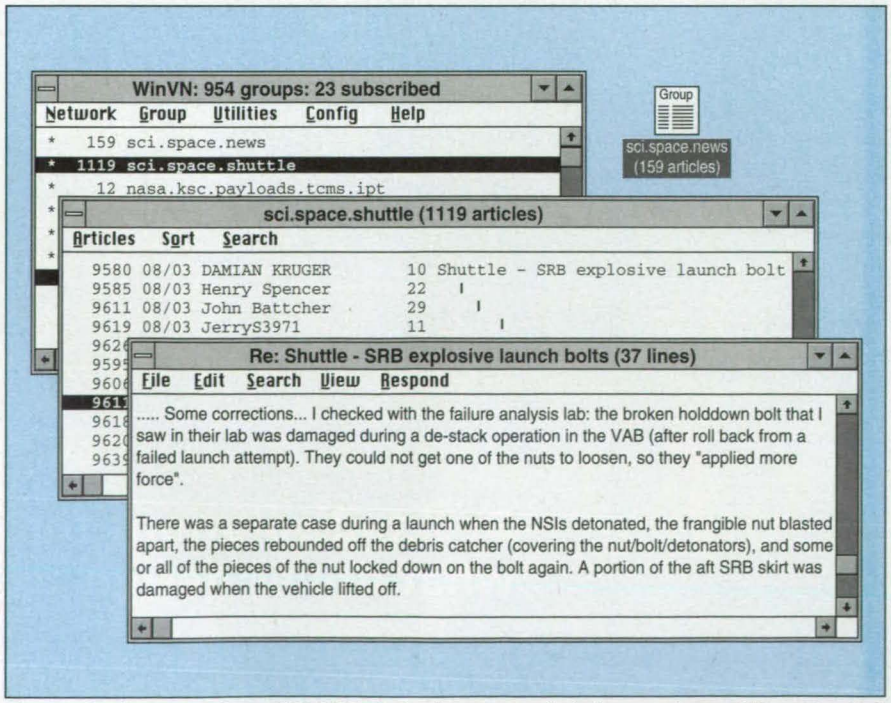
- The main window, which shows a list of all newsgroups;
- One or more group windows, each of which displays a list of the articles in a newsgroup; and
- One or more article windows, each of which displays an article.

Double-clicking on the name of a newsgroup or article causes that item to be displayed in a separate window. For writing an article, WinVN displays a posting window.

The provision of the REFERENCES header makes WinVN the first Windows-based news-reader computer program to support threading: In this special context, "threading" denotes a method for grouping together, reconstructing, and tracking articles (equivalently discussions). WinVN can sort articles by thread, author, subject, and other characteristics. With threading, multiple discussions can take place simultaneously within a newsgroup, and the software tracks which responses go with which discussions. WinVN also provides options for marking, retrieving, and referring to both unread and previously read articles.

The provision of the XOVER command makes WinVN the first windows-based news-reader computer program to take advantage of server-maintained directories of articles. This feature accelerates access by a factor of more than 10. WinVN was also the first Windows-based news-reader software to support the posting and decoding of graphical images.

WinVN is in the public domain. It is available in compiled 16- and 32-bit binary versions or in source form. English and Japanese versions are available, and versions in other languages (including French, German, and Russian) are undergoing development. The latest versions for both Windows and Windows/NT are available free of charge via anonymous FTP from FTP.KSC.NASA.GOV in the directory [pub.win3.winvn]. Questions can be sent to the developers via the mailing list "winvn@titan.ksc.nasa.gov" and anyone who wishes to join the list of developers can send an electronic-mail message to majordomo@news.ksc.nasa.gov with the words "subscribe winvn" in the body of the message.



The **Graphical User Interface of WinVN** includes three types of windows, each at a different level of a hierarchical classification of articles.

This work was done by Samuel M. Rushing and James M. Dumoulin of **Kennedy Space Center,** *John S. Cooper of Fineline Software, Inc., and Mark Riordan of Michigan State University. For further information, access the Technical Support Package (TSP)* ***free on-line at www.nasatech.com*** *under the Mathematics and Information Sciences category,* ***or circle no. 116*** *on the TSP Order Card in this issue to receive a copy by mail ($5 charge).*

KSC-11767

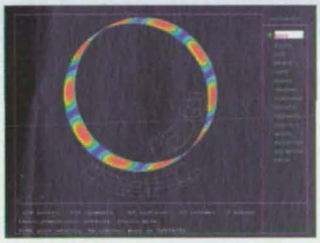
These won't save you time or money...

$$\nabla\times H=J+\epsilon\frac{\partial E}{\partial t}\qquad \nabla\times E=-\mu\frac{\partial H}{\partial t}\qquad \nabla\cdot E=\frac{\rho}{\epsilon}\qquad \nabla\cdot H=0$$

THESE WILL.

A CAE package that provides immediate productivity and saves prototyping dollars is very hard to find. With our line of fully integrated BEM electromagnetic simulation software, we can help.

Each of our packages is designed around three basic principles: advanced technology, productivity and exceptional customer service.



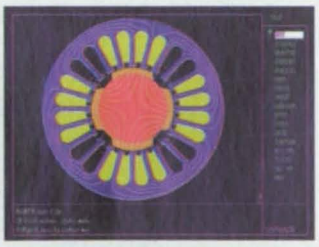
B-Field Bands: Periodic condition on a magnetic clutch for arbitrary rotor position.

Advanced Technology

"I have analyzed literally hundreds of linear and non-linear electromechanical devices with IES software. It has become an invaluable tool to me, as it's so much easier to work with than FEM software. Unlike FEM, BEM software does not necessitate any re-griding of the problem when one medium is being rotated or translated with respect to another, which results in a significant time saving."

Dr. Kent Davey
American Maglev

Progressive features like our automatic/adaptive boundary element refinement, relative error detection, 3D symmetry conditions and a consistent graphic interface give you the most advanced programs available anywhere.



Torque vs. position curves for optimal motor design are readily calculated.

Productivity

"IES BEM programs have consistently outperformed the seven FEM packages I have evaluated in the past few years. The operator interface of IES programs allows for immediate productivity, where there is a significant learning curve involved in all FEM packages."

Nicholas F. Campagna
Consultant

We have set up sample problems for you to work through along with databases of solved problems comparable to conventional industry-specific needs. Shorten the steps to your solution with IGES or DXF geometry translators and parametric definitions.

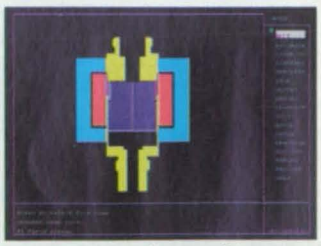
Customer Service

"IES has consistently impressed us with their speed of response and strong commitment to work with us on unique problems."

Jim Aydelotte
Dynacast Magnetics

On-line help, full technical support and two complete program enhancements each year keep you on the cutting edge of CAE design and analysis.

Load a single diskette or tape onto your PC or workstation. Within one day you will begin working on your own problems. In just a week, even the most sophisticated 3D design solutions are yours. We give you our word. And so have our customers.



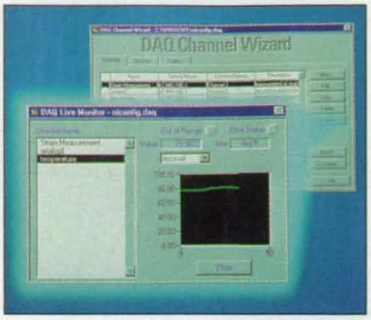
Use BEM to solve non-linear eddy current problems.

Call today for your 30-day no-charge software evaluation.

INTEGRATED
ENGINEERING SOFTWARE

TEL: (204) 632-5636 FAX: (204) 633-7780
e-mail: info@integrated.mb.ca

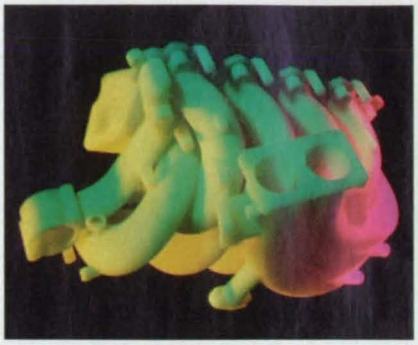
For More Information Circle No. 644



National Instruments, Austin, TX, has introduced Version 4.1 of LabVIEW **graphical instrumentation software** that features DAQ Wizards, which streamline data acquisition development through automatic program generation. Users describe measurement connections and the software generates a program in G source code that meets those specifications.

Other enhancements include automated links to LabVIEW sites on the World Wide Web and OLE automation interface for automated report generation via HiQ® for Windows 95/NT. It is available for Windows 95/NT/3.1, Macintosh/Power Macintosh, SUN SPARCstations, Hewlett-Packard workstations, and Concurrent Computer real-time systems. DAQ Wizards are available only on Windows platforms. Pricing starts at $995.

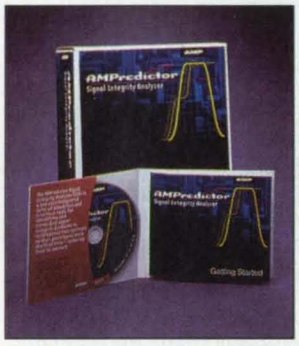
For More Information Circle No. 744



Version 3.0 of DFE (Data Front End) **rapid prototyping software** for the SGI workstation platform from Cubital America, Troy, MI, incorporates Cure algorithms into the Academy package with a graphical user interface. Enhanced user control over positive and negative volumes is provided, and a Batch Mode option allows users to pre-slice the entire job, or portions of it, prior to run time.

Tools for viewing models in the graphics applications Academy and Show are offered. Other enhancements include maintaining the corresponding scale between top, front, side, and isometric views; interactive view rotate; translucency; true clipping; and icon separation between display mode and type or cast modes.

For More Information Circle No. 739



AMPredictor Signal Integrity Analyzer from AMP, Harrisburg, PA, is a **signal integrity simulation software** suite that is used to identify and correct signal integrity problems in high-speed digital designs. It integrates printed circuit, connector, net, and power design areas with simulation and parameter extraction tools. The program allows analysis of millivolt drops in the power and ground planes to ensure adequate noise margins.

Users can build a printed circuit board stackup, define connector pinouts and what they connect to, create a net topology, and convert IBIS model files into SPICE files. A field solver extracts transmission line electrical parameters from these definitions and the AMPSPICE circuit simulator simulates the resulting information, converting it to waveforms for analysis. It operates under Windows 95 or NT 4.0 and is priced at $8,500 for a single-user license.

For More Information Circle No. 736

Cimatron, Burlington, ON, Canada, offers Re-Enge Version 2.0 **reverse engineering software** module that imports digitized data into the Cimatronit CAD/CAM environment to create CAD models. Users can create designs or molds from raw data scanned from design mockups, existing parts, or molds. Smooth surfaces are created from the data, and can be edited or combined with computer-generated elements.

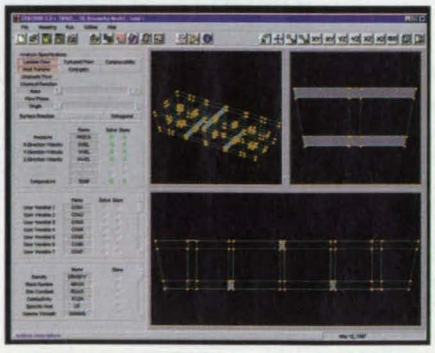
The program reads an unlimited number of scanned data points from sources such as ASCII, CMM, or custom data formats. Point data can be sectioned, segmented into regions, split into lines for automatic fitting, or projected onto planes. The software enables stereo lithography surfaces to be produced directly from point data.

For More Information Circle No. 738

Working Model, a Div. of Knowledge Revolution, San Mateo, CA, has announced Working Model® 3D 2.0 **modeling, simulation, and analysis software,** which includes a new object manager that enables users to quickly edit, organize, and manage various assembly objects. It supports OpenGL and provides a seamless interface with Autodesk Mechanical Desktop®, SolidWorks™, and Solid Edge™ CAD software.

The program offers 3D joints and constraints such as motors, actuators, springs, rods, and ropes, enabling users to model complex 3D mechanisms. It features automatic collision detection, which simulates how objects interact, slide, and collide. The new release enables users to model sub-assemblies with an enhanced version of Working Model Automatic Constraint Mapping™ (ACM) technology.

For More Information Circle No. 742

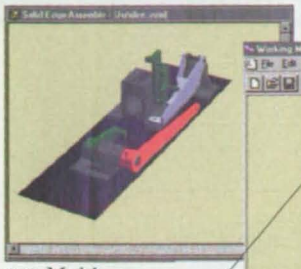


Adaptive Research, Santa Monica, CA, has introduced version 3.0 of CFD2000 **fluid dynamics modeling software** that operates on Windows 95/NT and UNIX platforms. The software features advanced CAD interoperability, automated mesh generation and geometry manipulation tools, and finite-rate chemistry modeling.

The program also offers CVD modeling, two-phase flow modeling, and advanced visualization capabilities.

For More Information Circle No. 735

You can cut a lot of metal, or you can design and test with Working Model®

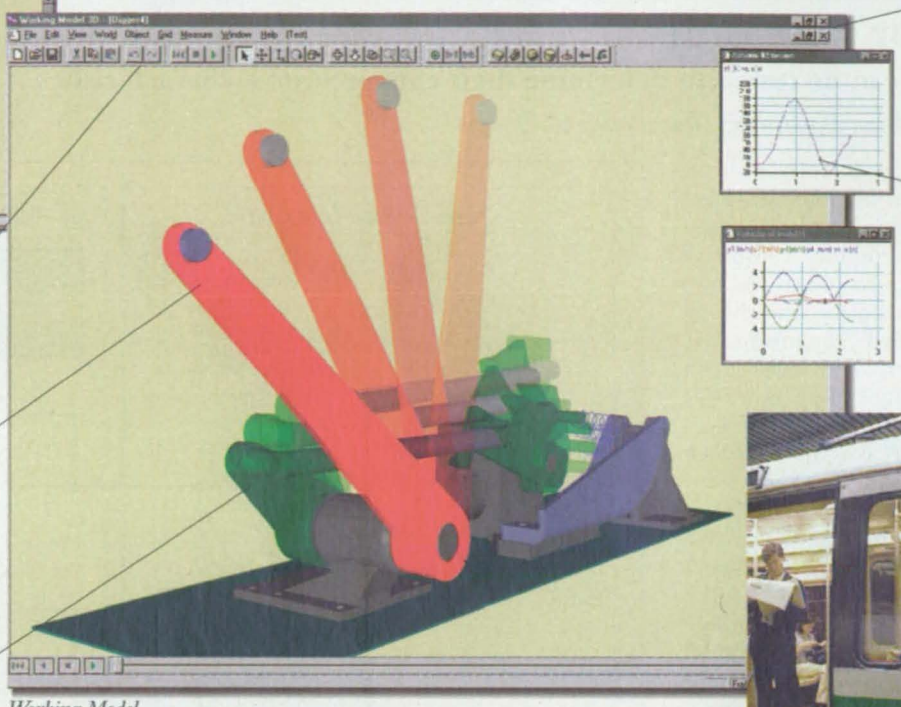


CAD Model

Fast "run-analyze-refine" cycle helps you optimize designs before you build physical prototypes.

Working Model handles all contacts, collisions, and frictions, and puts you in complete control of the simulation environment.

Simulate non-linear or user events using a built-in equation language.



Working Model

We are proud to introduce Working Model 3D v2.0. Speed has been increased by over 10 times.

Analyze your latest design by measuring forces (like torque, acceleration, etc.) that act on any part of your simulation.

Subway Door Mechanism
Modeled by Sean Taffert
Vapor Canada Inc., Quebec, Canada

*Final product functions as designed.**

The Motion Simulation Standard for Windows/NT

Most engineers build physical rather than computer prototypes. We don't blame them. Computer simulation can actually slow down the design process if the software isn't up to the task. Doing functional tests on a computer requires software that is accurate, reliable, and easy to use.

Working Model saves you time and money right out of the box. You'll notice it in the details; the clean, one-step installer makes getting up and running a breeze; the industry's most advanced motion simulation engine automatically handles collisions, contact, and friction; and Working Model's innovative user interface makes computer simulation accessible to even the occasional user.

You can design in your preferred environment with seamless interfaces to SolidWorks™, Intergraph Solid Edge™, and Autodesk Mechanical Desktop™. Automatic Constraint Mapping™ technology expands your CAD assembly into a functioning Working Model.

This is why Working Model has been recognized with two of the most prestigious awards in the mechanical CAD/CAE industry: "Product of the Year" from both *Design News* and *NASA Tech Briefs*.

For a demo or for your local dealer call 800-766-6615
Or contact us at www.workingmodel.com

1995 design news Product of the Year

Product of the Year TECH BRIEFS 1996

Working Model® SolidWorks Autodesk SOLID EDGE

* subway photo simulation

Working Model is used by thousands of engineers to design manufacturing floor robotics; material handling equipment; medical equipment; motorcycle and race car components; mountain and road bicycles; office equipment; packaging machinery; pool cleaning equipment; potato picker equipment; power tools; printing machinery; projectors; rail cars; restraint systems; robotics; rovers for asteroid exploration; satellite solar array; ski bindings; space shuttle parachute deployment; space shuttle robotics; subway door mechanisms; surgical equipment; suspension systems; switches.

Working Model, Inc.
A Division of Knowledge Revolution
66 Bovet Road, Suite 200
San Mateo, CA 94402

Gas-Sensor Test Chip

Polymer films can be tested to determine their chemiresistive characteristics.

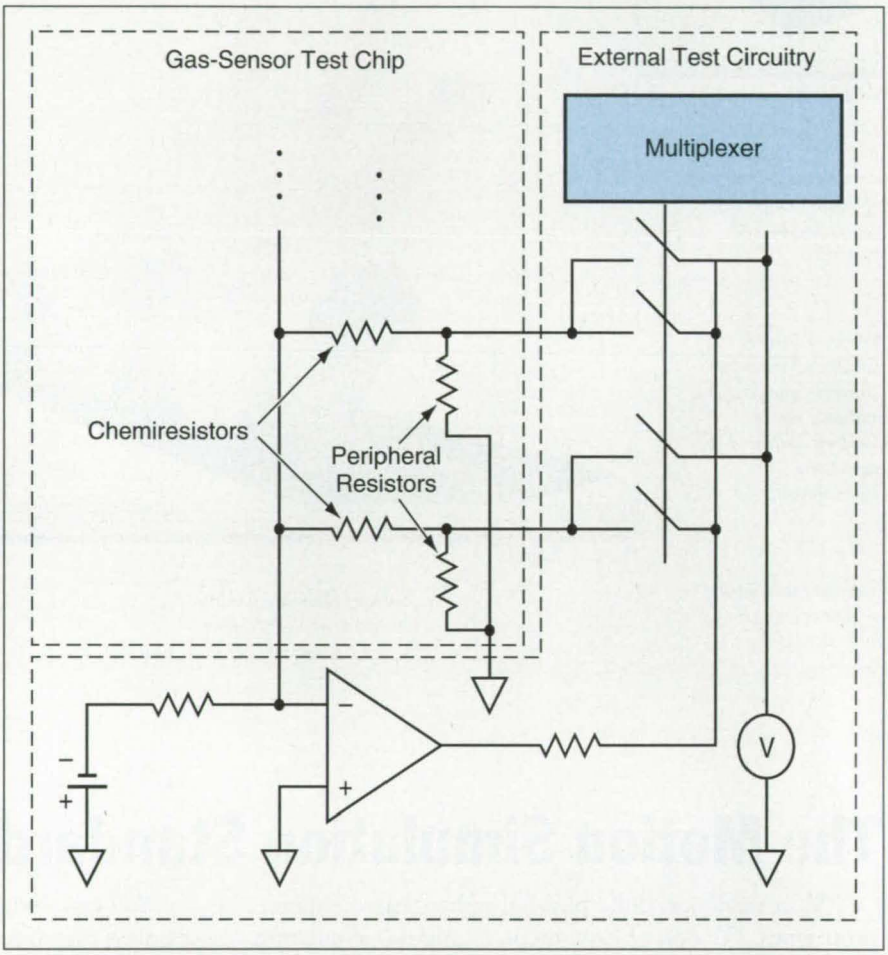
NASA's Jet Propulsion Laboratory, Pasadena, California

A small printed-circuit chip has been devised for measuring chemiresistive properties of polymer films that are candidates for use in the transducer elements of miniature electronic gas-sensor circuits. Gas-sensing transducers of this type are called "chemiresistors" or "chemoresistors" and have been described in a number of prior articles in *NASA Tech Briefs*, including "Gas-Sensing Flip-Flop Circuits" (NPO-19389), Vol. 19, No. 9 (September 1995), page 48 and "Electronic 'Noses' Made From Conductive Polymeric Films" (NPO-19537), Vol. 21, No. 7 (July 1997), page 60.

The chip is a cofired alumina substrate 24 mm long and 10 mm wide, with screen-printed gold contact pads, conductor lines, and electrode structures with comb and U-bend configurations. The minimum width of conductor lines and spaces is 125 μm. Altogether, the chip contains 11 electrode structures, making it possible to test different polymer films and/or multiple film specimens of the same polymer. In addition, the chip contains three electrical heaters for use in exerting temperature control over the polymerization of the films. Eighteen contact pins located on one edge of the chip provide access to the 11 test structures and heaters.

The design of the chip reflects a requirement to be able to test polymer films that cannot be patterned after deposition: the electrode structures provide the required test patterns. These patterns are such that the measurements taken with them yield data on sheet resistance, surface conduction, anisotropy of conduction, nonuniformity, and contact resistance for each film specimen.

The figure illustrates the measurement circuitry used in conjunction with the test chip. The circuitry includes a multiplexer that sequentially selects, and makes electrical connections to, each of the electrode structures for measurement of the resistances of the chemiresistors. During such a measurement, all chemiresistors except the one selected for measurement are grounded. The selected chemiresistor is placed in the feedback loop of an operational-amplifier circuit that drives a constant current through the chemiresistor. The output of the operational-amplifier circuit is a voltage indicative of the resistance of the chemiresistor. Changes in resistance as small as parts per million can be measured in this way.



The **Gas-Sensor Test Chip** contains patterned electrodes and contacts for chemiresistive polymer films deposited on its surface. The chemiresistors are connected to external test circuitry for measurement of their electrical resistances.

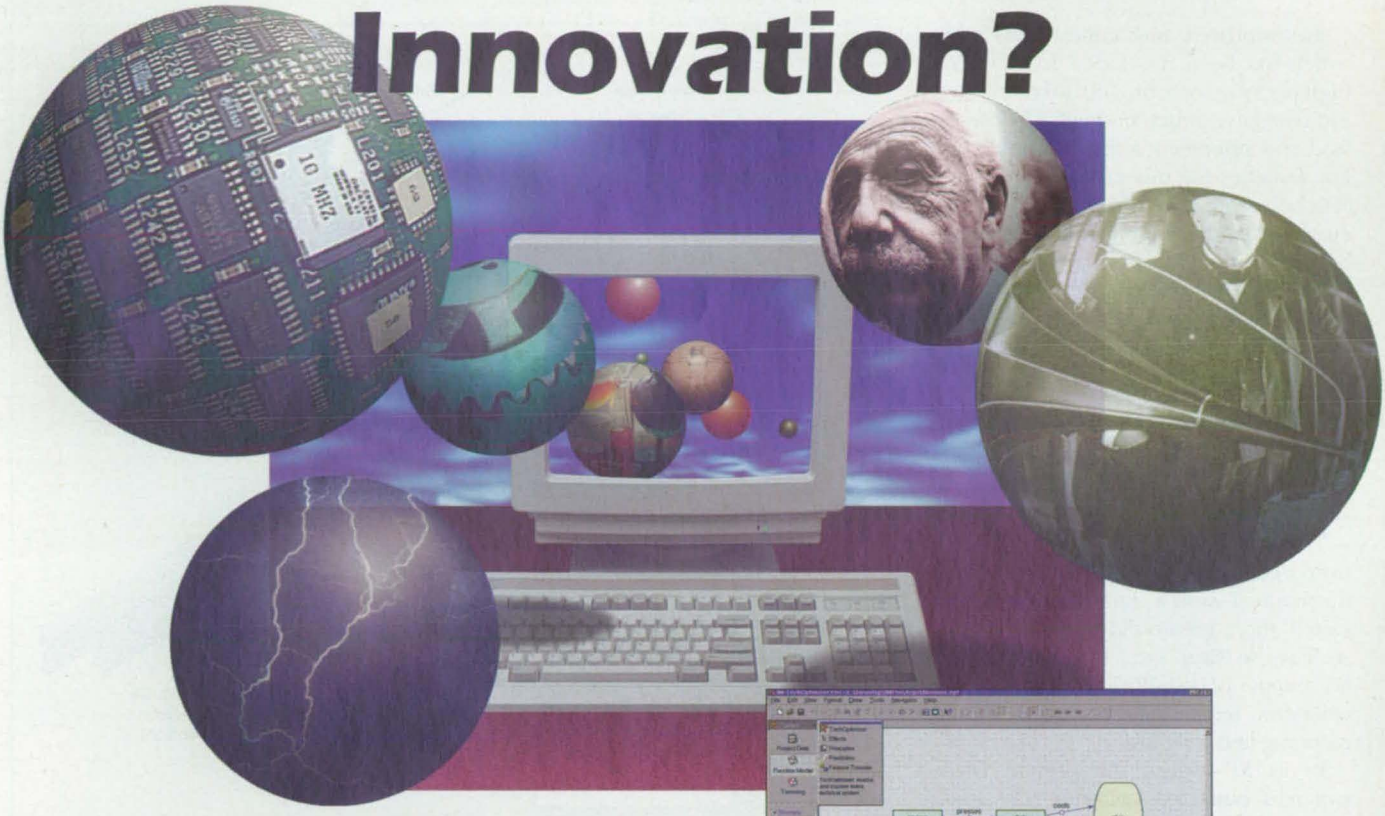
This work was done by Martin Buehler of Caltech for **NASA's Jet Propulsion Laboratory.** *For further information, access the Technical Support Package (TSP)* ***free on-line at www.nasatech.com*** *under the Electronic Components and Circuits category,* ***or circle no. 115*** *on the TSP Order Card in this issue to receive a copy by mail ($5 charge).*

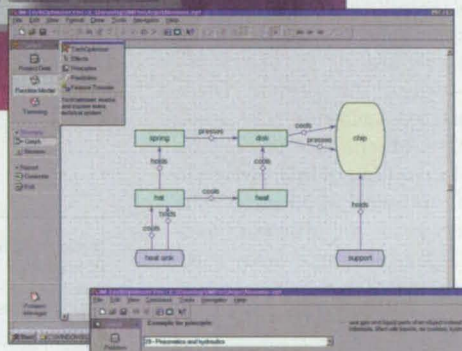
In accordance with Public Law 96-517, the contractor has elected to retain title to this invention. Inquiries concerning rights for its commercial use should be addressed to

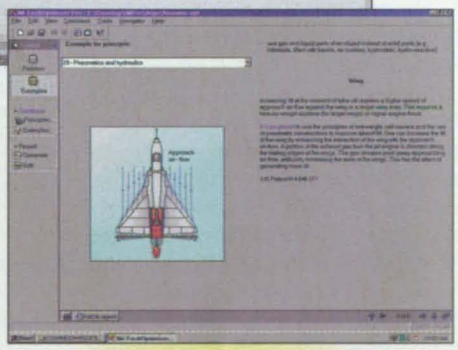
Larry Gilbert, Director
Technology Transfer
California Institute of Technology
Mail Code 315 - 6
Pasadena, CA 91125
(818) 395-3288

Refer to NPO-19781, volume and number of this NASA Tech Briefs *issue, and the page number.*

What Is Boundless Innovation?







TechOptimizer™

PROFESSIONAL EDITION

TechOptimizer Professional Edition is the only software product that assists you in the conceptual stage of design. This product offers you a systematic approach for thinking outside the box and generating new solutions without compromise.

TechOptimizer Professional Edition helps you out-think your competition by guiding your thought process. This unique software tool helps you to correctly state and solve your problems across many fields of engineering.

Best New Product

TechOptimizer Professional Edition allows you to:

- Speed the development of new products/processes
- Avoid expensive errors in the early stages of design
- Enhance inventive ideas by expanding your knowledge-base

MICROSOFT WINDOWS COMPATIBLE

Invention Machine®

Software That Invents™

Call about our FREE seminars and FREE Demo Disk!

800-595-5500 www.invention-machine.com

Dicke Radiometer Waveguide Switch Actuated by a Voice Coil

Some limitations of traditional Dicke switches are overcome.

NASA's Jet Propulsion Laboratory, Pasadena, California

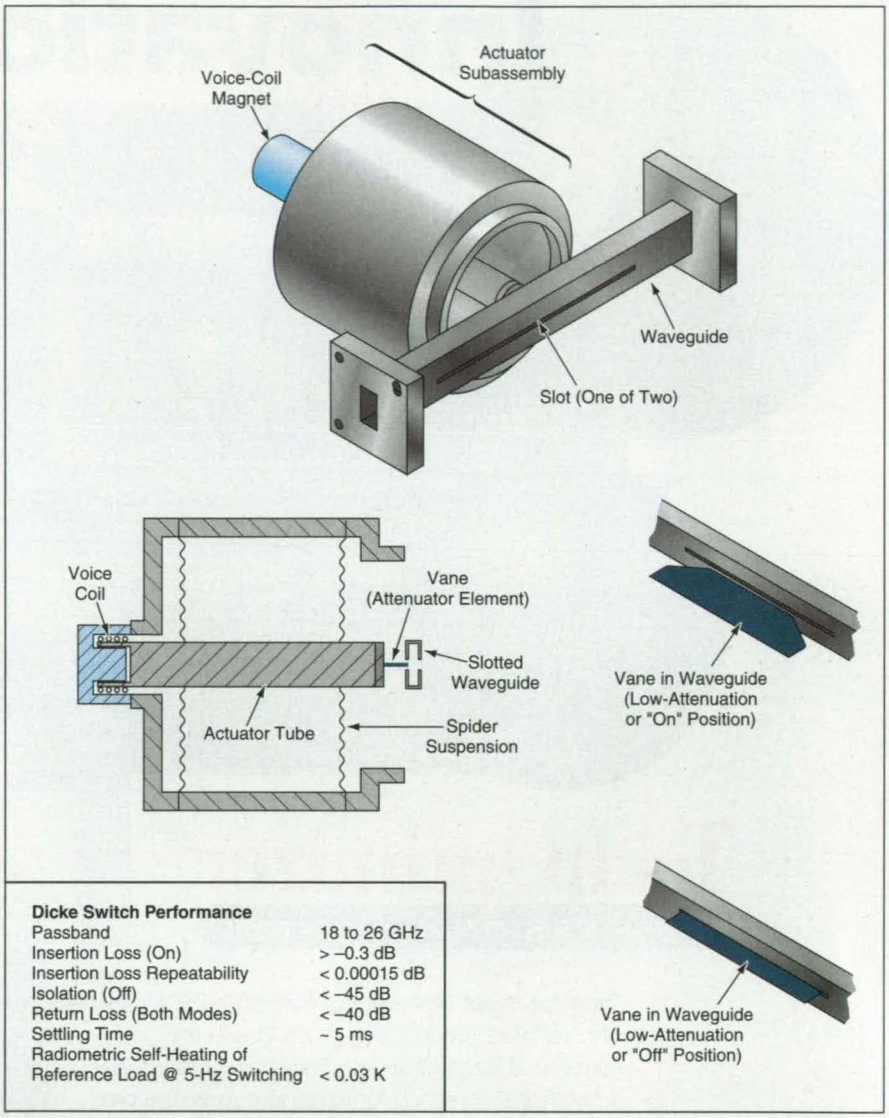
An improved mechanical waveguide switch has been developed for use in a high performance, broadband microwave radiometer to switch between a reference load and antenna at a repetition rate of 5 Hz. Switches for this purpose are called "Dicke" switches. Heretofore, various electronic and mechanical Dicke switches have been used. Electronic Dicke switches offer high switching speeds and long operating lifetimes but poor radio-frequency (RF) performance as characterized in terms of insertion loss, bandwidth, isolation, and return loss in the desired signal frequency range of 18 to 26 GHz. Mechanical Dicke switches have been limited in operating lifetime, reliability, and switching speed.

The design of the present Dicke switch overcomes some of the traditional mechanical switch limitations. In this switch, there are no sliding or contacting surfaces to wear out. The design takes advantage of established loudspeaker-voice-coil technology to achieve rapid response and long life.

In its RF aspect, the present Dicke switch is based on common waveguide vane attenuators, which, heretofore, have been used in fine-tuning of microwave circuits. For the present application, the attenuator serves as an efficient, well-matched single-pole-single-throw RF switch. The attenuator is rapidly switched by a voice-coil actuator between the high and low attenuation limits. The attenuator vane provides the reference load (i.e., the "black-body" temperature reference) needed by the radiometer.

The switch (see figure) is an assembly that includes a slotted waveguide and an actuator subassembly that moves the vane in and out of the waveguide through the slots. The moving structure within the actuator subassembly includes a thin-walled fiberglass tube filled with expanded polystyrene. The vane is attached to one end of the tube, and the loudspeaker voice coil is wound around the other end.

The outer part of the actuator subassembly holds a speaker magnet at one end, two loudspeaker spiders in the middle, and the slotted waveguide at the other end. The tube is approximately 4 in. (≈ 10 cm) long, so that (1) the stance between the two spiders provides sufficient mechanical advantage to guide the tube along a straight line, and (2) the vane is thermally insulated from the voice coil. The latter requirement is important since the physical temperature of the vane element is the reference for the radiometer.



Dicke Switch Performance

Passband	18 to 26 GHz
Insertion Loss (On)	> –0.3 dB
Insertion Loss Repeatability	< 0.00015 dB
Isolation (Off)	< –45 dB
Return Loss (Both Modes)	< –40 dB
Settling Time	~ 5 ms
Radiometric Self-Heating of Reference Load @ 5-Hz Switching	< 0.03 K

A **Loudspeaker Voice Coil** is used to stroke a vane into, then out of a waveguide to switch between high attenuation ("off") and low attenuation ("on").

A stroke of about 1/4 in. (≈ 6 mm) is needed to move the vane into and out of the waveguide, which is of a standard size known in the microwave industry as "WR-42." (If one were to use a waveguide of different size, it could be necessary to scale the stroke accordingly.) The slot on the side of the waveguide opposite the actuator subassembly allows the vane to protrude: this feature is needed to accommodate the overshoot and backlash of the actuator.

The electronic circuitry for driving the voice coil includes a regulated voltage source that can be switched between positive and negative polarities to move the vane to either of two extreme positions. Switching speed is further enhanced by adding accelerating and decelerating pulses to the driver waveform. As tested on a prototype unit, switching speeds as fast as 2 ms have been demonstrated. In practice, however, excess heat and vibration dictate a nominal switching speed of about 5 ms. At such a speed, and when continuously switching at 5 Hz, the excess heat produced at the vane element is less than 0.03°C in the prototype unit.

This work was done by Alan B. Tanner of Caltech for **NASA's Jet Propulsion Laboratory.** *For further information, access the Technical Support Package (TSP)* ***free on-line at www.nasatech.com*** *under the Electronic Components and Circuits category,* ***or circle no. 111*** *on the TSP Order Card in this issue to receive a copy by mail ($5 charge).*

NPO-20056

Revolutionary Industrial Grade PC Designed for PC Based Instrumentation

World's Fastest Data Acquisition Systems for PCI and ISA Bus

GagePC 580

- Front Access for all Connectors
- Built-In 10" Color Monitor
- Rugged, Industrial Grade Chassis
- 19" Rackmount Option
- 350 Watt, High Qualtiy Power Supply
- 200 CFM Forced Air Convection

GagePC Configuration 100

- **4 channel, 12 Bit 100 MSPS A/D Scope System**
  (4 board CS8012A Master/Slave System)

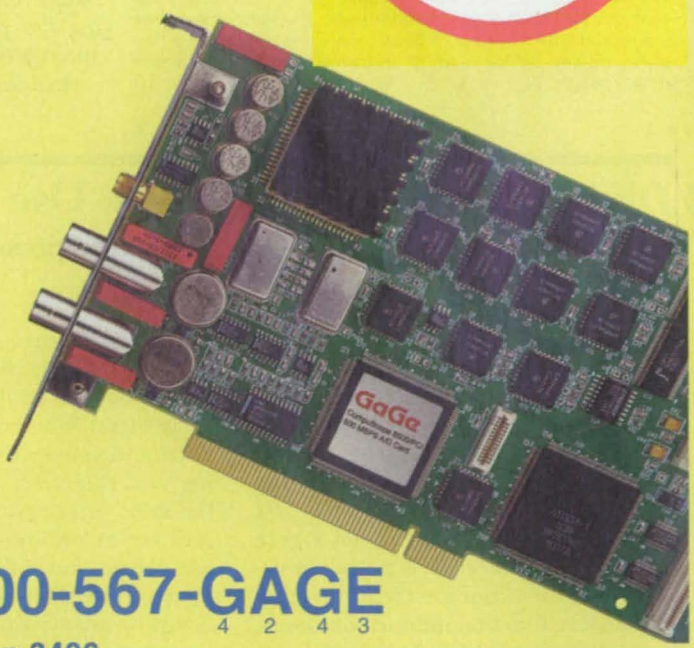
GagePC Configuration 101

- **2 channel, 500 MSPS A/D Scope System with data throughput rates of 100 MB/s**
  (2 board CS8500/PCI Master/Slave System)

GagePC Configuration 102

- **5 channel, 250 MSPS One Shot A/D Scope System**
  (5 board, CS2125 Master/Slave System)

Many other system configurations available



GaGe

GAGE APPLIED SCIENCES (U.S.) INC.
1233 Shelburne Road, Suite 400
South Burlington, VT 05403
Tel: 1-800-567-4243
Fax: 1-800-780-8411
e-mail: prodinfo@gage-applied.com
web site: http://www.gage-applied.com

Call 1-800-567-GAGE
4 2 4 3

Ask for extension 3406

From Outside the U.S. contact, Gage Applied Sciences Inc., 5610 Bois Franc, Montreal, QC, Canada, H4S 1A9 Tel: 514-337-6893 Fax: 514-337-9844

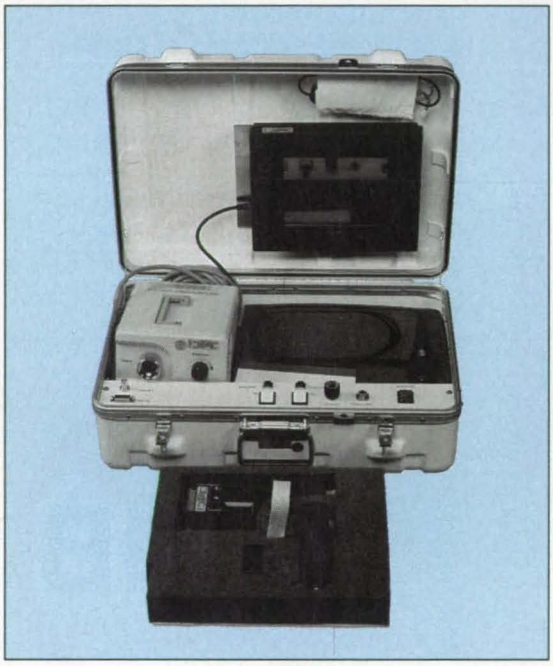
For More Information Circle No. 532

Compact Instrumentation Package for Remote Medical Diagnosis

Portable, integrated instruments could bring benefits of medical expertise to remote places.

Lyndon B. Johnson Space Center, Houston, Texas

The telemedicine instrumentation pack (TIP) contains equipment for generating video, audio, and digital data signals for remote diagnosis of medical problems. With little or no training, people on a space station, oil rig, remote farm, or disaster site, for example, can use the equipment in the suitcase-sized pack to provide distant physicians with the information they need to advise on treatment.



The **TIP** contains instruments needed for a remote physical examination. To save space and weight, the same video camera is used with a variety of lenses, the video monitor is a flat-panel display device, and all instruments share a common power supply.

A video camera captures images of the eyes, ears, nose, throat, and skin. A fiber-optic light source illuminates the required areas. An electronic stethoscope acquires heart, lung, and bowel sounds. Additional instruments acquire electrocardiograms, blood-pressure readings, and pulse-oximetry data. The images, sounds, and data are monitored locally on a flat-panel display and headphones (or loudspeaker) and are transmitted to remote experts by a telephone or radio link.

The TIP is compact and lightweight. It is designed to consume low power. The prototype TIP is powered from an ordinary 110-Vac outlet. The cost of reproducing the prototype would be about $30,000 (1995 prices).

In a demonstration, a nurse in a small family-medicine clinic in rural Texas examined patients with the telemedicine instrumentation pack. Signals were carried by telephone lines to specialists in otolaryngology, dermatology, and ophthalmology in Galveston, 30 miles (50 km) away. People at the two sites carried out a two-way, real-time medical consultation.

This work was done by Roger D. Billica of **Johnson Space Center** *and Scott C. Simmons, John R. Pohl, Terrell M. Guess, and Douglas A. Rushing of KRUG Life Sciences. For further information, access the Technical Support Package (TSP)* ***free on-line at www.nasatech.com*** *under the Electronic Systems category,* ***or circle no. 127*** *on the TSP Order Card in this issue to receive a copy by mail ($5 charge).*

Title to this invention has been waived under the provisions of the National Aeronautics and Space Act [42 U.S.C. 2457(f)], to KRUG Life Sciences. Inquiries concerning licenses for its commercial development should be addressed to:

KRUG Life Sciences
ATTN: Richard Markle
1290 Hercules Drive, Suite 120
Houston, TX 77058

Refer to MSC-22624, volume and number of this NASA Tech Briefs *issue, and the page number.*

Digital Receiver for Mobile Use in an Urban Environment

This receiver is designed to function in the presence of multipath signal propagation.

NASA's Jet Propulsion Laboratory, Pasadena, California

The Direct Broadcast Satellite-Radio (DBS-R) receiver is being developed for use in receiving digital audio and ancillary data signals transmitted in quaternary phase-shift keying (QPSK) from a satellite in orbit around the Earth and retransmitted from repeater stations in an urban area (see Figure 1). The DBS-R receiver is a flexible system that incorporates features that enable it to function indoors, outdoors, or in a moving vehicle in the presence of the multipath propagation characteristic of an urban environment.

The multipath characteristic poses a major design problem: The signals rebroadcast from multiple repeater stations and reflected from various moving and stationary objects all contain the same information but arrive at the receiver at different strengths, different delays, and different Doppler and phase shifts. Differences between the delays of two arriving signals can sometimes equal or exceed a symbol period, giving rise to intersymbol interference. For purposes of mathematical modeling, the signal arriving from each repeater station can be treated as having been smeared out to form a combination of signals with Rayleigh fading statistics.

The receiver (see Figure 2) uses concatenated coding and interleaving to correct errors and mitigate loss of signal, and an equalizer to synchronize multiple received signals. The major building blocks of the receiver are (1) a QPSK demodulator, (2) a lattice pre-

Backup 64 GB An Hour To The Strongest Tape Ever Made

Plug Compatible With

Alliant
Alpha Micro
Altos
Amdahl
Apollo
Arix
AT&T
Basic-4
Bull
Concurrent
Convergent
Data General
Digital
Gould/Encore
Harris
Honeywell
HP
IBM PC/Compatible
IBM Midrange/Mainframe
ICL
Intergraph
Macintosh
McDonnell Douglas
Motorola
NCR
NeXT
Novell
Pertec
Prime
Pyramid
Sequent
Silicon Graphics
Stratus
Sun
Texas Instruments
Unisys
Ultimate
Wang
Windows NT

Let's face it, your backup is only as good as your tape. And all the performance in the world won't get your data back if your tape is weak or dirty. Fortunately, there's no need to compromise. The CY-8000 is the safest, the most reliable, *and the fastest* 8mm tape drive on the market.

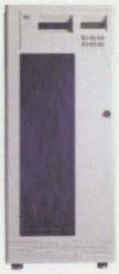
Compact in size, the CY-8000 can store up to 125 GB on each tape.

The CY-8000 uses ***Advanced Metal Evaporated*** media, a 100% cobalt, 2-layer tape that features a diamond-like coating for exceptional durability. And it's the *only* 8mm drive with a ***built-in head cleaner*** to keep the tape path free of contaminants, further ensuring data integrity and virtually eliminating the time and expense associated with cleaning kits.

In addition to superior design, the CY-8000 offers unbeatable performance. Able to store ***25 GB at 3 MBS***, uncompressed, you can achieve up to ***125 GB at 9 MBS*** with optional data compression. With 257% more capacity and 500% greater speed* than industry standard 8mm drives, the CY-8000 can backup faster to fewer tapes.


The superior design of the AME tape makes it suitable for 20,000 passes.

For maximum flexibility, our exclusive Advanced SCSI Processor option provides five recording modes — ***striping, mirroring, cascade, independent,*** and ***offline copy/verify***. So you can easily make duplicate tapes for off-site storage or data exchange, build fault tolerance, or simply maximize performance to accomplish bigger backups in less time. With the Advanced SCSI Processor, you've got a complete data storage management tool.


Automate access to up to six drives and 126 tapes with our intelligent tape library.

Available in a single or multi-drive desktop, rack mount, or library configuration, the CY-8000 is scalable to ***15.75 terabytes***. If you need to ensure the safety of your company's critical data, don't trust anything less.

** Uncompressed; CY-8000 performance advantages are even more impressive with data compression.*

(757) 833-9000

CYBERNETICS

111 Cybernetics Way • Yorktown, VA 23693 • Fax (757) 833-9300

NTB 8/97

dictive decision-feedback equalizer, (3) a deinterleaver, and (4) Viterbi and Reed-Solomon decoders. The receiver operates in open- or closed-loop mode, depending on whether it does or does not, respectively, detect multipath propagation. In the open-loop (multipath) mode, the numerically controlled oscillators (NCOs) in the carrier- and symbol-synchronizing loops are initialized and updated by use of estimated or predicted carrier frequency and symbol rate. In the closed-loop (no multipath) mode, the tracking loops in the receiver are closed, and the equalizer is bypassed.

The equalizer utilizes a training sequence as one of its inputs for adjusting its coefficients. A frame sync code is used for resolving the QPSK in-phase (I) and quadrature (Q) ambiguity, synchronizing frames in the deinterleaver and Reed-Solomon decoder, and determining the presence of multipath propagation. Computational simulations of the performance of the receiver have been carried out for some test cases involving both channels with additive-white-Gaussian-noise and multipath-Rayleigh channels. The results of the simulations show that the performance of the receiver in a multipath Rayleigh channel is significantly improved by use of equalization, and that fractional-symbol equalization offers a performance advantage over full-symbol equalization.

This work was done by John Gevargiz, David Bell, Leon Truong, Arvydas Vaisnys, Krisjani Suwitra, and Paul Henson of Caltech for **NASA's Jet Propulsion Laboratory.** *For further information, access the Technical Support Package (TSP)* ***free on-line at www.nasatech.com*** *under the Electronic Systems category,* ***or circle no. 120*** *on the TSP Order Card in this issue to receive a copy by mail ($5 charge).*

NPO-19639

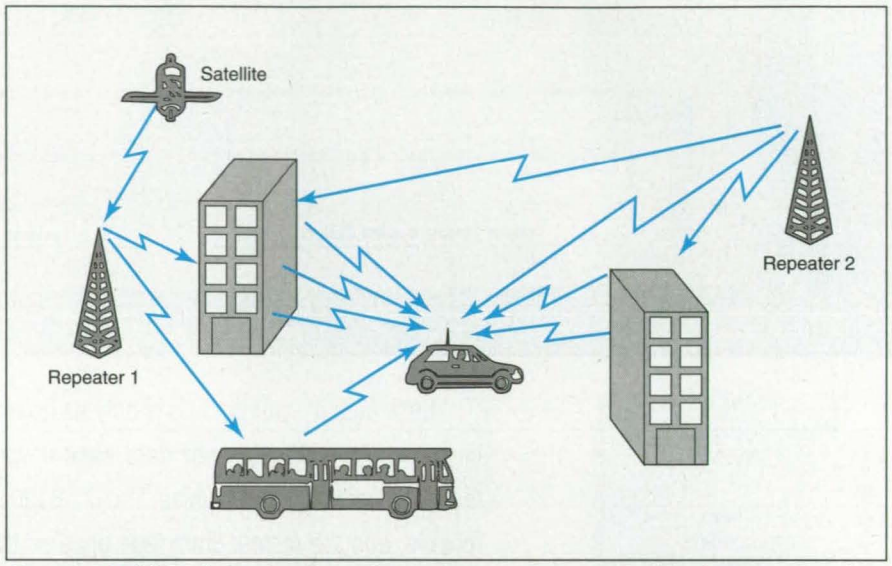


Figure 1. A **Mobile Radio Receiver** in an urban environment encounters multipath propagation of signals from multiple repeater stations.

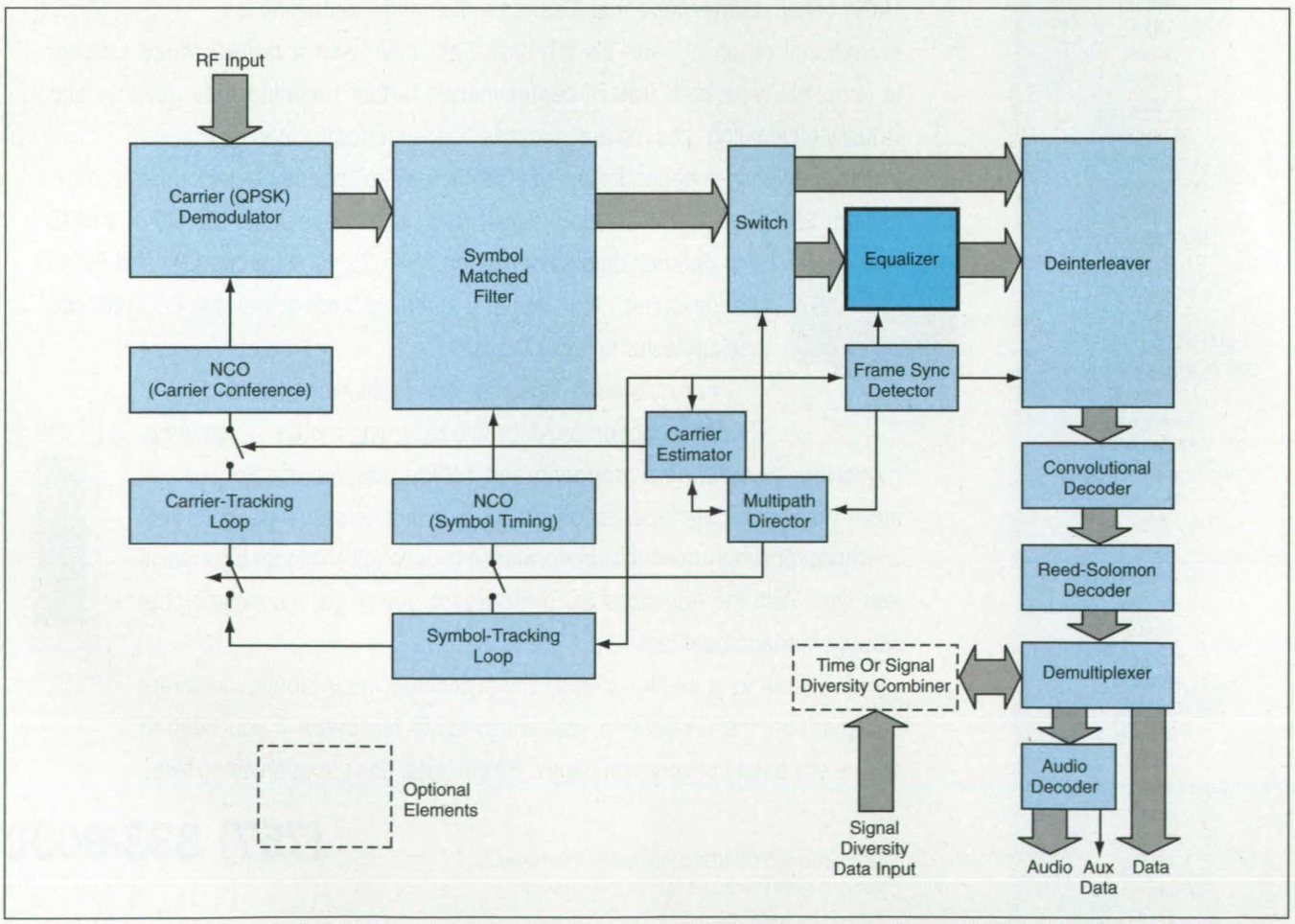


Figure 2. The **DBS-R Receiver** is a flexible system designed to function in the multipath environment, with a capability for equalization (including synchronization) of multiple simultaneously received signals.

Kid's stuff.

SOLID EDGE

MICROSTATION

SOLID WO

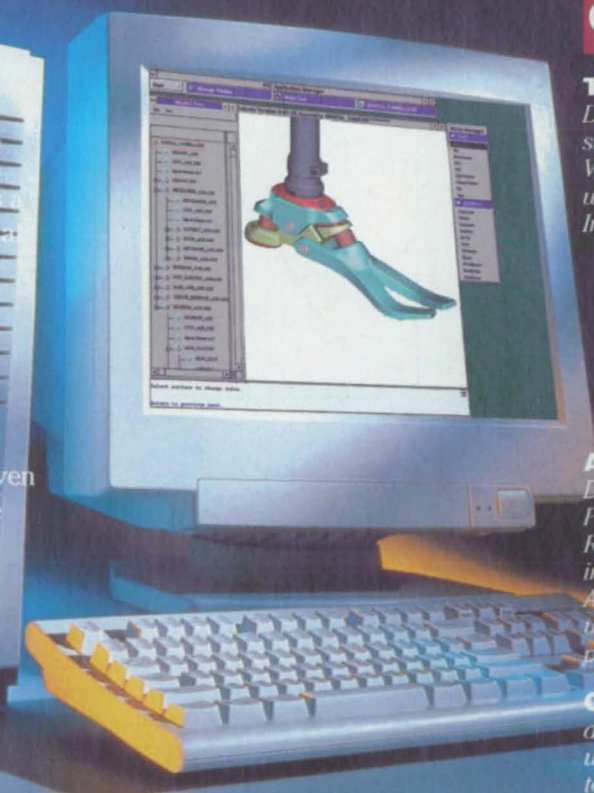
ARTI

AL DESKTOP

Our stuff.

Which would you rather design with?

The PT/Products™ family includes a fully associative suite of mechanical design and manufacturing applications. The core module, PT/Modeler™, is a robust, 3D, parametric, feature-based, solid modeling system for part and assembly design, detailing, and documentation. Based on the proven technology of Pro/ENGINEER®, the PT/Products family is production-ready and dependable software ideally suited for manufacturing companies making the transition from 2D CAD systems to solid modeling. **The U.S. list price for PT/Modeler is only $2995. Why pay more and get less?**



digital™

The Hardware.

Digital, the world's leading supplier of high performance Windows NT personal workstations, offers a family of Intel and Alpha platforms

- *which make all other solutions look like child's play.*
- *which will run PT/Products at blazing speeds without busting your drawing allowance.*

A Powerful Team.

Digital, in combination with PT/Products Authorized Resellers, is offering special incentives on both Intel and Alpha-based Windows personal workstations for maximum performance.

Call 1-800-DIGITAL *for full details. Ask to speak to a workstation specialist and refer to code "QKP".*

Visit us today at http://www.ptproducts.com and http://www.workstation.digital.com

For More Information Circle No. 575

Narrow-Band Optical Filters Made by Spectral Hole Burning

Pass wavelength(s) could be chosen at will.

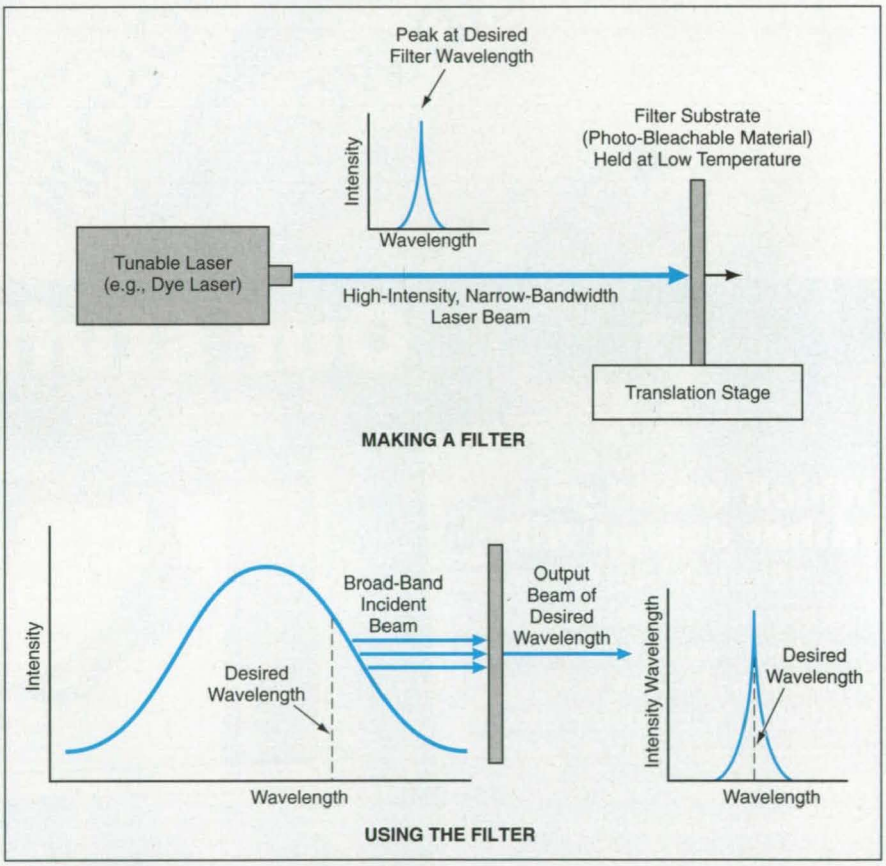
NASA's Jet Propulsion Laboratory, Pasadena, California

Spectral hole burning would be used, according to a proposal, to make optical filters with tailorable pass bands that could be made very narrow. The proposed filters could be useful for rejecting background light in diverse applications, including spectroscopy, remote sensing, optical communications, and lidar.

Currently available optical filters based, variously, on birefringence and interference can be tailored to desired pass wavelengths, but in a typical case, the pass band cannot be made narrower than some tens of angstroms. Also currently available are atomic-resonance filters, which offer typical bandwidth of a small fraction of an angstrom, but the pass wavelengths are not tailorable because they are limited to wavelengths that correspond to a few discrete transitions between electron-energy levels in the atoms in question. The proposed filters would combine the tailorability of interference- and birefringence-based filters with capability for narrow bandwidth of atomic-resonance filters.

Spectral hole burning is so named because it involves exposure of an initially opaque photo-bleachable material (a saturable absorber) to intense illumination to create a region of transparency in part of the spectrum (a "spectral hole"). Photo-bleaching is highly sensitive to changes in wavelength; each hole is transparent only to light of the same wavelength that created it. Thus, one could use a very-narrow-bandwidth, finely tunable laser to create a hole with a pass band at a desired wavelength (see figure), and the spectral width of the hole would be determined by the spectral width of the laser beam. Unlike a filter based on interference and/or birefringence, a filter made by spectral hole burning could have a field of view almost as wide as a hemisphere. It should be possible to create multiple holes with pass bands at different wavelengths in the same filter substrate. Once the hole had been created, the laser would no longer be needed.

Lasers suitable for this purpose include dye lasers and optical parametric oscillators that produce fundamental-frequency and harmonic radiation at wavelengths from 0.2 to more than 4 μm. Candidate spectral-hole-burning materials include polymers [polystyrene, poly(methyl methacrylate), polyvinyl alcohol, polyethylene, and others] doped with organic photochemicals. The homogeneous linewidth of a given material at low temperature is a factor in determining the ultimate minimum bandwidth achievable in a filter made of that material. Most photobleaching materials available today must be cooled to temperatures below 10 K to obtain long-lasting spectral holes, but researchers are attempting to identify spectral-hole-burning materials that can function as such at higher temperatures. Higher-temperature spectral-hole-burning materials are also sought for use in optical data-storage devices.



Spectral Hole Burning is a proposed technique for making a narrow-band optical filter in a photobleachable material. By use of the translation stage, the filter substrate could be stepped to different positions while the laser was stepped to different wavelengths. One could thus make a series of filter holes. The spectral and spatial width of each hole would be essentially the same as those of the laser beam used to create it.

This work was done by Hamid Hemmati of Caltech for **NASA's Jet Propulsion Laboratory**. *For further information, access the Technical Support Package (TSP)* ***free on-line at www.nasatech.com*** *under the Physical Sciences category, or* ***circle no. 103*** *on the TSP Order card in this issue to receive a copy by mail ($5 charge).*

NPO-19687

Miniature Gas-Chromatograph/Mass-Spectrometer

Quantitative analysis by GC/MS would no longer be restricted to laboratory settings.

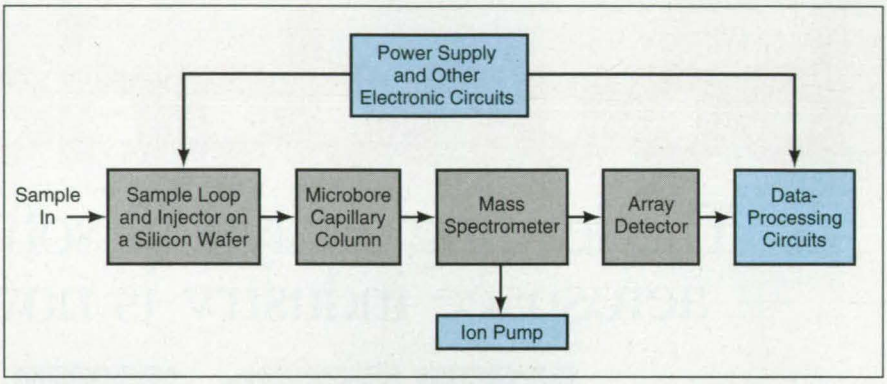
NASA's Jet Propulsion Laboratory, Pasadena, California

The micro-gas chromatograph mass spectrometer μ-GCMS (see figure) is a proposed hand-held instrument that could be carried into the field to measure the concentrations of volatile compounds (e.g., pollutant gases) in air, water, soil, industrial environments, and other environments not conducive to laboratory analysis. As its full name suggests, the μ-GCMS would comprise a highly miniaturized combination of the much larger, much heavier, and nonportable laboratory instrumentation customarily used to perform quantitative analysis by gas chromatography and mass spectrometry (GC/MS). Of course, by virtue of its microminiaturization, the μ-GCMS would also consume much less power than does a conventional laboratory GC/MS apparatus.

A sample of the gas to be analyzed would enter the μ-GCMS via a sample-loop-and-injection system fabricated on a silicon chip by micromachining. The miniaturization of the GC portion of the proposed instrument would be made possible by the development of a microbore capillary column (length 2 to 3 m, inside diameter ≤ 50 μm) in place of the conventional GC column. Molecules eluting from the GC column would be ionized as they entered the mass spectrometer. The column would lead directly into the ion source, so that there would be no dead volume in the column. The shortness of the column would result in a short analysis time.

The effluent gas flow in the microbore capillary column would be 0.02 to 0.05 atm·cm^3/min (3×10^{-5} to 8×10^{-5} Pa·m^3/s) — of the order of 1/100 that of a typical conventional GC gas flow. Thus, the size, weight, and power of the vacuum pump in the μ-GCMS could be much less than those of the vacuum pump in a conventional laboratory GC/MS apparatus. In addition, microbore columns are particularly suitable for instruments like this one because they offer high separation efficiency.

The mass-spectral peaks of the molecules eluting from the column would be narrow and closely spaced; this gives rise to a severe design requirement in that it would be necessary to acquire mass-spectral measurement data at a high rate in order to characterize these peaks. To satisfy the high-data-rate requirement, an array detector at the focal plane of the mass spectrometer would measure the mass-spectral peaks of ions of different masses simultaneously. This design concept would make it possible to utilize all of the mass spectral signal with 100-percent duty cycle, whereas a typical conventional scanning mass spectrometer utilizes less than 1 percent of its signal output.



The **μ-GCMS** would be a highly miniaturized instrument that would perform the functions of a conventional GC/MS apparatus that typically comprises several much larger, heavier pieces of equipment that consume much more power.

In the MS portion of the instrument, advanced magnetic materials would be exploited in the design of a novel magnetic deflection sector much smaller than that of a conventional mass spectrometer: The magnetic field would be supplied by a permanent magnet fabricated from a Nd/B/Fe alloy that has an energy product about 10 times that of a commonly used Al/Ni/Co permanent-magnet alloy. The yoke and pole pieces would be made of a high-permeability Fe/V/Co alloy. The permanent magnet and pole pieces would be shaped and dimensioned in a modified Dempster geometry in which the magnetic field in the focal plane would be configured, in relation to the focal plane, to enable operation of the array detector in the focal plane. The overall dimensions of the mass spectrometer would be only 2.9 by 1.8 by 0.6 in. (7.4 by 4.6 by 1.5 cm) and its mass would be only 250 g. The focal plane would be about 1 in. (about 2.5 cm) long. The mass range would be 2 to 200 daltons covered in steps.

The ions separated along the focal plane of the mass spectrometer would impinge on the array detector, which would comprise a microchannel-plate electron multiplier backed by an array of metal anode strips with a pitch of 25 μm. The array would be fabricated on a silicon chip. Also included on the chip would be a charge-pulse-sensor circuit, a pulse-counter circuit, and control and interface circuitry for each anode in the array. The electrons exiting the channels of the microchannel plate can also be detected with a photodiode or charge-coupled-device (CCD) array. For this method, the electrons first will impinge on a phosphor-coated fiber-optic plate where photon images of the ions/electrons are generated by phosphorescence.

This work was done by Mahadeva P. Sinha of Caltech for **NASA's Jet Propulsion Laboratory**. *For further information, access the Technical Support Package (TSP)* ***free on-line at www.nasatech.com*** *under the Physical Sciences category, or* ***circle no. 104*** *on the TSP Order card in this issue to receive a copy by mail ($5 charge).*

In accordance with Public Law 96-517, the contractor has elected to retain title to this invention. Inquiries concerning rights for its commercial use should be addressed to:

Larry Gilbert, Director
Technology Transfer
California Institute of Technology
Mail Code 315 - 6
Pasadena, CA 91125
(818) 395-3288

Refer to NPO-19536, volume and number of this NASA Tech Briefs *issue, and the page number.*

How effectively do your engineering teams relay designs?

Now, more than ever, with constraints of schedules and budgets clouding engineering projects, smoothing communications between design groups is crucial to the success of your project. Here's where the MATRIX$_X$® engineering productivity tools step in. The "design via simulation" environment has proven its value over the years in a variety of challenging programs. MATRIX$_X$'s open architecture framework facilitates rapid integration in your design process, while leveraging your design investment.

Valuable feedback from the MATRIX$_X$ worldwide user community, combined with Integrated Systems' commitment to engineering innovation and leadership, has driven the next generation of MATRIX$_X$ tools. Key enhancements include standard user interfaces, seamless workgroup integration, software specification flexibility, and a quantum leap in automatic code generation technology.

Version 6.0 is on the blocks and ready to go! Make your "design hand-off" a winner with MATRIX$_X$. Call: 800.770.3338 or send email to: info@isi.com.

Team MATRIX$_X$... Keeping Your Projects on Track

MATRIX$_X$

integrated systems

201 Moffett Park Drive • Sunnyvale, CA 94089 • 800.770.3338 • www.isi.com

For More Information Circle No. 513

Dual Cooling of a Pressure Probe

Evaporation and discharge of coolant are exploited to enhance cooling and decrease size.

Lewis Research Center, Cleveland, Ohio

An improved design for a probe that measures pressure in a flowing hot fluid provides for two flows of coolant liquid; (1) a primary flow that cools the pressure-transducer jacket and (2) a secondary flow that cools the probe inlet, through which the pressure is communicated from the hot fluid to the pressure transducer. Both flows are discharged into the flowing hot fluid.

Active cooling is necessary when the temperature of the fluid to be probed exceeds the maximum operating temperature of the pressure transducer. A probe of older design includes a coolant supply line and a coolant return line (both contained within the probe stem), plus a cooling jacket for the transducer. Because of the need to loop the coolant through the probe, (as opposed to discharging the coolant after it has flowed through the probe), the cooling jacket must be relatively bulky. The older design with the bulky cooling jacket entails the following three major disadvantages:

1. The probe inlet body is not cooled.
2. Flowing in through the supply line alongside the hot return line, the coolant is heated somewhat before it reaches the cooling jacket, with a resultant decrease in effectiveness of cooling.
3. One can compensate for the decrease in effectiveness of cooling by enlarging the cooling jacket, but in so doing, one lengthens the inlet body and thereby reduces the frequency response of the probe.

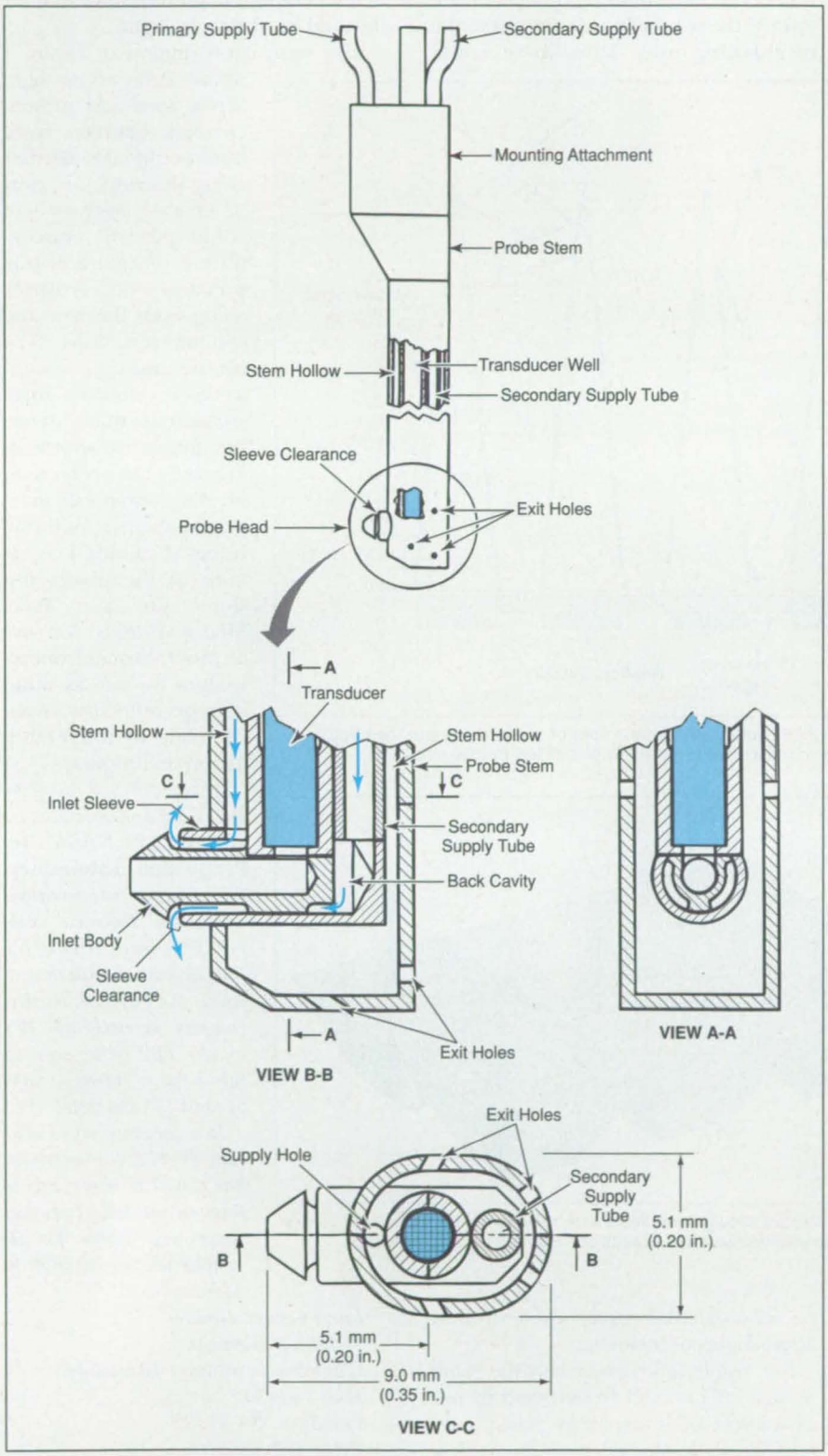
A probe of the present improved design is illustrated in the figure. The primary coolant enters the probe along the primary supply tube, then flows through the stem hollow along the transducer well. Most of the primary flow is then discharged into the hot environment through exit holes, the numbers and positions of which are chosen to suit the thermal and flow conditions.

The secondary coolant is delivered through the secondary supply tube into the back cavity in the inlet sleeve. The secondary coolant then flows from the back cavity along the sleeve clearance to the tip of the inlet body, where it is discharged. This arrangement minimizes the distance between the tip of the inlet body and the transducer, and thereby helps to maximize the frequency response of the probe. The secondary supply tube is insulated from the probe stem by the primary flow of coolant, and thus the secondary flow of coolant does not pick up heat before it reaches the inlet body. Some of the primary flow is discharged through the supply hole into the sleeve clearance, where it joins the secondary flow. The combined secondary/primary coolant discharged at the probe tip flows along the outer surface of the probe sleeve, providing additional evaporative cooling (if the coolant is a liquid) or film cooling (if the coolant is a gas).

This work was done by Jan Lepicovsky of NYMA, Inc., for **Lewis Research Center**.

For further information, access the Technical Support Package (TSP) ***free on-line at www.nasatech.com*** *under the Physical Sciences category, or* ***circle no. 110*** *on the TSP Order card in this issue to receive a copy by mail ($5 charge).*

Inquiries concerning rights for the commercial use of this invention should be addressed to NASA Lewis Research Center, Commercial Technology Office, Attn: Tech Brief Patent Status, Mail Stop 7–3, 21000 Brookpark Road, Cleveland, Ohio 44135. Refer to LEW-16301.



The **Dual-Coolant-Flow Probe Design** offers advantages of compactness and increased effectiveness of cooling in comparison with an older design that provides for a single circulating flow that cools the transducer jacket only. In addition, the inlet body and stem protect the transducer against impingement of debris, and the transducer can be replaced easily.

Microwedge Optical Concentrators for Image Sensors

Reflective microwedges would offer advantages over microlenses.

NASA's Jet Propulsion Laboratory, Pasadena, California

Reflective microwedges have been proposed for use as optical concentrators on image-sensing devices that contain focal-plane arrays of photodetectors and readout circuitry. Optical concentrators are needed to utilize incident light more fully. For example, between 70 and 80 percent of the area of each pixel in an active-pixel image sensor is occupied by a readout circuit that includes an amplifier; the light incident on this area cannot generally be detected unless an optical concentrator is used to redirect this light to the photoactive area of the pixel.

Attempts have been made to use microlenses as optical concentrators, but microlenses entail several difficulties and disadvantages:

- It is difficult to control the shapes of microlenses.
- At pixel sizes close to and below the diffraction limit, microlenses do not work.
- At some large angles of incidence, microlenses direct light to neighboring pixels, giving rise to crosstalk.
- Some of the light incident on microlenses at off-axis positions is reflected onto photodetectors of neighboring pixels, contributing further to crosstalk.

Figure 1 illustrates a basic microwedge configuration. High-aspect-ratio microscopic wedges coated with metal for reflectivity would be positioned to cover the readout-circuit areas in rows of pixels, leaving only the photoactive areas uncovered. Light traveling toward the covered readout-circuit areas at small angles of incidence would be reflected from the sides of the wedges onto the photoactive areas. The wedges would prevent spurious reflections between adjacent rows. Light entering at larger angles of incidence would undergo multiple reflections and could be reflected back toward the source but would not strike neighboring rows. Thus, there would be no crosstalk between rows, even at large angles of incidence.

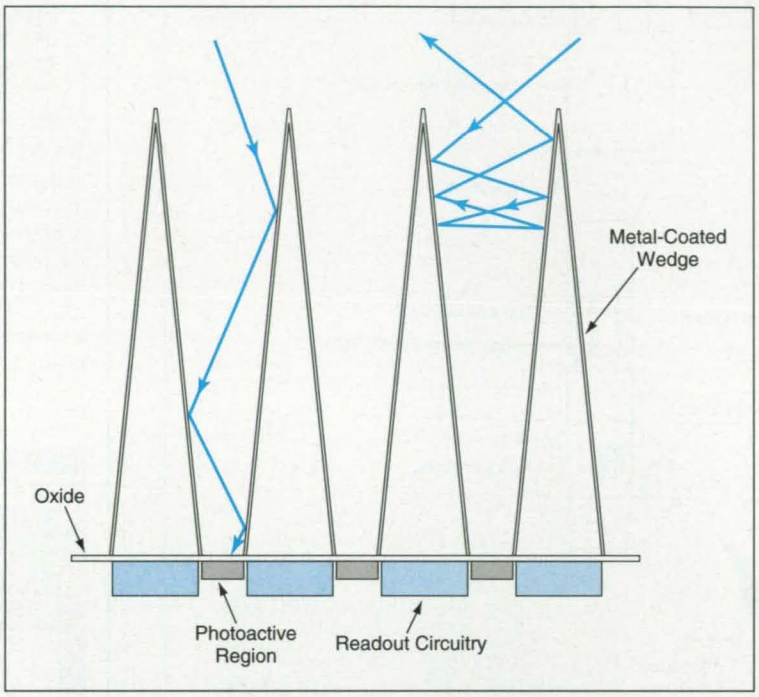


Figure 1. **Light Would Be Reflected** from the sides of the wedges onto the photoactive areas. The wedges would also serve as reflective barriers to crosstalk.

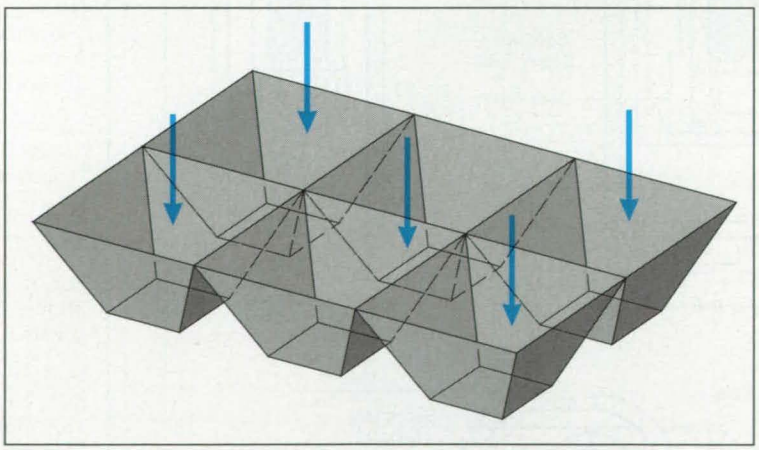


Figure 2. **Crossed Wedges Would Form Wells** with reflective sides that would concentrate light onto the photoactive areas in both the row and column directions.

For visible light, essentially the same optical effect could be achieved by use of a sheet of transparent plastic containing wedge-shaped grooves. Such a sheet could readily be mass-produced. Because of total internal reflection at the plastic/air interfaces of the grooves, it would not be necessary to coat the grooves with metal. This plastic-sheet design might not work well for infrared or ultraviolet light.

The basic configuration of Figure 1 would concentrate light across rows and prevent crosstalk between rows, but would do neither along the rows. An array of crossed microwedges could provide concentration of light and suppression of crosstalk along both the row and column directions. The intersecting microwedges would form pyramidal wells above the pixels, as shown in Figure 2. The array could be implemented in a plastic sheet containing integral molded pyramids at the pixel positions on one face. Micropyramids for use as mold dies and microwedges for use as mold dies or reflectors could be made by microfabrication techniques.

This work was done by Yu Wang and Eric Fossum of Caltech for **NASA's Jet Propulsion Laboratory**. *For further information, access the Technical Support Package (TSP)* ***free online at www.nasatech.com*** *under the Physical Sciences category, or* ***circle no. 105*** *on the TSP Order card in this issue to receive a copy by mail ($5 charge).*

In accordance with Public Law 96-517, the contractor has elected to retain title to this invention. Inquiries concerning rights for its commercial use should be addressed to:

Larry Gilbert, Director
Technology Transfer
California Institute of Technology
Mail Code 315 - 6
Pasadena, CA 91125
(818) 395-3288

Refer to NPO-19898, volume and number of this NASA Tech Briefs *issue, and the page number.*

Variable Thermal Resistor and Switch With Conical Gas Gap

The conical gap offers advantages over gaps between interleaved fins.

NASA's Jet Propulsion Laboratory, Pasadena, California

The figure illustrates an improved gas-gap thermal switch or variable thermal resistor that features a conical thermal interface. The baseline design of the device is for operation between temperatures of 140 and 60 K in a cryogenic system that would be used to cool arrays of infrared detectors to either of two selectable temperatures. The functionality of the device extends beyond the baseline temperature range, enabling operation at temperatures between 14 and 300 K.

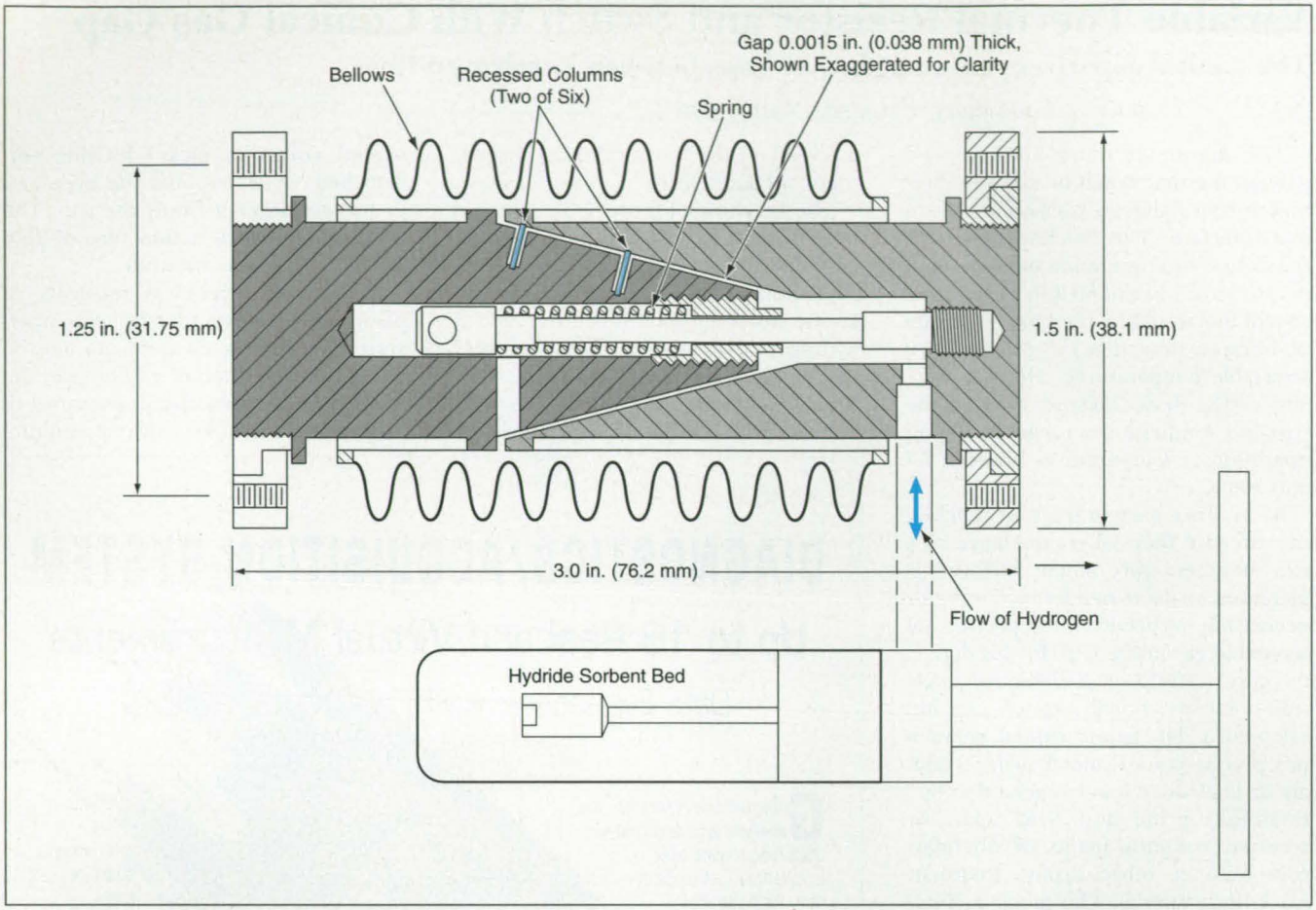
As in other gas-gap thermal switches, the effective thermal conductance of a gap between two metal surfaces is increased or decreased by increasing or decreasing, respectively, the pressure of a suitable gas in the gap. In this device, the gap is 0.0015 in. (0.038 mm) thick, with a cross-sectional area of 1.63 in.^{2} (10.5 cm^2). The gap is formed between two precise conical metal surfaces that are spring-loaded toward each other by a retaining spring and held apart by recessed columns made of fiberglass composite or other strong, thermally insulating material. The metal surfaces that face each other across the gap are coated with gold to minimize radiative transfer of heat across the gap when the switch is in the "off" state.

This conical-gap design is preferable to an alternative design for a gas gap formed between multiple interleaved fins, for the following reasons: In the case of interleaved fins, gradients of temperature and the attendant differential thermal expansion can be large enough to bring the facing metal surfaces into contact, so that, in effect, the switch becomes short-circuited. In contrast, the conical interface disturbs the heat-flux pattern minimally, so that it is possible to avoid large temperature gradients and thereby prevent short-circuiting. Moreover, the smoother flow of heat across the conical gap causes less of an undesired increase in thermal resistance when the switch is in the "on" state.

The gas gap is enclosed by a flexible leak-tight outer shell, which introduces some undesired thermal coupling between the two ends of the switch in the "off" state. This thermal coupling can be minimized by designing the outer shell to form a long, thin thermal path. Accordingly, the outer shell is made of a combination of thin-wall tubes and bellows. The outer-shell material is a 300-series stainless steel, which has low (relative to typical other metals) thermal conductivity.

The gas chosen for use in this switch is hydrogen, which provides high thermal conductivity and has the second lowest triple-point temperature (14 K) of all known working fluids. It is the choice of hydrogen that enables operation over the temperature range from 14 to 300 K. The gap volume communicates with a volume that contains an electrically heated zirconium-nickel hydride sorbent bed, which supplies the hydrogen to (or withdraws it from) the gap. The heating element is a thin film of platinum on a ceramic substrate.

Because the electrical resistivity of platinum is a known function of temperature, the heating element can also be used as a thermometer. Because the adsorption and desorption pressures of hydrogen in contact with zirconium-



The **Thin Gap Between the Metal Cones** is filled with (or depleted of) hydrogen to provide high (or low, respectively) thermal conductivity along the path between the two ends. The pressure of hydrogen in the gap (and thus the thermal conductance of the switch) is controlled by controlling the temperature of the hydride sorbent bed.

nickel hydride are known functions of temperature, the thermal conductance of the device can be controlled via temperature of the hydride bed. Thus, the switch can be turned "on" (set to maximum thermal conductance), turned "off" (set to minimum thermal conductance), or set to a desired intermediate level of thermal conductance by suitable control and monitoring of the electrical power supplied to the heater.

In tests, the switch exhibited "on"-state thermal resistances of about 1 K/W at heat flows up to 8 W and operating temperatures above 100 K. Temperature-dependent "off"-state thermal resistances ranged from 600 to 900 K/W. In particular, the "off"-state thermal resistance for operation between 60 and 140 was 660 K/W, and the "on"-state thermal resistance at 140 K was 0.92 K/W; the "off"/"on" switching thermal-resistance ratio was thus 660/0.92 = 717. The "off"-to-"on" and "on"-to-"off" switching times were found to be about 5 and 12 minutes, respectively.

This work was done by Jiunn Jenq Wu of Caltech for **NASA's Jet Propulsion Laboratory**. *For further information, access the Technical Support Package (TSP)* ***free online at www.nasatech.com*** *under the Physical Sciences category, or* ***circle no. 106*** *on the TSP Order card in this issue to receive a copy by mail ($5 charge).*
NPO-19976

Generating Harmonic Light in Nonlinear-Dielectric Spheres

Microspheres would be sized to support matching "whispering-gallery" resonant modes.

NASA's Jet Propulsion Laboratory, Pasadena, California

Optical resonators in the form of microspheres made of nonlinear-dielectric materials would be used to generate second-harmonic light, according to a proposal. For example, a resonator of this type would generate blue or ultraviolet light when excited by infrared or visible light from a diode laser. Microspheres typically have diameters that range from tens to hundreds of micrometers and could be integrated with diode lasers to make small, efficient sources of coherent blue or ultraviolet light.

The microspheres would be sized, in consideration of the linear and nonlinear components of their dielectric properties, to support "whispering-gallery" resonant electromagnetic-wave modes at the desired wavelengths. Studies have shown that using microspheres made of practical dielectric materials, it should be possible to achieve the high quality factors ($Q \geq 10^7$) in the whispering-gallery modes, enabling sufficient buildup of electromagnetic fields in those modes to generate useful amounts of second-harmonic radiation. [The quality factor (Q)

of a resonator is a measure of the sharpness of its resonance in the given mode and is defined as $2\pi \times$ the energy stored in the electromagnetic field in the resonator ÷ the energy dissipated per cycle of oscillation.]

The whispering-gallery modes of a dielectric microsphere represent electromagnetic fields confined by internal reflection to an interior region close to the surface of the sphere. For a microsphere with a diameter ≥ 10 μm, the dimension of the resonator is much larger than the wavelength of light. Thus, the loss due to the finite curvature of the resonator is negligible, resulting in a high Q that is limited mainly by the attenuation of the light in the dielectric material.

The design of a microsphere resonator involves numerical solution of equations that contain Bessel and Hankel functions that describe the whispering-gallery modes. The candidate solutions are those that support both the fundamental and the second-harmonic waves and that satisfy two phase-matching conditions. The first phase-matching condition — essential for the generation of the second harmonic — is that the total phase change suffered by a wavefront that starts from a given point in the sphere and propagates through the sphere, returning to the starting point, must be an integer multiple of 2π radians for both the fundamental and the second-harmonic wave. The second phase-matching condition — to ensure maximum transfer of power from the fundamental to the second harmonic — is that the phase difference between the fundamental and second-harmonic waves in the sphere is $\pi/2$ radians, so that the antinodes of the second-harmonic wave coincide with the antinodes of the nonlinear-polarization wave in the sphere.

Because the simplest approach to fabrication of microspheres involves melting, a nonlinear-dielectric material that retains the desired optical properties would be desirable. A likely candidate material for this approach is DAST, which is a crystalline material that retains its properties, including its crystal-axis orientation, after a melt. As an example, a DAST sphere with a diameter of 25 μm would support the appropriate whispering-gallery modes and satisfy the phase-matching conditions for generating second-harmonic light with a wavelength of 400 nm from input radiation at a fundamental wavelength of 800 nm. The calculated Q values of both the fundamental and the second-harmonic whispering-gallery modes exceed 10^9.

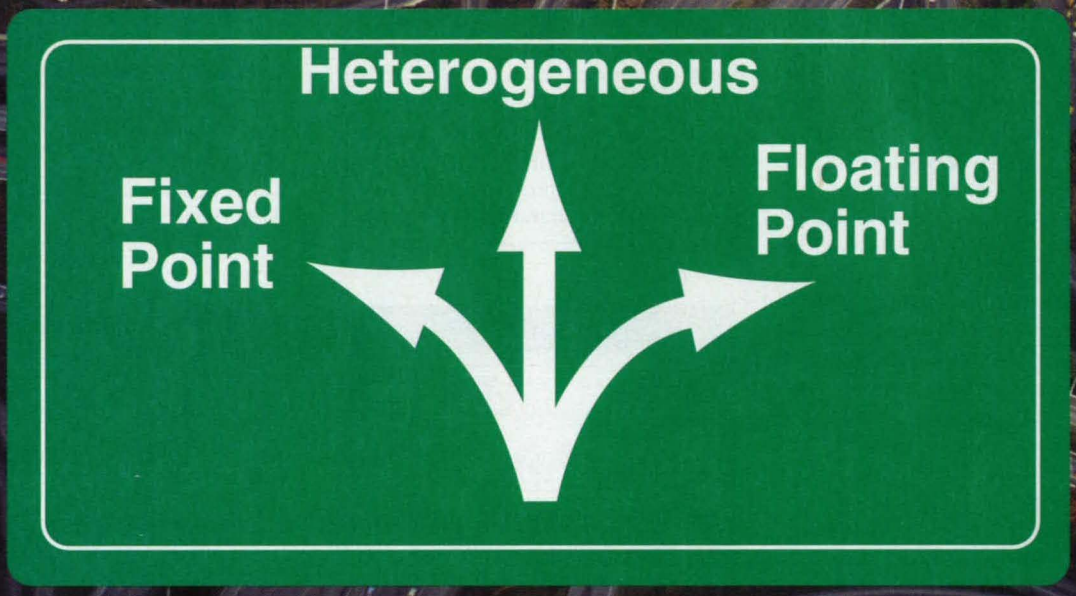
Two problems that arise in practical applications are those of tuning and of coupling radiation into and out of the microspheres. Tuning could likely be effected by distorting the microspheres mechanically, perhaps by use of the piezoelectric effect. The coupling problem has already been solved in principle; a fundamental-frequency evanescent wave could be coupled into a microsphere via a first prism or fiber, while a second-harmonic evanescent wave could be coupled out of the microsphere by use of a second prism or fiber located diametrically opposite the first prism.

By a suitable variation in the choice of whispering-gallery modes, it would be possible to use a microsphere resonator of this type as a parametric oscillator. For example, for parametric down-conversion, the design would be based on dividing the frequency of an input pump wave (ν_p) into the frequencies of two subharmonics (ν_1 and ν_2), which would be designated as the signal and idler waves, respectively.

This work was done by Lutfollah Maleki of Caltech for **NASA's Jet Propulsion Laboratory**. *For further information, access the Technical Support Package (TSP)* ***free online at www.nasatech.com*** *under the Physical Sciences category, or* ***circle no. 114*** *on the TSP Order card in this issue to receive a copy by mail ($5 charge).*

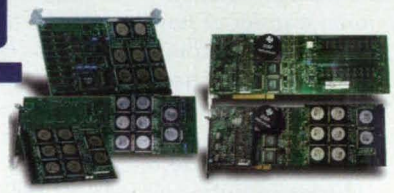
NPO-19548

Whatever Direction Your Computing Needs Take You ...



They All Lead To

ALACRON



High Performance Integer Calculations	
• 3 x 3 convolution	6.6 msec
• Dilation / Erosion	1.2 msec
• Add, subtract, threshold	2.4 msec
• Median filter	11 msec
• Sobel / Robert's filter	6.0 msec
• Histogram	3.3 msec

High Performance Floating Point Calculations	
8 SHARC 1DCFFT (1K)	0.072 msec
8 SHARC 2DCFFT (1K x 1K)	.138 msec
8 SHARC CONV3 (512 x 512)	9 msec

Alacron provides the optimal processing power for all your computing needs. Alacron's FT-C80 supplies 2 Giga Fixed Point OPs, while the FT-SHARC supplies up to 3 Giga Floating Point OPs per slot!!

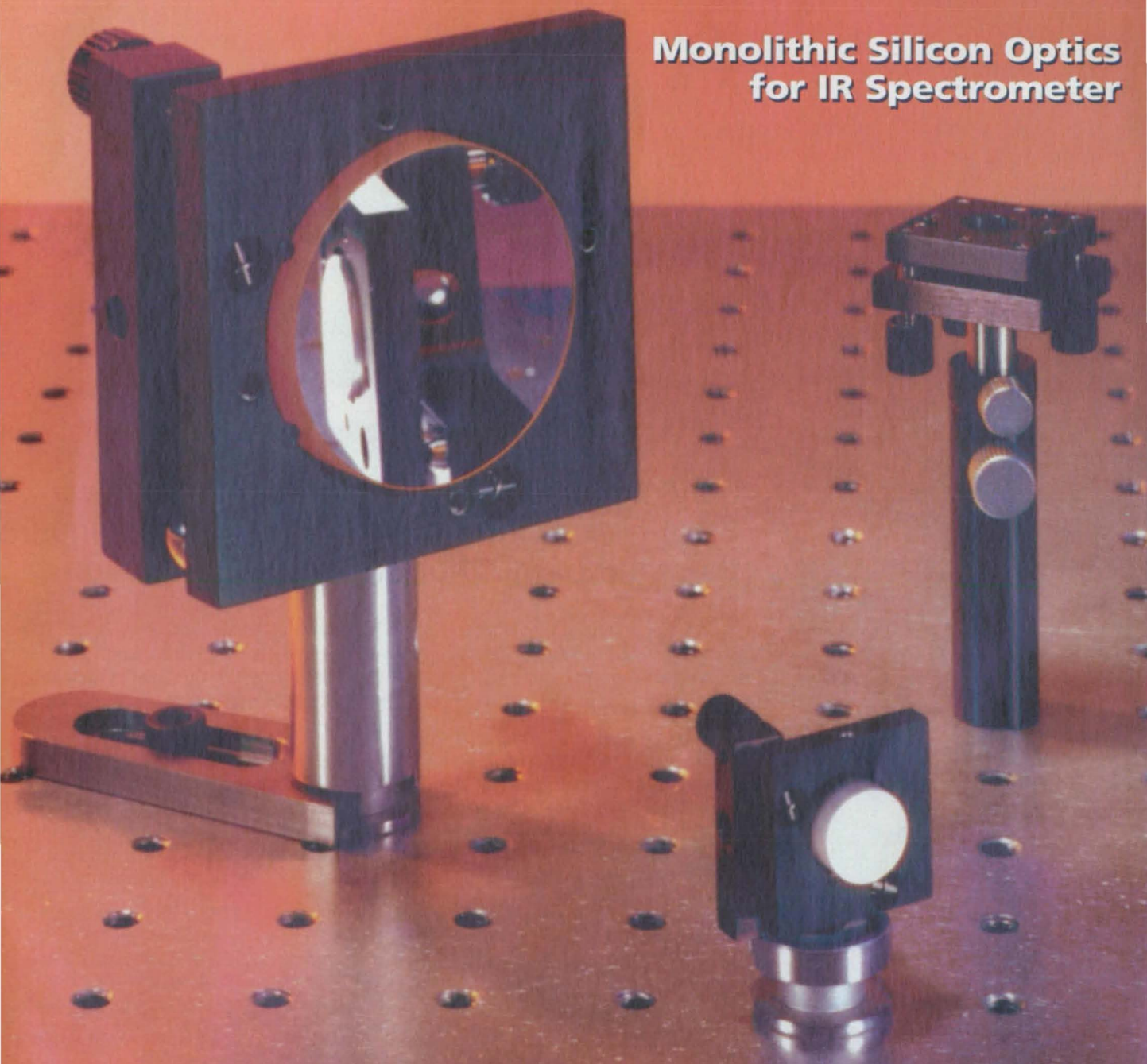
The FT-SHARC and FT-C80 support Alacron's family of digital and analog framegrabbers, and Alacron's high resolution video output modules.

ALACRON
71 Spitbrook Road, Nashua, NH 03060
TEL: (603) 891-2750
FAX: (603) 891-2745
Web: http://www.alacron.com
EMAIL: sales@alacron.com

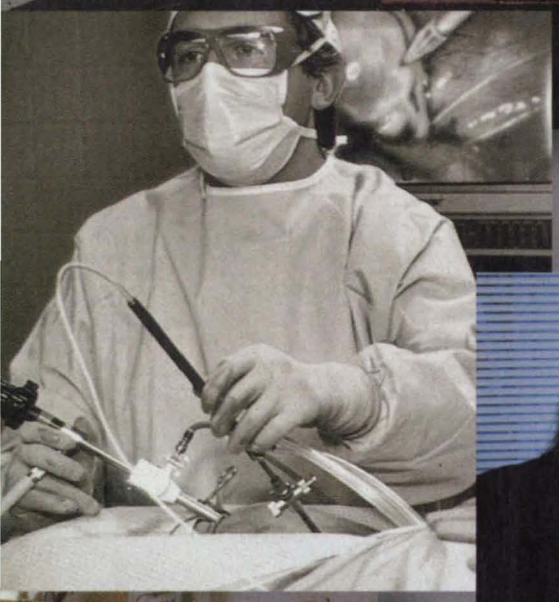
LASER TECH BRIEFS

Technology 2007: Photonics at Center Stage

Monolithic Silicon Optics for IR Spectrometer

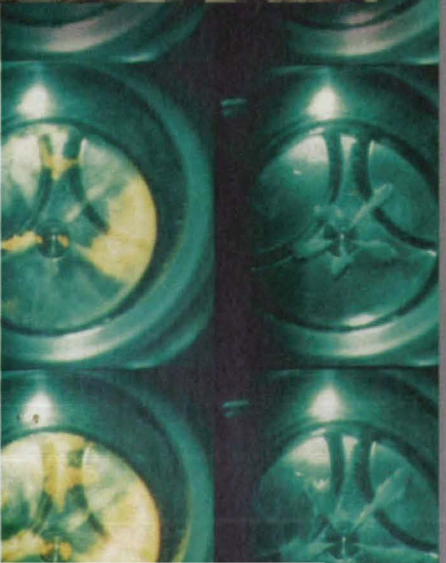


New Photonics Products—
See page 14a



From high tech... to high finance... to high in the sky

3M™ Specialty Single-Mode Fibers, Power-Core Fibers and Fiber Bragg Gratings ensure there's the right fiber for your application



3M Specialty Optical Fibers offers the most complete line of fibers available in the world today.

Whether you're checking the performance of fuel injectors from inside an engine, performing delicate, minimally invasive laser surgery, building the most advanced commercial aircraft in the air or creating sophisticated network systems, you can be sure that the fiber you need will be designed and manufactured to exactly meet your requirements.

3M Specialty Optical Fibers are the only fibers and gratings backed by the technological, engineering and manufacturing resources of 3M. Since we're vertically integrated, we control the process from preform to termination. Plus, by combining our expertise in polymer coatings with our strengths in optical fiber waveguide design, we produce truly high-performance optical fiber solutions.

And, because of our strong commitment to customer satisfaction, you get support from application planning through system operation, help with custom fiber designs for your tough applications, and ready availability and on-time deliveries.

Call us today. Get the fiber that's *exactly* right for your application, plus the support of 3M. 3M Specialty Optical Fibers, 420 Frontage Road, West Haven, CT 06516-4190. Telephone (203) 934-7961 or fax (203) 932-3883.

3M *Innovation*

LASER TECH BRIEFS

Laser Tech Briefs Supplement to *NASA Tech Briefs* August 1997 Issue Published by Associated Business Publications

LASER TECH BRIEFS

FEATURE

DEPARTMENTS

On the cover:

These new kinematic mirror and beamsplitter mounts feature what Melles Griot calls a unique spring-loaded counterbore that allows wobble-free rotation or adjustment about the vertical axis before final positioning. Photo courtesy Melles Griot Photonics Components, Irvine, CA

NEWS BRIEFS

Notes from Industry and the Federal Laboratories

Coherent Inc. of Santa Clara, CA, one of the world's leading designers and manufacturers of medical, scientific, and commercial lasers, has acquired the assets and operations of **Ealing Electro-Optics**, based in Watford, England, and its U.S. subsidiary in Holliston, MA. Ealing is well known for the design and manufacture of precision optical assemblies as well as complete lens and thermal imaging test systems, and the Ealing "Gold" catalog sells more than 5000 components to the photonics industry worldwide. The transaction, completed in May, involved a purchase price of approximately $9.5 million.

Ealing has become a part of Coherent's Auburn Group, which has production facilities for laser optics, laser diode modules, and laser instrumentation in Auburn, CA, and Leicester, England.

Robert Gelber, vice president and general manager of the Auburn Group, said of the acquisition, "The addition of Ealing affords us two important new areas of growth. The first is in the catalog area, where the addition of our standard instrumentation products and laser optics to the Ealing catalog creates a unique range of products available for fast delivery worldwide. I expect that the business acquired will double in size within three years."

Gelber announced that Paul Kenrick, formerly president and CEO of Opto-Sigma, a startup catalog operation, and before that of Melles Griot, had accepted a senior position to run the Coherent catalog operations worldwide.

"The second important piece of the Ealing acquisition," Gelber continued, "is its world-class optical assembly group," which will augment Coherent's existing precision optics capability.

OSI Inc. of Metuchen, NJ, announced that it had acquired a license from **Lawrence Livermore National Laboratory** (LLNL), of Livermore, CA, for proven microchannel technology for active cooling of high-power laser diode arrays. At the CLEO/QELS show held in Baltimore in May, OSI showed some of the products using the technology. These included a two-dimensional diode array stack capable of delivering optical power intensities approaching 400 W continuous-wave per square centimeter.

OSI says that the LLNL license will enable the company to make products with high optical power intensities for industrial applications, including welding, cutting, and metal hardening in the automotive and aerospace industries.

In addition to diode and solid-state lasers, OSI sells a variety of solid-state laser crystals and distributes laser products for Lasos and Bremlas. OSI is located at 101 Hillsdale Ave., Metuchen, NJ 08840; (908) 321-0375; fax: (908) 321-0892.

Merchantek Electro-Optics, a Carlsbad, CA, producer of laser test and micromachining equipment and laser microprobes, has merged with **Quantum Composers Inc.** of Bozeman, MT, which will now operate as a division of Merchantek. Quantum Composers has broad design and manufacturing capabilities for digital pulse generators, laser systems, and intelligent instruments and controls for OEMs and end users.

All engineering and manufacturing will be consolidated in a new plant in Bozeman. Corporate offices, sales, and applications engineering will be located in the California facility, at 6150A Yarrow Drive, Carlsbad, CA 92009; (619) 930-9191; fax: (619) 930-9192.

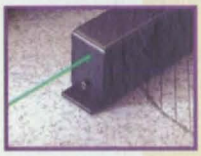
ULTRAVIOLET TO ULTRARED LASERS

meeting the OEM challenge

What's HOT ? from Uniphase

New ultraviolet StableLight™ lasers

We have extended the performance of our reliable Q-switched StableLight lasers into the deep UV with third- and fourth-harmonic generation. Three StableLight models, ranging from 266 nm to 355 nm, have an average output power from 10 mW to 100 mW.



NanoLasers™

This revolutionary laser uses a TE-coded diode-pumped passively-Q-switched Nd:YAG laser to pump a nonlinear crystal, producing several milliwatts of quasi cw power in a train of ~ 1-nanosecond pulses with a few microjoules of energy at 1064 and 532 nm.

Fiber-coupled diodes, LED and detectors

Uniphase now offers a full line of standard fiber-coupled diodes. With our state-of-the-art capability, we can also provide unique, customized packaging solutions to meet the specific needs of our OEM customers.

µGreen™ lasers

Uniphase µGreen lasers offer 5 to 50 mW of 532-nm low-noise output from a compact, 130-cm^3 TE-cooled head. These lasers are based on our patented micro-chip technology.

More air-cooled argon lasers

Each year we generate several new configurations of our ever-growing argon product line for new OEM customers, to meet their specific needs. These include new 1998 CE-approved power-factor correlated power supply. Find out why Uniphase argon lasers are still the laser of choice for most biotech and imaging applications.

High-power HeNe lasers

We have introduced a new line of helium-neon lasers with guaranteed output power as high as 25 mW. All Uniphase HeNe lasers feature our patented close-cathode design (which provides superior beam-pointing, warm-up, and power stability) and provide fast turn-on and low noise in a rugged package.

Revolutionary extended warranty program for HeNe lasers

It's an industry first. Based on 20 million hours of life test data, we're proud to announce the new Uniphase THREE LIGHT-YEAR™ and FIVE LIGHT-YEAR™ warranties which are now available on selected HeNe models. Call us today for complete details.

uniphase

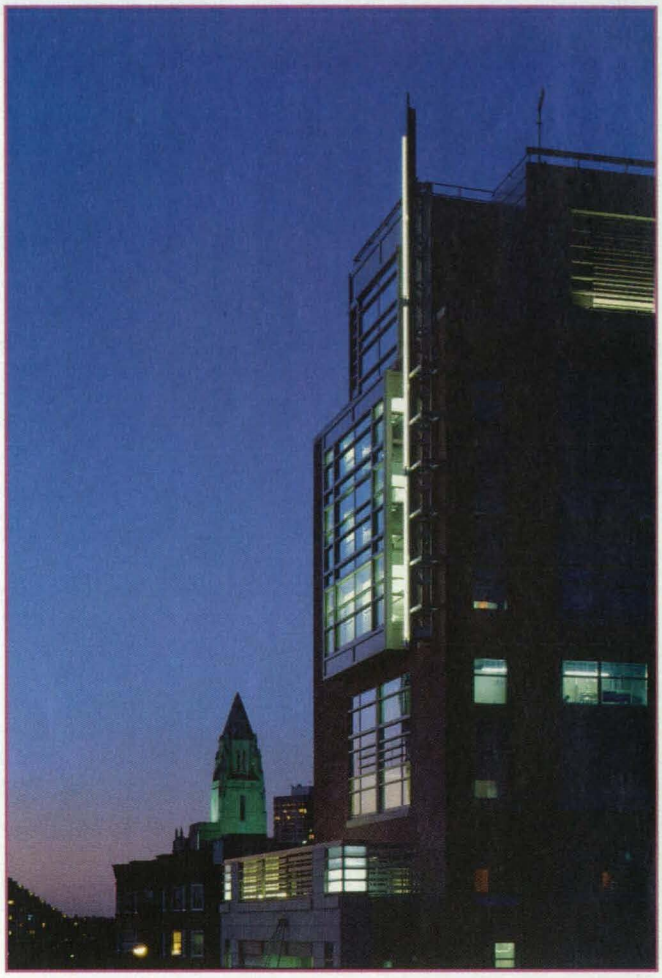
For complete information on any Uniphase product, call **1-800-644-8674**
or visit our worldwide web site at **http://www.uniphase.com**

For More Information Circle No. 441

PHOTONICS—

Photonics will be in the spotlight when Technology 2007, the world's leading conference and exhibition devoted to engineering innovation and technology transfer, opens its doors at the Hynes Convention Center in Boston September 22. One of the kickoff keynote addresses will be delivered by Dr. Donald C. Fraser, the director of Boston University's state-of-the-art Photonics Center. From that point forward for the conference's three days, the varied world of photonics will be on display in technical sessions, convention-floor exhibits, and tutorials.

Enhancing the centrality of photonics to the show, which is sponsored by *NASA Tech Briefs* magazine, NASA, the Federal Laboratory Consortium for Technology Transfer, and the Technology Utilization Foundation, is the fact that it is colocated this year with the Photonics East and Electronic Imaging International exhibitions of SPIE—the International Society for Optical Engineering. The combined shows are expected to draw an audience of more than 10,000 to the 80,000 sq. ft. of exhibits, featuring up to 300 exhibitors.



The Photonics Center on Boston University's Charles River campus features an 80-ft. Photonic Mast, a single-point source of uniform linear light, on its southwest corner. A tour of the state-of-the-art facility, opened in June, will be a highlight of Technology 2007.

BU Center Tour a Highlight

Dr. Fraser will set the tone with his address on Monday, the theme of which is "Photonics—A Major Global Economic Driver." This theme ties in directly with the mission of BU's Photonics Center. Inaugurated in June, the Center is an $80-million state-of-the-art facility dedicated to working with industry partners to develop new products based on photonics. Already the Center has forged more than a dozen business partnerships with companies through common business arrangements, including royalty agreements, equity partnerships, and joint ventures. A tour of the new facility Monday evening is expected to be a highlight of the conference.

"Our underlying philosophy," Dr. Fraser said, "is that joining with industry to get students and faculty directly involved in the process of developing and commercializing new products not only strengthens our educational and research programs in everything from engineering to management, but also allows us to apply the university's resources to directly stimulate the economy." The Center's goal, he believes, represents a new model for university-industry relations. Unlike the traditional models, the partnerships are true business relationships, and financial benefits accrue to the University only if and when a successful product is launched.

Products Focus of Optics Track

The Center's mission permeates the presentations to be given in the afternoon technical sessions that follow the plenary keynote session on the opening day. Dr. Paul R. Blasche, deputy director of the Center, will present an overview of the Center and its capabilities. The talks that follow that afternoon will describe specific development projects partnering the Center and area businesses.

Leading off will be Sol Norman, Program Manager for Lockheed-Martin's Infrared Imaging Systems in Lexington, MA, presenting a case study of an industry-university partnership program for the fabrication of an ultraviolet photodetector, and addressing such issues as intellectual property and publishing requirements. Following Norman, Dr. Chris Adams, CEO of Mosaic Technologies in Boston, will speak about "Photonic Instrumentation for Blood Viral Screening," new molecular chemistry developments and fiber-optic-based technology that promise to revolutionize the ability to assure a safe

CENTER STAGE AT TECHNOLOGY 2007

blood supply. Dr. Richard Clarke, CEO of Boston Advanced Technologies of Marlboro, MA, will describe field-portable spectroscopic products that yield fast, automated analysis of gasoline constituents, dye contaminants in diesel fuel, and chemical contamination of drinking water. Dr. Thomas Bifano, CEO of PRISM Inc. of Boston, will talk about a new application of neutral ion machining to fabrication of compact disc master stampers and other mass-produced components such as gratings and lenses. Closing the afternoon sessions will be William Riggs, a partner of Photonics Private Capital (PPC) in Boston, a private equity fund associated with BU's Photonics Center, who will address how the fund can contribute to the growth of entrepreneurial companies.

Harvey M. Pollicove, Director of the Center for Optics Manufacturing (COM) in Rochester, NY, will open the sessions on Tuesday morning, Sept. 23. Titled "Center for Optics Manufacturing: Leading the Fabrication Revolution," Pollicove's talk will describe how this Department of Defense Center of Excellence for Optics and winner of the Army Materiel Command MANTECH program's award for advancing optics manufacturing is driving a revolution that can be transferred to the optics factory floor. The Center's Opticam lensmaking equipment offers predictable precision to within millionths of an inch, and the magnetorheological finishing technique developed at the Center provides submicron form and finish tolerances. Pollicove will examine how the Center will lead the industry into the next generation of aspheric and conformal optics fabrication.

Following Pollicove, Robert Potenza, Vice President of Blue Sky Research of Santa Cruz, CA, will address "High-Quality Laser Light Technology through Innovative Optics." The company's CircuLaser microlens technology provides a circular beam, diffraction-limited performance, and low beam divergence in a laser diode that has many applications, from scanning to biomedical research and more. Pivotal to the development is the technique used to fabricate the microlens at low cost and high rates.

G. William Tasker and Martin Drexhage of the Center for Advanced Fiberoptic Applications (CAFA) in Southbridge, MA, will elaborate on the mission of this nonprofit alliance devoted to the expansion of the marketplace through development of advanced photonics products, processes, and applications for manufacture by CAFA participants or new corporate entities spawned by CAFA. Its current roster includes 11 companies and the University of Massachusetts. Currently working with members and with state and federal government to get its facilities fully operational, CAFA will have among its technical assets a full complement of optical and electronic test and characterization devices, computer-aided design and prototyping equipment, and clean room manufacturing areas.

Already under way with CAFA is a development program for "A Fiber-Based Current Sensor for Effective Power Management." Charles A. DiMarzio of Northeastern University in Boston will describe this work. Following that, "A Low-Cost Active Spectrometer Based on a Fiber Grating" is the topic of a talk by Michael Krainak of NASA Goddard Space Flight Center in Greenbelt, MD. Industrial material processing, medical spectroscopy, and environmental monitoring are among applications.

Bringing the sessions to a close Tuesday afternoon, James Veligdan of Brookhaven National Laboratory in Upton, NY, will describe a "Unique Interactive Projection Display Screen" called the Polyplanar Optical Display that combines high brightness and contrast with compact dimensions. Michael R. Cates and Jeffrey D. Muhs of Oak Ridge National Laboratory will outline the promise of "Hybrid Lighting: Illuminating the 21st Century." Finally, David M. Cornwell Jr. of NASA Goddard will tell of his work with a low-cost diffraction-limited semiconductor laser emitting better than 1 watt that should find uses in laser remote sensing and optical communication.

A number of photonics-related tutorials will take place over the three days. On Monday, Gerald Holst, a consultant for imaging system analysis and testing, is the instructor for "CCD Selection Criteria," highlighting the requirements for an end-to-end CCD camera system. Majid Rabbani, a senior research associate for Eastman Kodak's image compression and digital video processing groups, will hold a session on "Digital Image Processing Algorithms." Warren J. Smith, chief scientist for Kaiser Electro-Optics, has as his topic "Understanding Optical Imaging Systems."

A prototype magnetorheological finishing machine, which provides submicron form and finish tolerances for lensmaking, on site at the Center for Optics Manufacturing, where it was developed.

On Tuesday, Douglas S. Goodman of Polaroid's Optical Engineering Dept. will examine "Illumination for Optical Inspection and Machine Vision Fundamentals." On Wednesday, Andrew Karellas, Director of Radiologic Physics at the University of Massachusetts Medical Center, deals with "Electronic Medical X-Ray Imaging: Current and Emerging Technologies," and Kurt Linden, Manager of Laser Product

Development for the Spire Corporation, details "How to Select Diode Lasers and What to Expect from Them."

These tutorials, conducted by SPIE, are included as part of Technology 2007 registration packages: any of them for full registrants, and those of the day selected for one-day registrants. You may also register directly for the tutorials; cost is $75 each by September 5 and $100 each thereafter. SPIE will also be holding short courses during the conference. Topics include "Precision Mounting of Optical Components," "Evaluation of CCD Arrays and Solid-State Cameras," "Fundamentals of Digital Image Processing," "Principles of Optical System Layout," "Introduction to Neural Networks," "Laser-Diode-Pumped Solid-State Lasers," "Laser Diodes and LEDs: Fundamentals and Applications," and "Illumination for Machine Vision." Call SPIE at (360) 676-3290 for details, or visit the Photonics East web site at www.spie.org/info/pe/.

Dr. Donald C. Fraser, Director of BU's Photonics Center, will be a keynote speaker at Technology 2007's opening plenary session.

In addition, the colocated conference/exhibitions will offer business-oriented short courses, a wide variety of OEM, government, and academic exhibits, poster presentations, special tracks on assistive technology and the benefits for state and local governments in working with Federal labs, product demonstrations, and networking receptions.

For more information on Technology 2007 and a registration form, see pages 77-79 of this* NASA Tech Briefs *issue. For further conference details and program updates, visit the Technology 2007 web site: www.abptuf.org/T2007.

Using Multiple Prisms To Manipulate Beams of Light

Various combinations of direction, lateral position, attenuation, and polarization can be selected.

NASA's Jet Propulsion Laboratory, Pasadena, California

Several functions are combined into one compact package by cascading Fresnel reflections off uncoated glass prism surfaces: operation over a very wide waveband, high attenuation, selectable polarization, extreme insensitivity to environmental effects or aging, optional optical path deviation and beam steering, in a package, the cross section of which can be as small as approximately twice the beam area. The transmitted wavefront quality can be very good to permit unaberrated imaging of bright sources over moderate fields-of-view. The use of prism substrates to redirect the rejected component of the input beam simplifies the internal structure, eliminating the need for beam dump and heat dissipation features in the design.

The basic principle of operation is Fresnel reflection off uncoated glass surfaces. The amount of light reflected from each surface, and the polarization thereof, is controlled by varying the angle of incidence. By cascading several such surfaces, and by suitable selection of angles of incidence, a highly attenuating and polarizing optical system can be created (see Figure 1). Since reflectivity is a function of the refractive index of the glass material utilized, reasonably flat attenuation curves can be generated by selection of glass with a suitably flat refractive index profile. By avoiding angles of incidence much larger than 45 degrees, the size of each prism can be approximately the same as the sampled beam, allowing the entire device to be packaged in a compact assembly. Note that, in applications where cross section is not a limiting factor, the prisms can be configured to bend the light out of plane at each subsequent reflection, permitting a transmitted beam with virtually no net polarization effects.

Since the surface reflection is low, there is a relatively large component transmitted into each substrate. The additional Fresnel reflection off the rear surface of a flat substrate into the output path is eliminated by using substrates in the form of right-angle prisms, whereby the transmitted energy is reflected back in the direction of the input beam (see Figure 2). For material of sufficiently high index, total internal reflection causes 100 percent of the transmitted energy, less the amount absorbed by the bulk absorption properties of the substrate material, to be reflected back without the need for mirror coatings on the rear prism surfaces. If the application permits, retroreflecting cube corner shapes could be similarly used. In either case, if precise retroreflection is undesired, the prisms (or cube corner) angles can be purpose-made to redirect the transmitted energy into some other direction.

Some applications may require more surfaces for beam steering and deviation than for attenuation and polarization control (for example, three prisms may suffice to attenuate and polarize an input beam to the requisite degree, but four prisms are needed to redirect the beam in the desired direction.) In such cases, the introduction of a mirrored surface in place of a prism can provide the beam pointing properties without appreciably affecting the beam attenuation and polarization.

This approach, developed as a no-power, low-mass, in-flight calibration source for the Cassini Visible and Infrared Mapping Spectrometer instrument, has prime applicability to other solar imaging and analysis functions common to many NASA missions. It is also suitable for laboratory and industrial imaging of sources, potentially in hostile environments, that require attenuation and polarization analysis over wide wavebands without wavefront aberration.

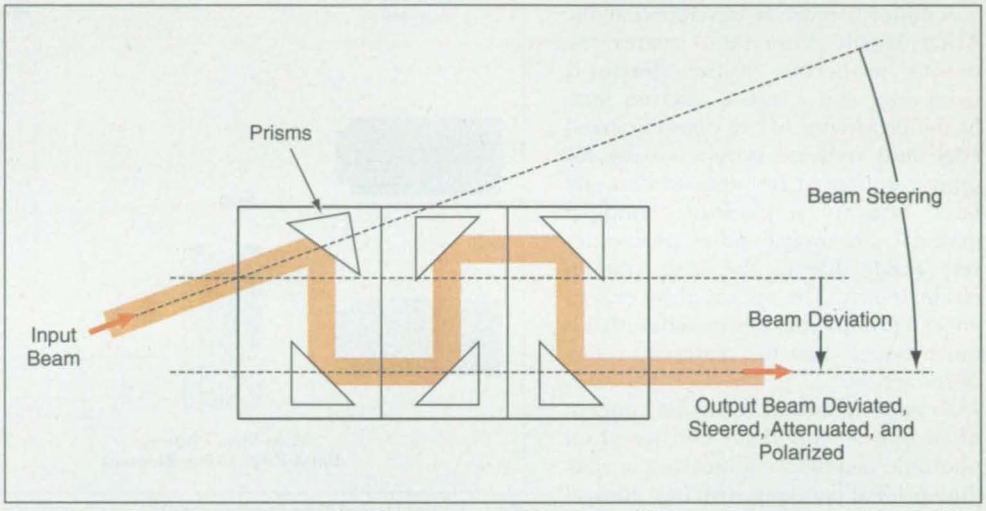


Figure 1. **Cascaded Reflections From Multiple Prisms** redirect the beam of light and attenuate the light to different degrees in two perpendicular polarizations. This is one of many possible arrangements of prisms. Assuming that the prisms in this assembly are made of water-free ZnS, the output beam is 10^{-4} times as intense as the input beam, and the polarization ratio of the output beam (for an unpolarized input beam) is 2,000:1.

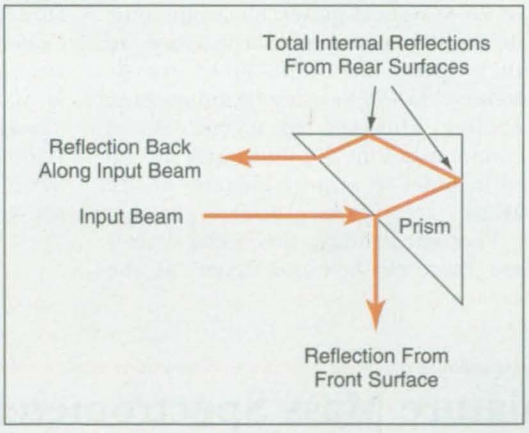


Figure 2. The **Rear Surfaces of the Prism** are oriented to exploit total internal reflection and to send the internally reflected light back along the input beam.

This work was done by Jeffrey M. Oseas of Caltech for **NASA's Jet Propulsion Laboratory**. *For further information, access the Technical Support Package (TSP)* ***free on-line at www.nasatech.com*** *under the Physical Sciences category, or* ***circle no. 180*** *on the TSP Order card in this issue to receive a copy by mail ($5 charge).*

NPO-19971

Compact Optical Time Delay Unit

Photonic bandgap technology provides low-jitter time delay.

U.S. Army Missile Command, Redstone Arsenal, Alabama

An emerging technology known as photonic bandgap engineering is providing new devices for applications in optics and microwaves. A photonic bandgap is analogous to electronic bandgaps in semiconductors with the exception that the gaps represent forbidden energies for electromagnetic radiation instead of electrons.

A concept recently developed at the Army Missile Command relates the unique properties of the electronic band edge and effective electron mass to the properties of the photonic band edge and reduced group velocity for optical pulses. At frequencies near the band edge of a photonic bandgap material, an optical pulse propagates very slowly due to the large photon mode density. The optical pulse experiences a group index of refraction that is much larger than the material's index of refraction.

To experimentally verify the concept of an optical time delay unit based on photonic bandgap engineering, a one-dimensional bandgap structure consisting of alternating layers of AlAs and GaAs was grown by molecular beam epitaxy. The time delay measurements were performed by Prof. R. Fork's group at the University of Alabama in Huntsville, using 2-picosecond-long optical pulses from an erbium-doped fiber laser. Although the delay device was only 8 mm long, the apparent optical length of the device could be varied from 10 mm to 110 mm. The corresponding time delay was variable up to 0.3 ps. The active tuning can be achieved by the electro-optic effect, varying the frequency of the laser, or by a slight rotation of the sample that causes a shift in the forbidden gap frequency.

Time delay units based on photonic bandgap structures have immediate applications in phased-array radars and ultrawideband communications (also known as impulse radio). In applications that require precise time control of RF or optical pulses, electronic time delays are unacceptable because of their jitter. Electronic jitter can be reduced to ~20 ps using thermoelectric coolers. However, in ultrawideband communications the jitter must be <20 ps in order to achieve bit rates of >10 Mbps.

Photonic bandgap time delay devices are currently being designed at the Army Missile Command that have tunable delays from 0-200 ps. The delay units are extremely compact, on the order of a few optical cycles long, and do not require thermoelectric coolers for low jitter performance.

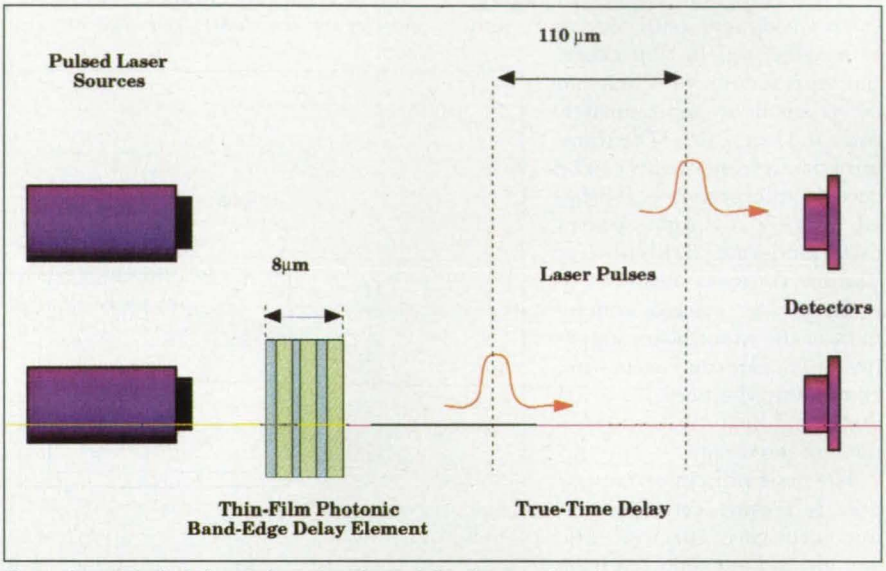


Illustration of **Optical Time Delay** using photonic bandgap engineering.

This work was done by Mark Bloemer, Mike Todd, Mike Scalora, Jon Dowling, and Charles Bowden of the **Weapons Sciences Directorate, U.S. Army Missile Command**. *Inquiries concerning commercial use of the invention should be addressed to Mr. Kelly McGuire, U.S. Army Missile Command, AMSMI-RD-TI, Bldg. 5400, Redstone Arsenal, AL 35898-5243; (205) 876-5066; fax: (205) 876-8866; E-mail: orta@redstone.army.mil.*

Ion Detectors for Miniature Mass Spectrometers

These detectors can be operated at relatively high background pressures.

NASA's Jet Propulsion Laboratory, Pasadena, Californi

Ion detectors based on excitation of luminescence by impinging ions are undergoing development. These ion detectors are intended principally for use in a new generation of highly miniaturized, portable mass spectrometers.

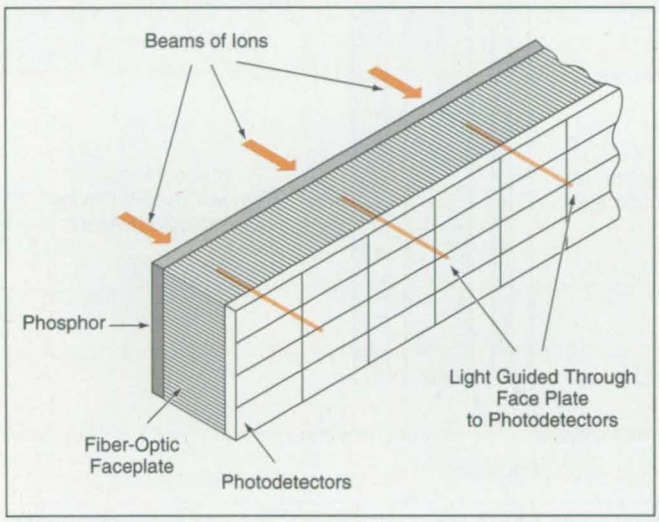
Heretofore, the mass-spectral images of ions dispersed along the focal planes of mass spectrometers have been converted to electron images and intensified in microchannel-plate (MCP) electron multipliers. Unfortunately, MCP electron multipliers are vulnerable to disruption of electron trajectories by fringing magnetic fields at the output ends of the spectrometer mass-separation sectors. In addition, MCP electron multipliers require both high potentials (1 to 3 kV) and high vacuums [maximum residual pressures of about 10^{-6} torr (about 10^{-4} Pa)] for proper operation.

The developmental ion detectors do not require high potentials. They can operate at much higher residual pressures [up to about 10^{-3} torr (about 10^{-1} Pa)], which are consistent with the relatively high maximum operating pressures of the mass-separation sectors of highly miniaturized mass spectrometers. These features reduce the vacuum-pumping and electric-power demands, thereby contributing to progress toward

miniaturization. In addition, the developmental ion detectors can be made relatively invulnerable to fringing magnetic fields, as explained below.

An ion detector of the present type (see figure) includes a fiber-optic faceplate, one face of which is coated with a phosphor (for example, Zn_2SiO_4:Mn) and placed in the focal plane of a mass spectrometer. Mounted on the other face of the fiber-optic faceplate is an integrated-circuit image sensor which could be a charge-coupled device (CCD) imaging array or an array of photodiodes or active-pixel sensors. In the mass spectrometer, ions are accelerated to kinetic energies in the approximate range of 1 to 2 keV. After traversing the mass-separation sector, the ions impinge on the phosphor.

Luminescence excited by the ions impinging at a given position is guided via the local optical fibers to the photodetector at the corresponding position on the opposite face of the fiber-optic faceplate. In a case in which the performance of the image sensor could be adversely affected by the fringing magnetic field, one can simply mount the image sensor outside the fringing magnetic field by use of a fiber-optic faceplate of sufficient thickness.



Ions Impinging on the Phosphor Excite Luminescence, which is guided through the thickness of the fiber-optic faceplate to a photodetector in an imaging array.

The electrical output of a photodetector in an ion detector of this type is typically between 10^{-6} and 10^{-3} times that of a conventional ion detector with an MCP electron multiplier. At first glance, the loss of gain may seem unacceptably large. However, the loss of gain can be counteracted by use of higher pressure of the analyte in the ion source of the mass spectrometer and by integrating the photodetector output for a longer time.

This work was done by Mahadeva P. Sinha of Caltech for **NASA's Jet Propulsion Laboratory**. *For further information, access the Technical Support Package (TSP)* ***free on-line at www.nasatech.com*** *under the Physical Sciences category, or* ***circle no. 181*** *on the TSP Order card in this issue to receive a copy by mail ($5 charge).*

In accordance with Public Law 96-517, the contractor has elected to retain title to this invention. Inquiries concerning rights for its commercial use should be addressed to:

Larry Gilbert, Director
Technology Transfer
California Institute of Technology
Mail Code 315 - 6
Pasadena, CA 91125
(818) 395-3288

Refer to NPO-19594, volume and number of this Laser Tech Briefs *issue, and the page number.*

Improved Ion Detectors for Mass Spectrometers

Adverse effects of fringing fields of magnetic sectors would be reduced.

NASA's Jet Propulsion Laboratory, Pasadena, California

Ion detectors that are relatively insensitive to magnetic fields have been proposed for use in the focal planes of mass spectrometers (both conventional laboratory mass spectrometers and a new generation of portable miniature mass spectrometers). Unlike the magnetic-field-sensitive ion detectors now used in laboratory mass spectrometers, the proposed ion detectors could perform well without special attention to their geometric relationships with the fringing magnetic fields at the focal planes of the magnetic mass-separation sectors of the spectrometers. The net result would be that the mass spectrometers could be made simpler, more compact, more rugged, less expensive, and capable of higher mass resolution.

A description of a conventional ion detector in a conventional laboratory mass spectrometer is prerequisite to an explanation of the proposed ion detectors. The ions leaving the magnetic sector impinge on a multichannel-plate (MCP) electron multiplier, which produces approximately 10^4 electrons per ion. These electrons are accelerated (typically to a kinetic energy between 4 and 5 keV) to a phosphor-coated fiber-optic plate to produce an image in which spots of light at different locations represent ions of different masses. This image is detected by an array of photodiodes.

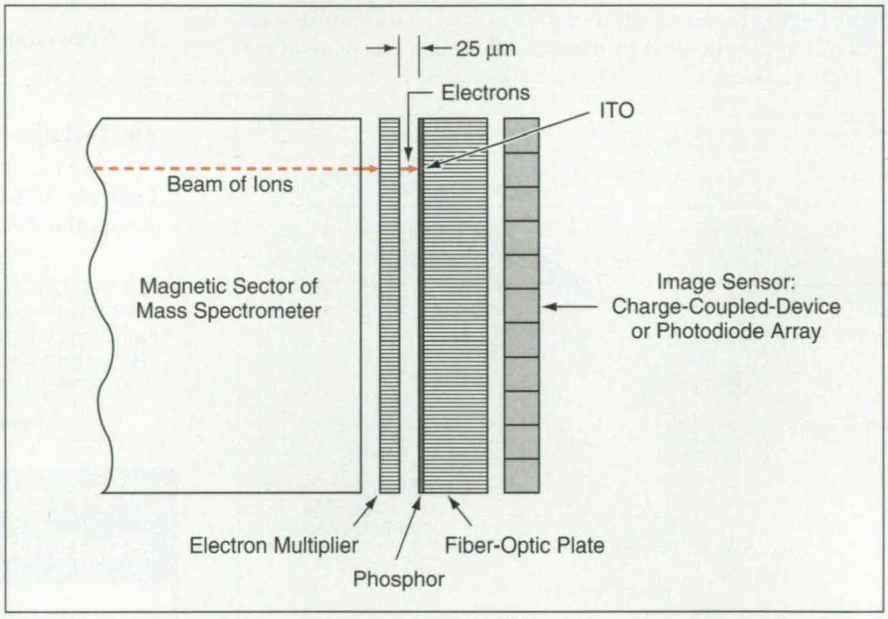
The front surface of the phosphor is coated with an electrically conductive layer of aluminum to prevent electrical charging of the phosphor. To minimize the probability that the electron-accelerating electric field will cause electrical breakdown, it is necessary to maintain a gap at least 1 mm wide between the back surface of the MCP electron multiplier and the phosphor. However, the fringing magnetic field acting over a gap as wide as this can affect the trajectories of the accelerated electrons to such an extent that many or all of them are diverted away from the phosphor.

In a typical design to reduce the adverse effect of the fringing magnetic field, the pole pieces of the magnetic sector are modified to configure the fringing field more favorably, and the phosphor-coated fiber-optic plate is tilted with respect to the focal plane. Unfortunately, these corrective measures distort and dislocate the focal plane in relation to the phosphor, thereby distorting the mass-spectral image and degrading its resolution. This completes the description of a conventional ion detector.

In an ion detector according to the proposal, the effect of the fringing magnetic field would be reduced by reducing the width of the MCP/phosphor gap to about 25 to 100 μm (see figure). To prevent electrical breakdown in this small gap, the electron-accelerating potential would have to be reduced correspondingly, giving rise to a phosphor that could be excited by electrons impinging with correspondingly lower kinetic energy. (The reduction in kinetic energy would increase the sensitivity of electron trajectories to the magnetic field, but this increase would be more than offset by the reduction in sensitivity afforded by narrowing the gap.)

One suitable phosphor would be ZnO:Zn, in which phosphorescence can be excited by electrons at 50 to 500 eV. Moreover, ZnO:Zn inherently contains oxygen vacancies that make it electrically conductive, and the conductivity could be increased by mixing in SnO. Therefore, no aluminum coat would be needed. A transparent conductive layer of indium tin oxide (ITO) was layered on the fiber-optic plate prior to the deposition of phosphor thereon. The optimum ITO layer thickness is about 50 ohms per square. ITO is connected to ground for providing the electrons a path to ground.

Because it would be relatively insensitive to the fringing magnetic field, it would not be necessary to tilt the detector away from the focal plane, nor would it be necessary to modify the pole pieces. Thus, the overall design would be simplified, and the magnetic sector and the ion detector could be assembled and operated in the configuration that minimizes the distortion and maximizes the resolution of the mass-spectral image.



This **Improved Ion Detector** for a mass spectrometer would feature a narrow MCP/phosphor gap and a low-excitation-energy, electrically conductive phosphor.

This work was done by Mahadeva P. Sinha of Caltech for **NASA's Jet Propulsion Laboratory**. *For further information, access the Technical Support Package (TSP)* ***free on-line at www.nasatech.com*** *under the Physical Sciences category, or* ***circle no. 182*** *on the TSP Order card in this issue to receive a copy by mail ($5 charge).*

In accordance with Public Law 96-517, the contractor has elected to retain title to this invention. Inquiries concerning rights for its commercial use should be addressed to:

Larry Gilbert, Director
Technology Transfer
California Institute of Technology
Mail Code 315 - 6
Pasadena, CA 91125
(818) 395-3288

Refer to NPO-19787, volume and number of this Laser Tech Briefs *issue, and the page number.*

Laser-Based Coatings Removal Workstation

The system enables dry, no-chemicals removal of coatings from parts, reducing damage and waste volume.

F2 Associates Inc., Albuquerque, New Mexico

The government is funding the development of new technology for the removal of lead-based paint, other rad-contaminated hydrocarbon-based coatings, and metallic coatings from various kinds of substrates. Some work is oriented toward decontamination and decommissioning (D&D) of nuclear facilities; other work is oriented toward removal of coatings on aircraft parts for inspection for microcracks. F2 Associates has contracts from the Department of Energy and the U.S. Air Force/SERDP to develop industrial-scale systems for both kinds of work. Goals include (1) automation using robots; (2) capture and filter all removed material; (3) clean out surface pores; (4) no mechanical, thermal, or chemical damage to the substrate; (5) eliminate use of chemicals, reduce waste volume, and enhance worker safety.

In the process of developing these larger systems, a small system was built for testing to determine the proper laser parameters for various coatings on various substrates. That small system is now ready for commercialization for decoating small parts. It consists of a 150-W (average power) pulsed CO_2 laser, a short beam delivery into a "fume hood," vacuum and filtration (HEPA and charcoal) for the hood to handle all particulates, gases, and vapors, an X-Y translator for scanning (moving) the parts in front of the laser beam for decoating, and laser eye protection.

The system is especially good at removing hydrocarbon-based coatings like lead-based paint, epoxy, oil-based paint, inks, etc. These can be removed a thin layer at a time if desired. And the laser parameters are such that binders like linseed in lead-based paint are reduced to simpler-molecule gases and vapors that can be filtered and released, resulting in waste volume reduction and saving on disposal costs.

As one example, the Department of Defense is refurbishing circuit cards that are potted in a type of epoxy. The potting must be removed, the backside contacts desoldered, and the components tested to find, remove, and replace the defective one(s), and then they must be repotted. Currently the decoating is done with hazardous chemicals that the EPA wants phased out, and decoating-process damage levels are noticeable. The following process has been demonstrated with the F2 system: Dry-decoat (laser-ablate) only the potting on the back of the card, and test to find the defective component. Turn the card over, depot only that component, and remove and replace it. Then spot-repot the front and repot the back. The process is dry, uses no chemicals, and is done in a filtered chamber.

There are many other applications. F2 invites prospective customers to bring in samples for testing. The unit can be customized in size of the fume hood, part-holder, scan speed/mode, and on-target laser power density for individual needs, using commercially available components.

This work was done by a team of employees of **F2 Associates Inc.** *Technology base work was supported by the* **Dept. of Energy** *(contract DE-AR21-94MC30359, S. Bossart, COR, METC), the* **U.S. Air Force/SERDP** *(contract F33615-95-R-5515, M. Waddell, COR, WL/MTPN), and* **Los Alamos National Laboratory** *(Tech Assistance Grant).* *F2 has filed provisional patent applications for key components in the system. Inquiries regarding commercialization should be directed to Ms. Joyce Freiwald, President, F2 Associates, 14800 Central Ave. SE, Albuquerque, NM 87123; (505) 271-0260; FAX (505) 271-1437.*

Monolithic Silicon Optics for Imaging Infrared Spectrometer

Advantages would be ruggedness, compactness, and light weight.

NASA's Jet Propulsion Laboratory, Pasadena, California

The three optical components of a proposed imaging spectrometer for wavelengths > 1.1 μm would be made from two blocks of silicon, which would then be joined into a single piece. The resulting spectrometer optics would be a compact, lightweight unit that would remain permanently aligned, even when exposed to substantial shock and vibration.

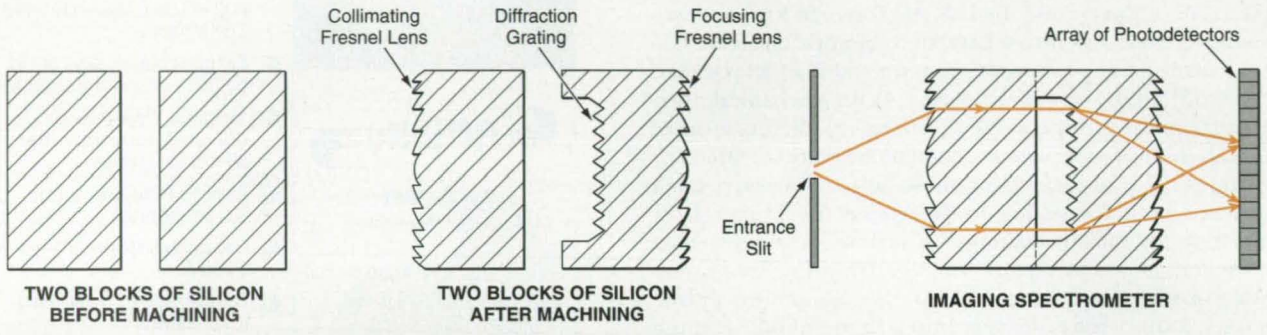
The optical components would be a collimating Fresnel lens, a focusing Fresnel lens, and a diffraction grating. These components would be fabricated by machining the required mating alignment features and optical surfaces on the two blocks of silicon: On one block, the diffraction grating would be micromachined into one face, and the focusing Fresnel lens would be micromachined or diamond-turned into the opposite face (see figure). The collimating Fresnel lens would be micromachined or diamond-turned into one face of the other block. Optionally, the diffraction grating could be coated with metal for use in a reflection mode.

After fabrication, the two blocks would be subjected to a process that is reminiscent of both electroplating and diffusion welding and that works only for silicon: The pieces would be placed in contact with alignment features, mated, then heated in an oven while a small electric potential was applied between them. This process would bond the two blocks into one piece.

Because micromachining could be used, the spectrometer could be made rather small. Another advantage of the rugged, unitary, compact structure is that the optics could easily be cooled to reduce background radiation.

This work was done by Paul K. Henry and Gregory H. Bearman of Caltech for **NASA's Jet Propulsion Laboratory**. *For further information, access the Technical Support Package (TSP)* ***free on-line at www.nasatech.com*** *under the Physical Sciences category, or* ***circle no. 183*** *on the TSP Order card in this issue to receive a copy by mail ($5 charge).*

NPO-19346



The **Optical Surfaces Would Be Micromachined** or diamond-turned into two blocks of silicon, which would then be bonded into one piece.

Noncontact Determination of Wave Velocities in CMC Plates

Changes in mechanical properties could be measured during fabrication, testing, or operation.

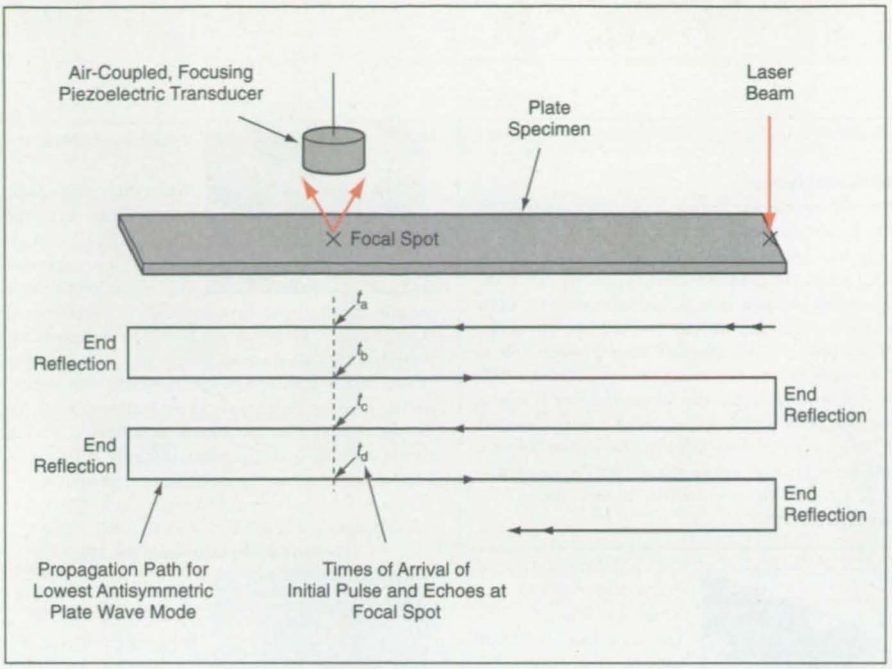
Lewis Research Center, Cleveland, Ohio

A noncontact technique for measuring acoustic velocities in a plate specimen of a ceramic-matrix composite (CMC) material is undergoing development. Plate wave analysis has shown that acoustic velocities are indicative of some mechanical properties of the material — specifically, stiffness moduli. By making it possible to measure such velocities nondestructively and without direct mechanical contact, the present technique could prove useful in such tasks as measuring changing mechanical properties during thermomechanical testing or monitoring otherwise inaccessible structural components during use to obtain indications of deterioration.

Though the implementation of the technique involves some moderately complex electronic signal and data processing, the basic principle of the technique is simple: One uses a pulsed beam from a neodymium: yttrium aluminum garnet (Nd:YAG) laser to excite an acoustic pulse at one end of a plate specimen, and uses an air-coupled, focusing piezoelectric transducer to measure the acoustic signal at some other position along the specimen (see figure). The output of the transducer is digitized and analyzed to identify pulses that indicate arrival of the initial acoustic pulse and subsequently of echoes. This analysis is aided by a trigger signal supplied by a laser-pulse-energy sensor; this signal provides a time reference for measuring pulse delays, which, in turn, are used to calculate velocities.

One acoustic velocity of particular interest is the velocity of the first antisymmetric plate wave mode. In previous studies, this mode has been shown to dominate the frequency spectra of the acoustic signals in CMC plate specimens. The velocity is sensitive to the shear and flexure moduli of materials; in the case of reaction-bonded silicon nitride composite materials, it is also sensitive to the fiber/matrix interfacial shear strength.

The feasibility of this noncontact technique was demonstrated in experiments on 20-percent-porous SiC/SiC composite tensile specimens with three different fiber layups. The shear-wave velocities of the specimens as determined by this technique were found to be approximately in agreement with shear-wave velocities measured with contact ultrasonic transducers.



A Laser Pulse Is Applied to one end of a plate specimen to generate an acoustic pulse, which then gives rise to acoustic waves that propagate along the plate and are reflected at the ends. The acoustic signal is sampled at one spot by use of an air-coupled, focusing transducer.

A side effect of interest in its own right was observed during the experiments: Repeated laser pulsing at the same location led to deterioration of the ultrasonic signal, though the signal recovered after about 24 hours. The mechanism of the deterioration was initially conjectured to be evaporation of a regenerating surface layer (possibly from water vapor) that is necessary for transforming the laser energy to ultrasonic energy. However, attempts to accelerate recovery by applying water were unsuccessful.

This work was done by Harold E. Kautz of **Lewis Research Center**. *For further information, access the Technical Support Package (TSP)* ***free on-line at www.nasatech.com*** *under the Physical Sciences category, or* ***circle no. 184*** *on the TSP Order card in this issue to receive a copy by mail ($5 charge).*

Inquiries concerning rights for the commercial use of this invention should be addressed to NASA Lewis Research Center, Commercial Technology Office, Attn: Tech Brief Patent Status, Mail Stop 7–3, 21000 Brookpark Road, Cleveland, Ohio 44135. Refer to LEW-16479.

LASER TECH BRIEFS LITERATURE

SPECIALTY OPTICAL FIBERS AND BRAGG GRATINGS

16-page brochure provides an overview of the fiber Bragg gratings, specialty fibers, and components available from 3M Specialty Optical Fibers. Specialty fibers include polarization-maintaining, polarizing, and low-wavelength single-mode; multimode fibers and assemblies in core sizes up to 1.5 mm, including polyimide-coated and hard-clad silica. 3M Specialty Optical Fibers, 420 Frontage Rd., West Haven, CT 06516; (203) 934-7961; Fax: (203) 932-3883; E-mail: sgambino@mmm.com

3M Specialty Optical Fibers

For More Information Circle No. 470

NEW QUALITY, AFFORDABLE LASER LINE PROJECTOR

Lasiris introduces the new LC series laser line generators with fixed pattern heads and factory-set focus adjustment. Now you can get our renowned quality in a better-priced laser. The LC series laser features: uniform (non-Gaussian) intensity distribution; ultra-thin line down to 25 mm; over temperature and over voltage protection; ESD protection to more than 8000 V; CDRH and IEC compliance, all in a compact, rugged design. Lasiris Inc., 3549 Ashby, St.-Laurent, Quebec, Canada H4R 2K3. Tel 1-800-814-9552 or (514) 335-1005; Fax: (514) 335-4576; E-mail: sales@lasiris.com; Internet: http://www.lasiris.com

Lasiris

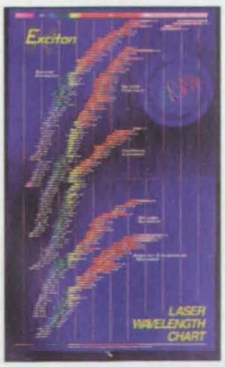
For More Information Circle No. 471

SPECIALTY SILICA/ SILICA FIBERS

Multimode, single-mode, step index, graded index. Solarization resistant and fluorescence-quenching fiber. FDA-certified assembly division manufactures fiber optic assemblies for medical, telecom, mass memory/data storage, laser, spectroscopy, industrial and hi-temp markets. Micro/macro photonics packaging, V-grooves, MxN arrays, gold tip/lensed fiber, gold and aluminum metallized fiber. Fiberguide Industries, 1 Bay St., Stirling, NJ 07980; (908) 647-6601; Fax: 908-647-8464; http://www.fiberguide.com

Fiberguide Industries

For More Information Circle No. 472



LASER DYES

With Exciton, you get a specialized team of professionals knowledgeable in the field of laser dyes. Since more than one dye may cover a given spectral region, we provide the latest information concerning the best dye selection for a specific laser system and application. Exciton Inc., PO Box 31126, Overlook Station, Dayton, OH 45437; Tel: 937-252-2989.

Exciton Inc.

For More Information Circle No. 473

LIGHT MEASUREMENT CATALOG

International Light offers their latest version full-line catalog describing light measurement instrumentation, applications, and basic concepts of Radiometry/Photometry. Many new products are introduced covering a wide range of UV-VIS-IR applications. All technical details such as spectral and spatial responses, measurement ranges, and descriptions have been either updated, enlarged, or expanded in scope. International Light, Inc., 17 Graf Rd., Newburyport, MA 01950-4092; (508) 465-5983; Fax (508) 462-0759; E-mail: ilsales@intllight.com; Internet: http: //www.intl-light.com

International Light

For More Information Circle No. 474

IMPROVE ANY FUZZY PROBLEM WITH APART!

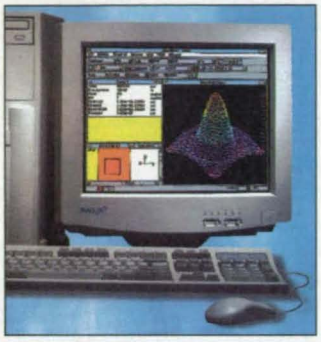
• World's leading stray light program! • Improve your signal-to-noise ratio (SNR) in any optical system. • Optimize your contrast/detection on any ground- or space-based system. • Specify your surface quality and BRDF from a full coating library. • Calculate ghost, glints, and particle problems before they happen. Breault Research Organization Inc., 6400 East Grant Rd., Ste. 350, Tucson, AZ 85715; Tel: (800) 882-5085 or (520) 721-0500; FAX: (520) 721-9630. E-mail: sales@breault.com; http://www.breault.com

Breault Research Organization Inc.

For More Information Circle No. 475

NEW PRODUCTS

Product of the Month



PC Laser Beam Analyzer

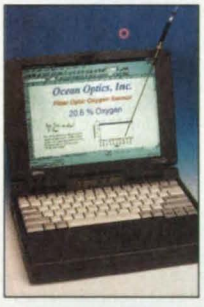
Spiricon, Logan, UT, says the just released LBA-300PC laser beam analyzer Version 1.2 incorporates a number of features for higher performance. Chief among these, according to the company, is the patented Ultracal automatic calibration technique, which sets the baseline of the camera precisely at zero, and saves negative numbers for use in precise beam calculations. Spiricon says this makes the LBA-300PC the only commercial-grade camera system able to make second moment beamwidth measurements, the new ISO standard. This version runs under the 32-bit mode of Windows 95B, which speeds up beam profile access and processing. Another new feature is beam convolution, enabling the user to remove noise from both the beam view and beam calculations. Resolution is selectable from 512-X-480 down to 16-X-15, in steps of 2.

For More Information Circle No. 793

Handheld Infrared Thermometer

The Model 425250 handheld infrared thermometer available from Extech, Waltham, MA, combines noncontact infrared temperature measurements and contact Type K measurements in one instrument. Surface readings range from 14 to 662°F (-10 to 350°C), with 0.1/1° resolution providing more precision in low ranges. Wide emissivity adjustment of 0.1 to 0.95 accommodates a large number of applications, according to Extech. Features include a selectable Centigrade/Fahrenheit temperature units, Record/Recall of Min/Max readings, relative temperature measurement display, and Data Hold. Price is $299.

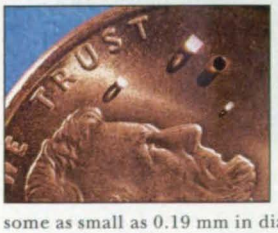
For More Information Circle No. 795



Fiber Optic Oxygen Sensor

Suitable for on-line, laboratory, or field applications, the spectrometer-coupled fiber optic oxygen sensor from Ocean Optics, Dunedin, FL, provides real-time full spectral analysis of dissolved or gaseous oxygen concentration. It consists of a fiber fluorescence probe with a thin-film coating on its tip, and a blue LED as the excitation source. Ocean Optics' S2000 miniature fiber optic spectrometer, with a 550-nm cut-off filter, and Windows®-based software complete the system. The sensor costs less than $3000.

For More Information Circle No. 798



Custom Precision Micro-Optics

Bern Optics, Easthampton, MA, introduces a new line of custom micro-optics, some as small as 0.19 mm in diameter. The lenses can be fashioned from virtually any glass type, the company says, and are virtually chip-free. Radius, center thickness, and diameter can be held to 10-micron tolerances. Bern says that innovative manufacturing techniques insure tilt-free and concentric lenses. Custom reflective and antireflective coatings are also available.

For More Information Circle No. 801

Polarized Helium Neon Lasers

The new line of 35-mW+ helium neon lasers from Melles Griot, Irvine, CA, comes in a rugged rectangular exoskeleton housing designed for better power stability and repeatable performance. The 05 LHP 928 linearly polarized and 05 LHR 928 randomly polarized lasers are intended to be drop-in replacements into OEM systems with universal mounting slots and industry-standard 50.8-mm beam delivery optical axes without system modification. Using the company's hard-sealed internal cavity mirror construction, Melles Griot suggests the lasers for high-speed laser printing, Raman spectroscopy, long-haul fiber break testing, holography, and other applications.

For More Information Circle No. 796

Compact Motor Polygon Assembly

Lincoln Laser, Phoenix, AZ, says its MPC-32 scanner is the smallest of its type on the market, at about one quarter the size of standard motor polygon assemblies. It incorporates the company's patented air bearing. Speed range is 16,000-32,000 rpm, and speed stability <0.015 percent over 1000 revolutions. Among features of the MPC-32, the company says, are low cost resulting from the integration of the polygon and the drive system, and greatest mean time between failures in the scanner's class.

For More Information Circle No. 799

Solid-State Deep-UV Laser

Lambda Physik, Ft. Lauderdale, FL, is offering the StarLine™ 266 frequency-quadrupled diode-pumped Nd:YAG laser that delivers 1 W average power at 266 nm at repetition rates up to 1 kHz. The company says that the laser combines the high peak power of Q-switched Nd:YAG technology with the high duty cycle of laser diode pumping. Its 1.5-mJ 10-nsec pulses allow for efficient pumping of nonlinear processes. Pulse-to-pulse stability is better than 1.5 percent. The output beam is TEM_{00}, and divergence is 0.5 mrad, permitting tight focusing for nonlinear excitation or fine micromachining.

For More Information Circle No. 802

Fiber-Pigtailed Laser Systems

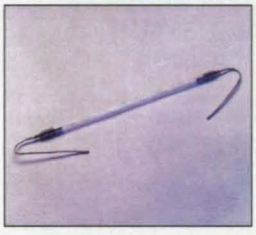
Blue Sky Research, Santa Cruz, CA, and Point Source Ltd. of the UK are coproducing a line of fiber-pigtailed diode laser systems called FiberBrite.™ CircuLaser™ diodes from Blue Sky Research are coupled into single-mode fibers and assembled by Point Source Ltd. Options include bare, collimating, or focused outputs, and power supplies. Blue Sky Research says that the system produces a circular beam with a true Gaussian intensity distribution across the wavefront, eliminating the need for spatial filters. Output powers at 635 nm include 3, 6, 9, and 12 mW, and at 670 nm 3, 6, and 18 mW.

For More Information Circle No. 794

Piezoelectric Tip/Tilt Platform

Polytec PI, Auburn, MA, introduces the S-340 piezoelectric tip/tilt platform for fast laser-beam steering and image stabilization. Accommodating mirrors and optics up to 3 in. in diameter, they can be operated in step or continuous mode. Tilting range for both axes is +/-1 mrad at 0-100-V operating voltage. The S-340 has two piezo actuators and LVDT sensors per axis assure maximum temperature stability and less than 1 µrad resolution and repeatability. The resonant frequency of 1.4 kHz allows for step response on the order of 1 ms open-loop and 3 ms closed-loop.

For More Information Circle No. 797



Sapphire-Envelope Flashlamps and Arc Lamps

Now available from ILC Technology Inc., Sunnyvale, CA, are sapphire-envelope linear flashlamps and continuous-wave arc lamps. The company says the lamps' long lifetimes are due to less devitrification, that they can withstand high internal pressures over a broad range of temperatures, are capable of high UV transmission, and have rugged seals. They are suggested for use in multicavity and multikilowatt lasers, UV curing, photolithography, and sterilization.

For More Information Circle No. 800

Laser Diode Controller

The Laser Test 22 from EXFO E.O. Engineering, Vanier, Quebec, Canada. is called by the company the most powerful laser controller system of its kind available. EXFO says that its highly stable current safely drives all common laser diodes, such as Butterfly, DIL, and TOCAN, over a temperature range of -50 °C to +199 °C. With an RS-232 or IEEE interface, the device can be connected to a PC or an EXFO IQ-200 optical test systems, and is compatible with the EXFO VCALC and VBURN software applications used to plot device characteristics and calculate typical parameters such as threshold current and serial resistance.

For More Information Circle No. 803

Magnetron-Sputtered Solid Lubricant for High-Temperature Use

This material is a valuable addition to the "'212" product line.

Lewis Research Center, Cleveland, Ohio

"MS-212" denotes a magnetron-sputtered composite solid material that is self-lubricating at temperatures up to about 800 °C. Similar materials that been reported previously in *NASA Tech Briefs* include PS-212 (deposited by plasma spraying), PM-212 (made by powder metallurgy), and EX-212 (a variant of PM-212 formed by extrusion). All of the "'212" materials have the same average chemical composition and are made from the same ingredients: 70 weight percent metal-bonded chromium carbide, 15 weight percent silver, and 15 weight percent of a eutectic mixture of barium and calcium fluorides.

MS-212 was developed for applications in which solid PM-212 bearings cannot be used and there are requirements for solid lubricant coats that conform closely to the topographies of substrates and are thinner than the coats customarily produced by plasma spraying. Both PM-212 and PS-212 have relatively coarse microstructures with segregation of phases; thus, they are not suitable for making thin conformal coats. Moreover, PM-212 and PS-212 must be machined to final dimensions. On the other hand, MS-212 in the as-deposited condition has the requisite homogeneity and smoothness (see figure), and can be used without machining or surface finishing.

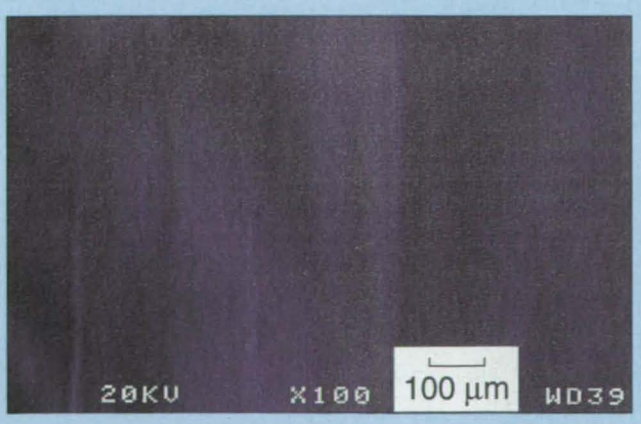
The friction and wear properties of MS-212 were evaluated in tests in which hemispherically tipped pins were slid on disks while pressing against the disks with known forces. Some of the pins were made of aluminum oxide, others of a cobalt-base alloy. Some of the disks were made of a soft aluminum alloy, others of a nickel-base turbine alloy. Some of the disks of each alloy were left bare, while others of each type were coated with MS-212. The tests with aluminum disks were performed at ambient temperature, while the tests with nickel-alloy disks were performed at temperatures from ambient to 800 °C.

The following are some of the conclusions drawn from the results of the tests:

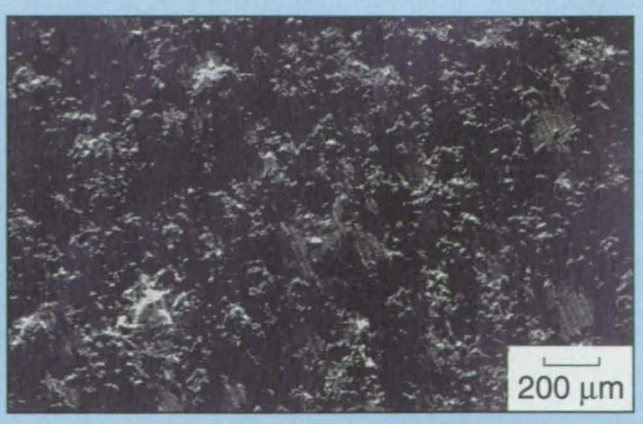
- In sliding against both cobalt-alloy and aluminum oxide pins, the aluminum-alloy disks coated with MS-212 exhibited less friction and greater resistance to wear than did the bare aluminum-alloy disks. The MS-212 coatings also prevented the severe galling typical of aluminum in sliding tests. However, the lubricating property of MS-212 on a soft metal like this aluminum alloy is load-limited in the sense that at high applied load, the soft substrate material deforms plastically, with resultant cracking and spalling of the hard MS-212.
- In sliding against cobalt-alloy pins at ambient temperature and at 350 °C, and in sliding against aluminum oxide pins at all test temperatures from 25 to 800 °C, the nickel-alloy disks coated with MS-212 exhibited less friction than did the bare nickel-alloy disks.
- At temperatures of 25 and 350 °C, the alumina pins that were slid against nickel-alloy disks with 20-μm-thick coats of MS-212 exhibited less wear than did the alumina pins that were slid against bare nickel-alloy disks. However, at temperatures of 600 and 800 °C, the alumina pins that were slid against the 20-μm-MS-212-coated disks exhibited somewhat more wear than did the alumina pins that were slid against bare nickel-alloy disks; this result has been tentatively attributed to the formation of lubricous oxides on the nickel-alloy disks at these high temperatures.

This work was done by Harold E. Sliney of **Lewis Research Center** *and Richard Soltis of Omni Corp. For further information, access the Technical Support Package (TSP)* ***free online at www.nasatech.com*** *under the Materials category,* ***or circle no. 122*** *on the TSP Order Card in this issue to receive a copy by mail ($5 charge).*

Inquiries concerning rights for the commercial use of this invention should be addressed to NASA Lewis Research Center, Commercial Technology Office, Attn: Tech Brief Patent Status, Mail Stop 7–3, 21000 Brookpark Road, Cleveland, Ohio 44135. Refer to LEW-16396.



MS212 AS DEPOSITED ON A POLISHED SURFACE



DIAMOND-GROUND PM-212

MS-212 As Deposited appears homogeneous, with no distinguishable grain boundaries or segregation of phases. On the other hand, PM-212 exhibits segregation of components and has a grainy surface, even after diamond grinding.

Small, High-Torque Reaction/Inertia/Momentum Wheel

The design provides high torque with reduced weight and improved balance.

Goddard Space Flight Center, Greenbelt, Maryland

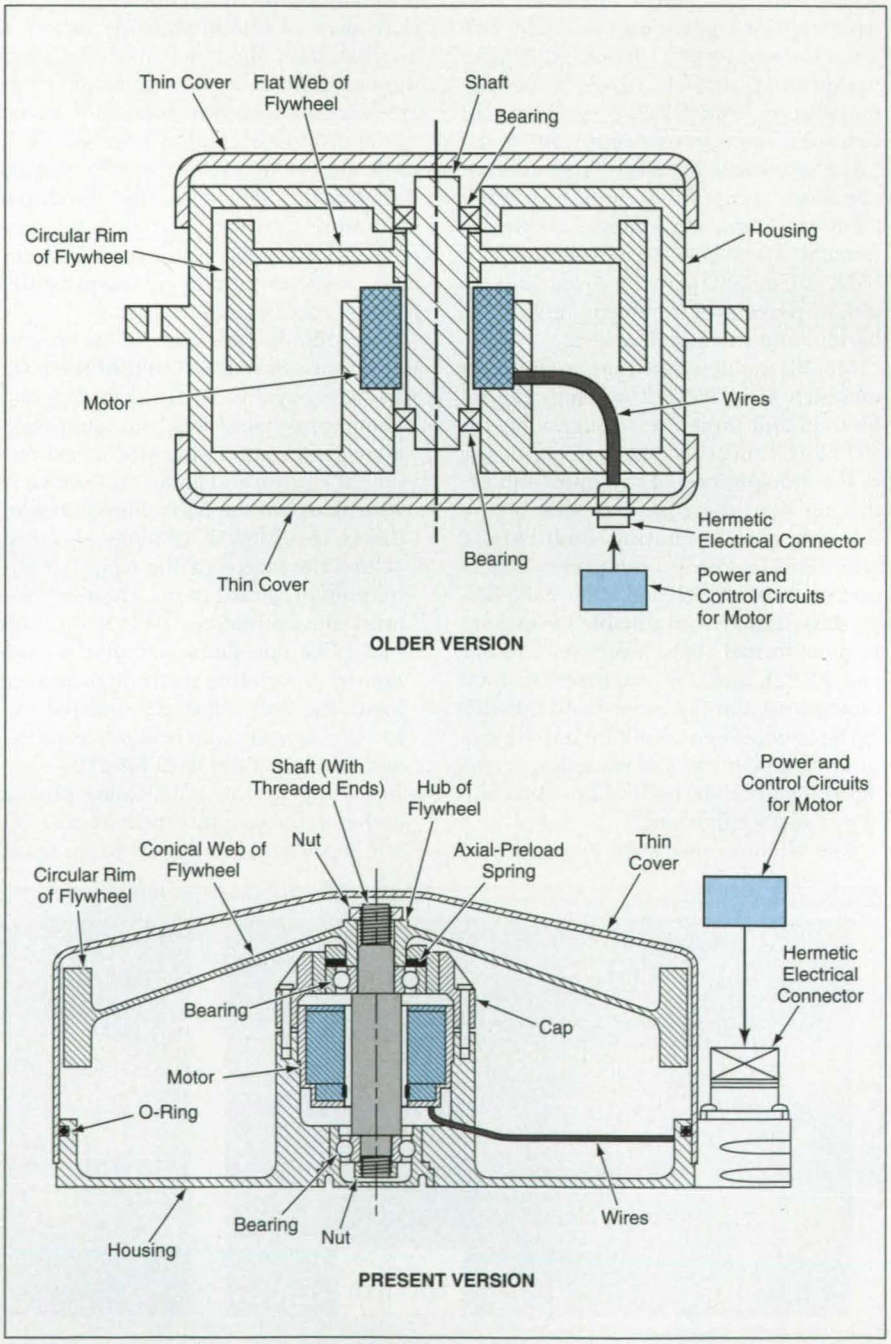
A design for a reaction/inertia/momentum wheel differs from older designs by incorporating features to provide high torque with virtually no increase in weight or size. This wheel is also capable of meeting stringent dynamic balance requirements. Originally designed for use as parts of attitude-control systems of spacecraft, this and older reaction/inertia/momentum wheels could also be used on Earth — for example, to aim optical instruments that are carried aboard moving bases like aircraft, ships, or land vehicles.

The term "reaction/inertia/momentum" is used here to reflect the fact that machines of this type have been called "reaction wheels," "inertia wheels," and "momentum wheels" on different occasions and because each of these terms represents an aspect of the basic principle of operation. The major functional block of a reaction/inertia/momentum wheel is a flywheel driven by an electric motor equipped with Hall-effect sensors for measuring its shaft angle and speed, and with its axis of rotation coincident with that of the instrument to be aimed. To initiate rotation of the instrument toward a commanded angular position, an attitude-sensing-and-control subsystem causes the motor to apply a torque to the flywheel; the rotational inertia of the flywheel reacts against the torque, applying an equal and opposite torque back through the motor to the instrument, and angularly accelerates the instrument in the commanded direction at the commanded rate. The term "momentum" refers to the angular momentum that is stored in the rotation of the flywheel.

The figure presents simplified meridional-plane cross sections of a typical older reaction/inertia/momentum wheel and of the present improved version. Whereas the flywheel in the older version is mounted on the shaft at an intermediate position between the bearings, the flywheel in the present version is mounted in cantilever fashion at the tip of a portion of the shaft that protrudes beyond one of the bearings. The different configuration for supporting the flywheel in the present version makes it possible to use a smaller and less massive housing to support the bearings. As a result, the torque-to-weight ratio in the present version is about 50 percent greater than that of the older version.

In the older version, the flywheel is inaccessible once it is mounted on the shaft; therefore, the flywheel must be balanced before installing it on the shaft, and there is no way to correct for any residual imbalance in the shaft itself, or for misalignment between the flywheel and shaft. In the present version, the flywheel is still accessible for balancing when it is mounted on the shaft; consequently, it is possible to balance the mounted flywheel to compensate more precisely for imbalance in the entire rotating mass to minimize vibrations during operation, which reduces spacecraft jitter.

The bearing lubricant in the present version is chosen with regard to requirements to minimize leakage, evaporation, and frictional torque. It is desirable to



The End Mounting of the Flywheel in the Present Version makes the flywheel more accessible for balancing; one must remove the thin cover to gain access, but the flywheel can remain on the shaft. The flywheel in the older version is inaccessible for balancing when mounted on the shaft inside the housing.

minimize frictional torque not only to reduce the power needed to maintain a steady speed but also to minimize heating, which accelerates degradation of the bearings and other components. After tests of many different lubricants, the one that was chosen is a diester-based grease that contains a lithium-based-soap additive and that has been filtered to remove all particles larger than 10 μm. The choice of a grease is contrary to the tendency to choose an oil on the basis of the intuitive (but in this case incorrect) expectation that the lower viscosity of an oil would result in less bearing friction. An additional advantage of this choice is that there is no need for the extra seals, channels, and reservoirs that would be necessary to contain an oil, and the difficulty and cost of fabrication are reduced accordingly.

This work was done by Charles Edward Clagett of **Goddard Space Flight Center.** *For further information, access the Technical Support Package (TSP)* ***free on-line at www.nasatech.com*** *under the Materials category,* ***or circle no. 112*** *on the TSP Order Card in this issue to receive a copy by mail ($5 charge).*

This invention is owned by NASA, and a patent application has been filed. Inquiries concerning nonexclusive or exclusive license for its commercial development should be addressed to the Patent Counsel, Goddard Space Flight Center; (301) 286-7351. Refer to GSC-13649.

Cheaper Fillers for Titanium Aluminide Welds

High-aluminum titanium aluminide powder is supplied in titanium tubes.

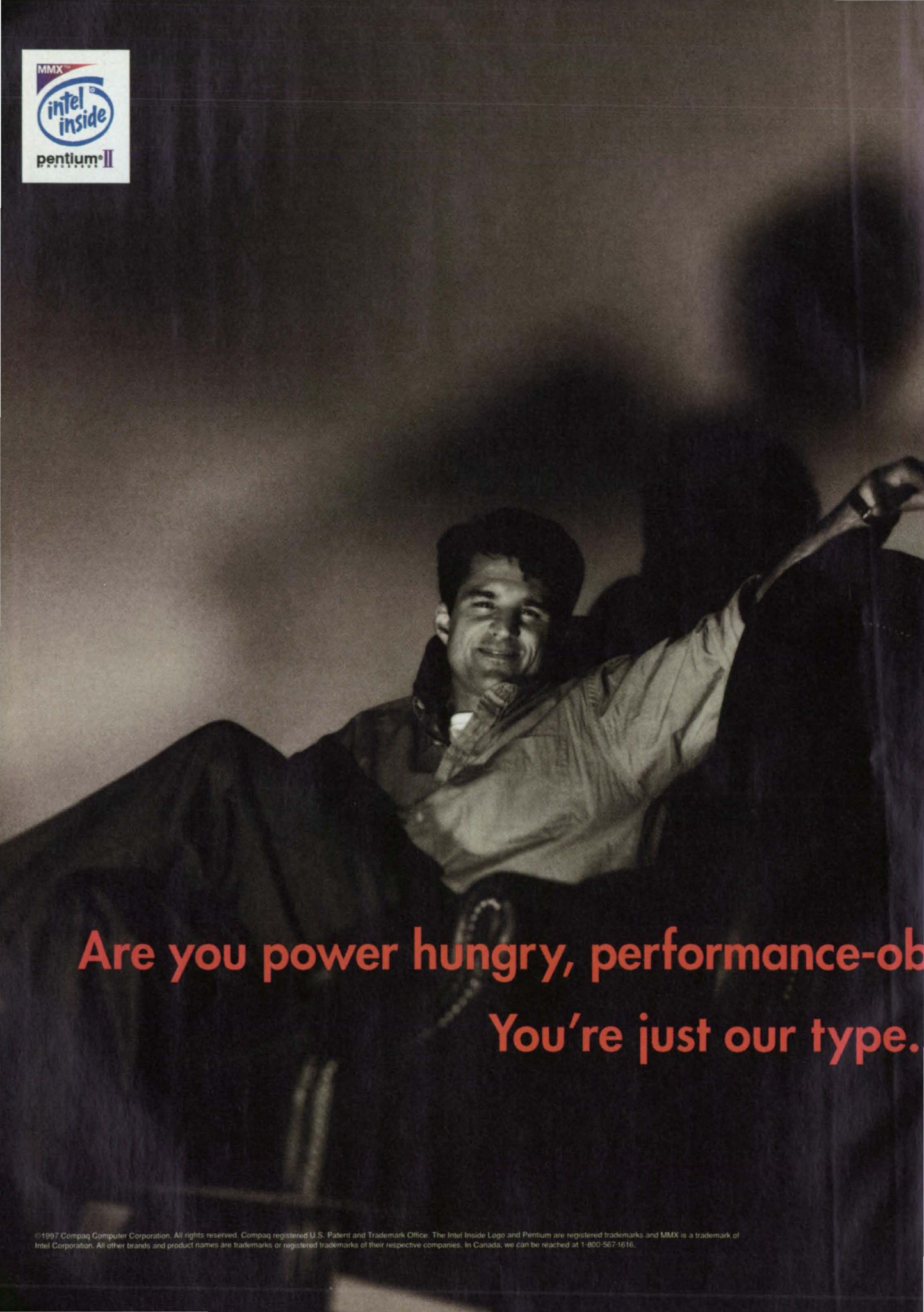
Lewis Research Center, Cleveland, Ohio

Tubes of welding filler material for fabrication and welding of gamma titanium aluminide (γ-TiAl)-based alloys can now be made at about one-tenth the unit cost of the filler rods used previously. Heretofore, welding filler metals with compositions matched to those of γ-TiAl-based alloys could be made only by coextrusion, using canned assemblies of cast rods and/or ingots. This type of processing is very expensive, resulting in a cost (in 1995 prices) of about $1,500 per pound ($3,300 per kilogram) of filler thus produced.

The present, cheaper filler material is produced in an adaptation of a process that has been used previously to make steel and nickel tubes filled with powders of hard-facing metals. A titanium strip is passed through a machine that forms it into a trough of U-shaped cross section. The trough is pulled through a hopper, from which the trough is filled with titanium aluminide powder with a high aluminum content such that the overall composition of the trough and its contents is that of the required γ-TiAl-based alloy. The powder-filled trough is formed into a tube by overlapping the edges of the U, then the resulting powder-filled tube is drawn to the desired diameter for use in welding. When the filler is subsequently fused into a weld, it forms an alloy of the required composition.

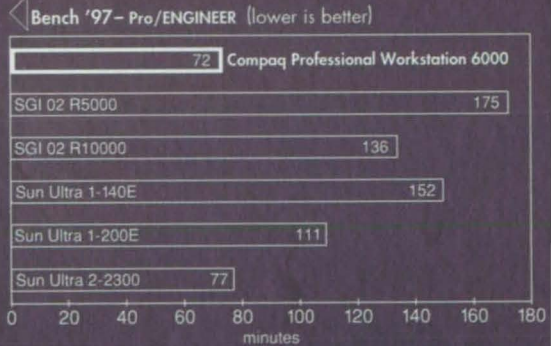
This work was done by Thomas J. Kelly and Curtiss M. Austin of General Electric Co. for **Lewis Research Center.** *For further information, access the Technical Support Package (TSP)* ***free on-line at www.nasatech.com*** *under the Materials category,* ***or circle no. 102*** *on the TSP Order Card in this issue to receive a copy by mail ($5 charge).*

Inquiries concerning rights for the commercial use of this invention should be addressed to NASA Lewis Research Center, Commercial Technology Office, Attn: Tech Brief Patent Status, Mail Stop 7–3, 21000 Brookpark Road, Cleveland, Ohio 44135. Refer to LEW-16178.



Introducing the new expanded family of Compaq Professional Workstations. The 5000, 6000, and 8000 series are powerful Windows NT®-based systems that not only outperform other industry-standard workstations, but most UNIX systems as well.

Interested in faster time to market? Our innovative Highly Parallel System Architecture gives you advanced multiprocessing so you can utilize up to two Pentium® II processors or four Pentium Pro processors. The dual PCI buses give you parallel access to peripheral devices and our dual memory controllers provide you with bandwidth that's two to four times faster (1.06GB/s) than competitive Intel-based workstations. These industry-standard Compaq workstations are optimized to run premier engineering applications like Pro/ENGINEER, I-DEAS Master Series, Unigraphics, AutoCad, SolidWorks 97 and MicroStation. And your choices don't



stop there. We are forging new partnerships with leading CAE application vendors like Altair Computing Inc., ANSYS Inc., Fluent Inc., The MacNeal Schwendler Corp., and Mechanical Dynamics Inc. It all comes down to this. You want power. You want performance. You want proof. We're going to give them to you. Call your local Compaq Authorized Reseller and ask about our "try and buy" program, or visit us at www.compaq.com.

sessed, and ego-driven?

COMPAQ

For More Information Circle No. 557

Computer Software

Automated Planning Software for Antenna Operations and Other Procedure Automation Tasks

The Deep Space Network antenna operations Planner, DPLAN, automatically generates antenna tracking plans for the highly sensitive radio-science and telecommunication antennas of the Deep Space Network (DSN). DPLAN accepts information about the equipment configurations and requested tracking services as inputs, which it utilizes in conjunction with its knowledge base of antenna operation procedures. Then by using the Artificial-Intelligence planning techniques of Hierarchical-task-network and operator-based planning, DPLAN produces a plan (sequence) of activities to provide the requested services and to configure equipment for this purpose. Continuing efforts in the development of DPLAN are focused on issues of knowledge representation, reasoning about the relative merits of alternative plans, representation of information pertaining to real-time changes in equipment and requested services, and replanning (before or during operation) in response to changes in equipment, services, or evaluations of alternative plans.

DPLAN is a general-purpose planning engine implemented in C, which has been successfully applied to other procedure automation tasks, such as image processing. Using DPLAN for a new domain simply requires creating the appropriate knowledge base. The knowledge base consists of task decomposition rules and task definitions. The decomposition rules are "if-then" type rules, which specify how high-level abstract tasks are decomposed into smaller low-level rules or executable tasks. These rules allow for the creation of a modular knowledge base which separates abstract knowledge from lower-level detailed knowledge. Changes in the specific details of a domain (for example, in the DSN domain if a new piece of equipment were to be added) only affect the lower-level rules and do not require changes in the higher-level abstract rules. Additionally, task definitions can be specified that describe the preconditions and postconditions of a given task. The preconditions are necessary states or events that must occur before the given task, and the postconditions are the effects of executing that task. The planner then ensures that the preconditions are satisfied and also tracks the postconditions that may in turn be the preconditions of other tasks. DPLAN's algorithm uses both the decomposition rules and the task definitions to determine a correct executable plan of activities. All interactions between tasks are tracked, and DPLAN ensures that there are no conflicts in the final plan.

This program was written by Steve Chien, Anita Govindjee, Tara Estlin, XueMei Wang, Randall Hill, Jr., and Forest Fisher of Caltech for **NASA's Jet Propulsion Laboratory.** *For further information, access the Technical Support Package (TSP)* ***free on-line at www.nasatech.com*** *under the Computer Software category,* ***or circle no. 176*** *on the TSP Order Card in this issue to receive a copy by mail ($5 charge).*

This software is available for commercial licensing. Please contact Don Hart of the California Institute of Technology at (818) 393-3425. Refer to NPO-20083.

Programs Make Finite-Element Models of Spiral Bevel Gears

POINTS/PAT is a set of two computer programs that generate (1) the surface geometry of face-milled spiral bevel gears in mesh and (2) finite-element models suitable for three-dimensional contact analysis of these gears. Finite-element analysis of spiral bevel gears can be used to determine contact stresses, bending stresses, stiffnesses for dynamic analysis, load sharing, contact area, and thermal gradients.

POINTS is based on the equation of meshing for spiral bevel gears. POINTS uses machine-tool settings to solve for an $N \times M$ mesh of points on four surfaces: pinion concave and convex, and gear concave and convex. POINTS creates an ASCII file containing NM points for each surface (N and M are the numbers of node points along the length and height, respectively, of a tooth).

PAT reads the ASCII file created by POINTS and creates a file that consists of a series of PATRAN input commands. Variables specified by the user are the density of the mesh on the face of a tooth, the number of finite elements through the thickness of a tooth, and the number of finite elements along the full fillet of a tooth. Full fillets are assumed to exist for both the pinion and the gear.

POINTS/PAT is written in FORTRAN 77. It has been successfully executed on a Sun SPARC workstation running SunOS 4.1.3, a Sun SPARC workstation running Solaris 2.5, and an SGI Indigo 2 computer running IRIX 6.2. The standard distribution medium for POINTS/PAT is one 3.5-in., 1.44MB diskette in MS-DOS format. Alternate distribution media and formats are available on request. POINTS/PAT was released to COSMIC in 1996.

This program was written by G. Bibel of the University of North Dakota and S. Reddy and A. Kumar of the University of Akron for **Lewis Research Center.** *For further information, access the Technical Support Package (TSP)* ***free on-line at www.nasatech.com*** *under the Computer Software category,* ***or circle no. 124*** *on the TSP Order Card in this issue to receive a copy by mail ($5 charge).*

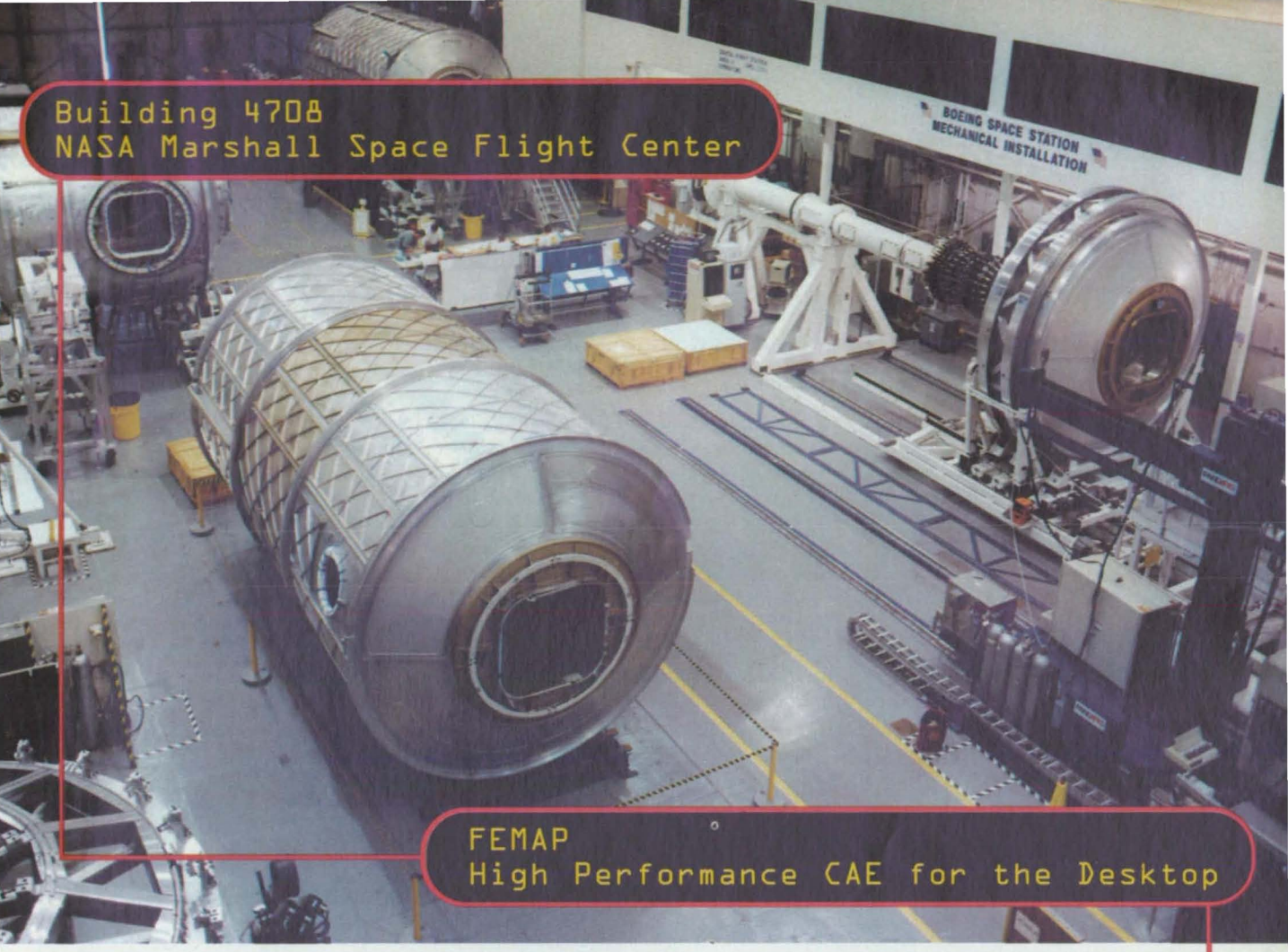
Inquiries concerning rights for the commercial use of this invention should be addressed to NASA Lewis Research Center, Commercial Technology Office, Attn: Tech Brief Patent Status, Mail Stop 7–3, 21000 Brookpark Road, Cleveland, Ohio 44135. Refer to LEW-16279.

COSMIC, NASA's Software Technology Transfer Center, has an inventory of over 800 software packages that originally were developed by NASA and its contractors for the U.S. space program. These packages have a wide range of applications other than space exploration and are used by industry, academic institutions, and other government agencies.

For further information about software available from COSMIC, or to receive a free diskette catalog, contact COSMIC at:

COSMIC
The University of Georgia
382 East Broad Street
Athens, GA 30602-4272

Phone: 706-542-3265
Fax: 706-542-4807
e-mail:
service@cosmic.uga.edu
WWW:
http://www.cosmic.uga.edu

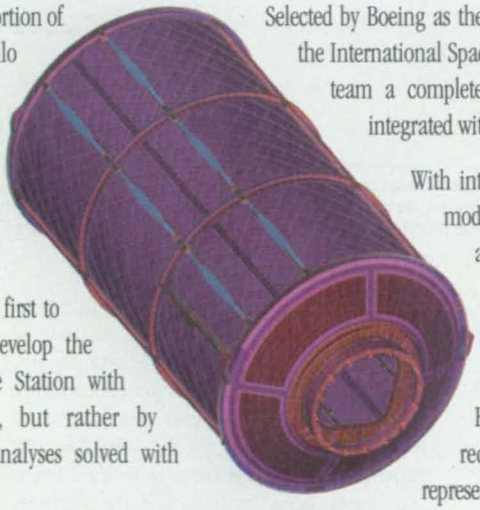


If FEMAP® can handle THIS team's modeling needs, it can handle YOURS.

Each day visitors tour the place where the U.S. portion of the most ambitious space program since the Apollo moon landings is coming to life.

Only a short distance away in Room 229 a team of engineers is looking at the Space Station in another way — through the eyes of FEMAP®.

Engineers in Huntsville were in many ways the first to "see" the Space Station using FEMAP to develop the structural design. They examine the Space Station with FEMAP, not directly with eyes or hands, but rather by interpreting the results of finite element analyses solved with NASTRAN and ABAQUS.



Selected by Boeing as the primary analysis modeling system for the International Space Station, FEMAP affords the Huntsville team a complete engineering solution that is tightly integrated with their Windows desktop environment.

With integrated beam, shell and solid analysis modeling, support for a wide range of solvers and flexible results processing, FEMAP has become the product of choice for professional analysis modeling on the desktop.

For more information or to discuss your requirements with a FEMAP technical representative, call 610-458-3660.

ENTERPRISE SOFTWARE PRODUCTS, INC. • 415 Eagleview Boulevard • Exton, PA 19341 USA • Tel: +1 610 458 3660 • FAX: +1 610 458 3665 • www.femap.com

Protocol for High-Quality Vibration Tests

Noise is reduced, accuracy is increased, and anomalies are detected.

Goddard Space Flight Center, Greenbelt, Maryland

Over the years, a protocol that specifies a laboratory setup and procedures has been developed and used successfully at Goddard Space Flight Center to ensure safety, consistency, and high quality in vibration testing. Originally applied to testing of space-flight hardware, the protocol could be adaptable to vibration testing of a variety of terrestrial and space-flight equipment.

The first element of the protocol is to install at least two control accelerometers at the structural interface between the item to be tested and the shaker table used to perform the test. This helps to protect the item against overtesting in case one control accelerometer fails. If two control accelerometers are used, then they are placed at opposite corners of the interface to monitor vibrations more effectively. When more control accelerometers are used, they are spaced evenly around the interface.

The strategy implemented by the control computer during a test includes a provision to use the highest of the readings of all the control accelerometers, according to a principle of maximum or extremal control, to ensure that testing remains within limits. This is another reason for multiple-control accelerometers at various locations to capture the full distribution of motion and avoid being misled by readings taken at vibrational nodes.

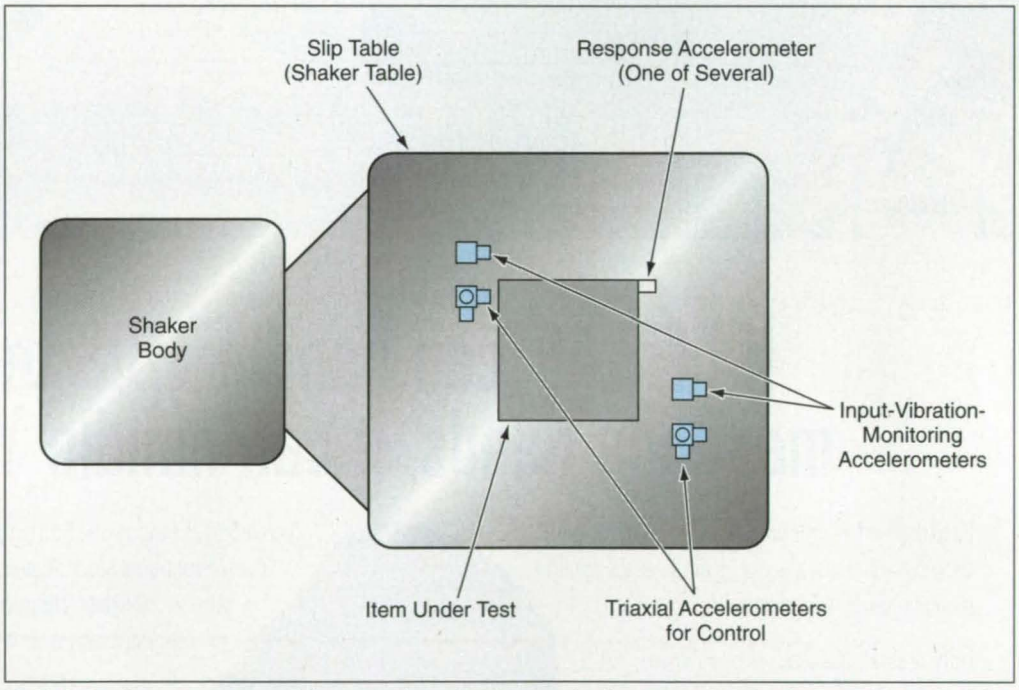
The second element of the protocol is to minimize background electrical noise. This can be accomplished by use of coaxial cable and proper isolation for all accelerometer channels. In general, noise attributable to building vibrations plus electrical sources can be reduced to signal levels equivalent to accelerations of the order of 0.005 × normal Earth gravitational acceleration.

The third element of the protocol is to monitor raw vibration signals. Analog vibration signals are always monitored by use of oscilloscopes and voltmeters. This practice ensures that the desired waveform (e.g., sine, random, or transient) has been applied to the shaker. The monitored signals can also be readily interpreted as indicating such anomalies as loose mechanical connections, stray pieces of hardware, or a malfunction of the shaker.

The need for such monitoring arises because of the fundamental nature of vibration analyzers (digital/analog systems used to analyze the accelerometer outputs). Although most vibration analyzers can operate in an oscilloscope mode, they do not usually record measurement data in a time-base format. Instead, they process the data and the processing includes averaging; this obscures signal features indicative of the anomalies mentioned above.

The fourth element of the protocol is to assign separate technicians at different locations to the control and the response-data-acquisition tasks. Inasmuch as many flight-hardware tests involve large complements of instrumentation, this separation of tasks makes it possible to devote the necessary expertise and attention to each task.

The fifth element of the protocol is to obtain further confirmation of the accuracy of a test. For this purpose, the response-data-acquisition crew also monitors the input vibration at each control location by use of a separate accelerometer and signal conditioner.



Multiple Accelerometers are used for protective redundancy, to implement a principle of extremal control, and to capture the full distribution of motion. The outputs of the control accelerometers are monitored by a control crew; those of the input and response accelerometers by the response-data-acquisition crew.

This work was done by Peter Rossoni of **Goddard Space Flight Center**. *For further information, access the Technical Support Package (TSP)* ***free on-line at www.nasatech.com*** *under the Mechanics category,* ***or circle no. 138*** *on the TSP Order card in this issue to receive a copy by mail ($5 charge).*

GSC-13822

Scanning Long, Narrow Cylinders

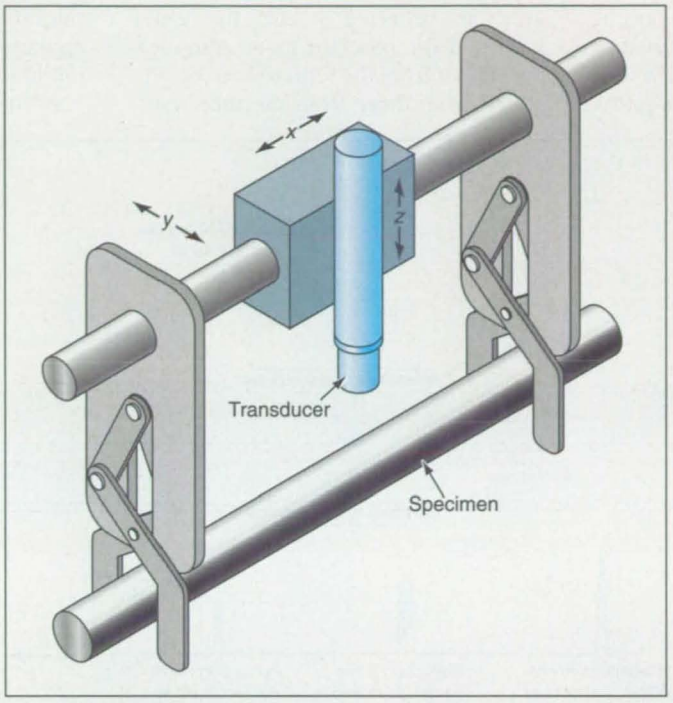
A fixture inexpensively adapts an ultrasonic scanner to a difficult task.

Goddard Space Flight Center, Greenbelt, Maryland

A simple fixture gives a standard x–y scanner the ability to inspect small-diameter cylindrical specimens ultrasonically. Heretofore, ultrasonic C-scan inspection of such specimens has been difficult because a special mechanical scanner is required to enable the scanning of a long, narrow cylinder.

The fixture is attached to the y (indexing) axis of the scanner (see figure). The specimen is placed at the bottom of the ultrasonic inspection tank, parallel to the x (scanning) axis. The opening of the scissorslike fixture legs is adjusted so that they fit snugly on the specimen without clamping it.

The scanner is then operated just as if it were doing a conventional x–y scan. The ultrasonic transducer scans the cylindrical specimen along its longitudinal axis. When the line scan is finished, the scanner indexes along its y axis, rolling the specimen as it moves so that a new surface is exposed to view. The transducer performs another line scan. The steps are repeated until the surface of the cylinder has been fully scanned. The x–y scan then represents a rolled-out image of the cylindrical specimen — that is, an x–θ scan.



Scissorslike Fixture Legs roll the specimen when the scanning mechanism indexes in the y direction. At the same time, the fixture holds the specimen in precise alignment with the x axis.

This work was done by Engmin James Chern of **Goddard Space Flight Center**. *For further information, access the Technical Support Package (TSP)* ***free on-line at www.nasatech.com*** *under the Mechanics category,* ***or circle no. 165*** *on the TSP Order card in this issue to receive a copy by mail ($5 charge).*

GSC-13794

Imaging Internal Solder Joints in Tubes

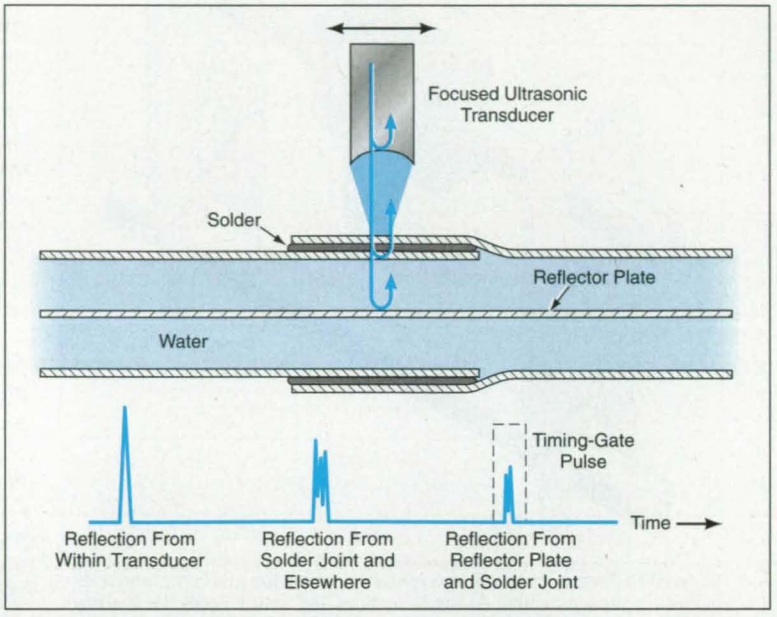
An internal reflector clarifies an otherwise obscure ultrasonic image.

Goddard Space Flight Center, Greenbelt, Maryland

A simple reflector plate makes it possible to generate ultrasonic images of solder joints between thin-wall tubes. Until now, images of such joints have been difficult to generate because signals from the solder bond are embedded in the reflections from the two tube walls. The reflector plate allows nondestructive evaluation of the joint quality so that hazardous and costly leaks can be avoided.

A long, thin metal reflector plate is inserted into the soldered tube, and the tube is immersed in water, as usual, for ultrasonic scanning. The tube joint is insonified at a frequency of approximately 10 MHz by an ultrasonic transducer (see figure). Ultrasonic waves are reflected by both the solder joint and the reflector plate. Although the signals from the joint cannot be separated from those from the tube walls, the reflected pulses from the plate also contain information on the joint without masking by the wall reflections.

A timing gate is imposed on the pulse reflection, while the tube is indexed by rolling on its circumference as described in further detail in the preceding article. The resulting ultrasonic C-scan provides an image of the internal joint.



Reflected Pulses From a Reflector Plate contain discernible information on the internal solder joint, while pulses from the joint itself are masked by the tube wall reflections.

This work was done by Engmin James Chern of **Goddard Space Flight Center**. *For further information, access the Technical Support Package (TSP)* ***free on-line at www.nasatech.com*** *under the Mechanics category,* ***or circle no. 147*** *on the TSP Order card in this issue to receive a copy by mail ($5 charge).*

GSC-13795

Device for Temporary Storage of Bolts

Lyndon B. Johnson Space Center, Houston, Texas

A holder has been devised for use in temporarily storing bolts that have been removed from equipment and are to be reinstalled in the equipment. The device includes two pieces of card stock hinged together by use of plastic ties. One piece of card stock is perforated with a number of holes into which the bolts fit snugly. Upon removal of a bolt from the equipment, the bolt is placed in one of the holes, where it is retained until retrieved for reinstallation in the equipment. Devices like these could be useful in workshops, helping to keep track of fasteners removed during repairs.

This work was done by Pierre J. Thuot of **Johnson Space Center** *and Oscar S. Koehler of Rockwell International Corp. For further information, access the Technical Support Package (TSP)* ***free on-line at www.nasatech.com*** *under the Mechanics category,* ***or circle no. 142*** *on the TSP Order card in this issue to receive a copy by mail ($5 charge).*

MSC-22599

Fractional-Step, Finite-Volume Computations on Moving Grids

Incompressible flows are computed to second order in space and first order in time.

Ames Research Center, Moffett Field, California

Time-dependent flows of incompressible, viscous fluids in the presence of boundaries that move can be computed by an extended, moving-grid version of a method of computing such flows on fixed coordinate grids that conform to fixed boundaries. This is an important development in that many flows of practical importance are bounded by moving surfaces: examples include internal flows driven by pistons, biofluids (blood) moving within elastic boundaries (blood vessels and the heart), and external flows over moving control surfaces of aircraft.

Aspects of the fixed-grid version of the method were described in several prior articles in *NASA Tech Briefs,* including "Fractional-Step, Finite-Volume Computation of Flow" (ARC-12621), Vol. 16, No. 2 (February 1992), page 80; "A Fractional-Step Method of Computing Incompressible Flow" (ARC-13154), Vol. 17, No. 2 (February 1993), page 78; and "Multigrid, Fractional-Step Computation of Flow" (ARC-13196), Vol. 20, No. 3 (March 1996), page 78. To recapitulate: The Navier-Stokes equations of incompressible flow are solved numerically on a general nonorthogonal curvilinear coordinate grid, using finite volumes defined by the grid and by using volume fluxes (instead of velocities) to account for the finite volumes of the grid cells. The pressure is the remaining dependent flow-field variable. At each time step, computations are performed in two fractional steps. In the first fractional step, the equations of conservation of momentum are solved by use of the gradient of pressure from the preceding time step via an explicit approximate-factorization method, yielding an approximate flow field that does not satisfy the equation of conservation of mass. In the second fractional step, a discrete Poisson-like equation with Neumann-type boundary conditions, formed by combining the equations of conservation of momentum and mass, is solved iteratively.

The extension of the fixed-grid version of the method to a moving grid begins with a return to the original integral formulation of the Navier-Stokes and conservation equations that was used to derive the fixed-grid version. The motion of the grid is incorporated into the equations via terms in the velocity of each surface element in the grid and in the time dependence of the geometry (volume and surface-element areas) of each grid cell. To preserve accuracy in the finite-volume discretization, special attention is paid to the satisfaction of geometric conservation laws in the moving coordinate system (these laws relate the volumes and the areas of the surface elements of the computational cells in such a way as to enforce the conservation of volume, which is equivalent to the conservation of mass in the case of incompressibility).

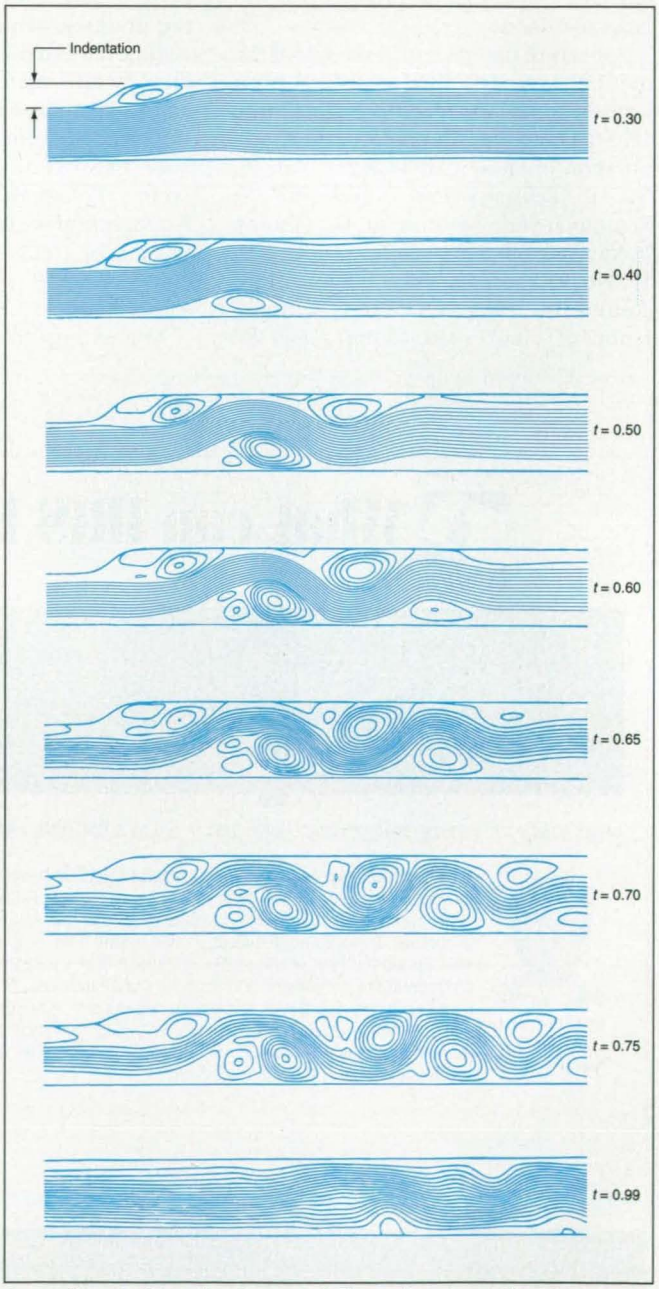
In the fixed-grid version of the method, an explicit approximation of the convection terms is used. In the moving-grid version, the convection terms

can also be approximated implicitly. Explicit or implicit fourth-order numerical dissipation can be used for flows with high Reynolds numbers, and boundary conditions can be of the Dirchlet, Neumann, or periodic type in the moving-grid version.

The figure shows streamlines computed by the moving-grid version of the method for a test case in which laminar flow in a two-dimensional channel is affected by an oscillating indentation in one boundary of the channel: This case is roughly analogous to oscillations excited by flow of a liquid in a collapsible tube like a vein.

This work was done by Dochan Kwak of **Ames Research Center** *and Moshe Rosenfeld of Tel Aviv University. For further information, access the Technical Support Package (TSP)* ***free on-line at www.nasatech.com*** *under the Mechanics category,* ***or circle no. 144*** *on the TSP Order Card in this issue to receive a copy by mail ($5 charge).*

ARC-13253



Streamlines Indicate the Computed Flow of a viscous liquid in a two-dimensional channel with an oscillating indentation in the upper wall. The times indicated next to these views are in units of one cycle of the oscillation.

Plan Now to Attend

TECHNOLOGY 2007

The Engineering Innovation Show

September 22-24, 1997

Hynes Convention Center, Boston, MA

Explore Hundreds of Exhibits Featuring America's Best New Inventions and Products

Discover a Gold Mine of Government and University R&D Ripe for Commercialization

Meet Tech Transfer Experts Who Can Help You Turn Ideas Into Profitable Products

Sponsored by:

NASA TECH BRIEFS

Technology Utilization Foundation

NASA

Hosted by:

Center for Technology Commercialization

Colocated with SPIE's Photonics East and Electronic Imaging Intl. Exhibitions

Register by September 5 and Save

Three events, one incredible opportunity to explore the cutting edge.

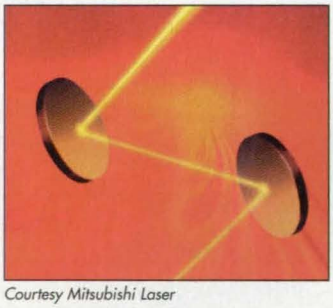
The Engineering Innovation Show

NASA Tech Briefs magazine's "Engineering Innovation Show" is coming to the northeast for the first time on September 22-24, joining forces with SPIE's Photonics East and Electronic Imaging Intl. conferences in Boston's Hynes Convention Center.

80,000+ sq. ft. of free exhibits featuring hot new inventions and products from federal labs, universities, and leading OEMs. Don't miss the NASA pavilion, offering an amazing array of space-based technologies with down-to-Earth applications, or the New England Technology Showcase, gathering the region's high-tech pathsetters in one place, at one time. Your Technology 2007 registration gets you into all three shows' exhibits at no charge.

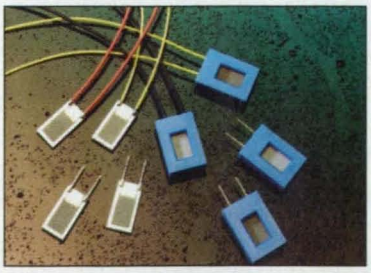
Technology-focused sessions spotlighting advances in manufacturing/materials, environmental technology, lasers and optics, and sensors/instrumentation. Many will be unveiled for the first time, and available immediately for license or commercial production.

Plenary "windows on the future" where industry and government visionaries will discuss the breakthroughs that will shape tomorrow's business arena. Hear how the "Next-Generation Internet" project could speed electronic communications by a thousand times, and how emerging photonics technologies will drive major changes in medicine and other economically-critical fields.



Courtesy Mitsubishi Laser

Business-boosting short courses where you can learn from the pros how to start/finance a small high-tech company, find profitable niche markets, win government grants, protect your intellectual property, and more.



All this, plus poster presentations, tutorials, product demos, and networking receptions. Register today using the form at right and get a jump-start on tomorrow... and your competition.

"An incredible gathering of the world's finest technology providers... if you have any interest in leading-edge technologies and their potential applications, this is the place to be."

Enterprise Reengineering Magazine

"A vital resource that puts attendees in direct contact with the premier technology developers and tech transfer experts in federal labs and industry."

Spotlight on Technology

"Innovative ideas abound...brings together America's top engineers and scientists to help attendees solve design and manufacturing problems, create new or improved products, and expand market opportunities."

Machine Design Magazine

Visit the Tech 2007 web site — www.abptuf.org/T2007 — for complete conference and short course information.

To reserve hotel rooms call 1-800-399-2282. For travel discounts, call 1-800-724-0968.
Questions? Call 212-490-3999

REGISTRATION FORM

1644

1. BADGE INFORMATION

First Name M.I. Last Name

Title SPIE Member Number (if applicable)

Company

Address

City State Zip/Postal Code

Country (other than USA)

Tel. Fax E-mail

Registration for

Photonics EAST

September 22-24, 1997

RETURN WITH PAYMENT INFORMATION TO:

T2007/Photonics
c/o Convention Data Services, Inc.
P.O. Box 1328, Hyannis, MA 02601

For faster processing, fax to: 508-778-7718

2. REGISTRATION

Please register me for the items checked below: *(check the appropriate pricing below)*

	BY 9/5	AFTER 9/5
A. ❑ Full Registration **Includes:** All sessions and receptions on Mon. 9/22 & Tue. 9/23, tutorials, product demos, exhibits, poster presentations	**❑ $325**	**❑ $375**
B. ❑ Daily Registration (circle: Mon. or Tue.) **Includes:** All sessions, tutorials, product demos, and the reception on your registration day, exhibits, poster presentations	**❑ $175**	**❑ $225**
C. ❑ Tutorials **Includes:** All tutorials, exhibits, product demos	**❑ $75**	**❑ $100**
D. ❑ Spouse/Guest Registration **Includes:** receptions on Mon. and Tue., and visitation of exhibits	**❑ $75**	**❑ $100**
E. ❑ Exhibits Only	**FREE**	**FREE**

Registration Total

$

3. SHORT COURSES

Write the number(s) and respective fee(s) of the courses you will attend.

SC#____ @ $____ SC#____ @ $____ SC#____ @ $____ SC#____ @ $____

Short Course Total

$

4. Extra Awards Reception Tickets

(quantity _____) **❑ $50** **❑ $50**

Additional Banquet Tickets Total

$

5. Payment Method

❑ Check/MO enclosed (payable to: "Technology Utilization Foundation")

❑ Charge my: ❑ MasterCard ❑ Visa ❑ American Express

Card number _____

Signature: _____ Exp. Date. _____

TOTAL AMOUNT ENCLOSED

$

Registrations & reception tickets are transferable.
Cancellations must be received in writing by 5 September 1997 for a full refund (a $50 processing fee applies for all refunds).
No refunds after 5 September. No refunds for "no shows."

Lightweight Inspection Crawling Apparatus

Inspections and other operations can be performed remotely.

NASA's Jet Propulsion Laboratory, Pasadena, California

The multifunction automated crawling system (MACS) is a relatively compact, lightweight apparatus utilizing suction cups to crawl on aircraft and perform inspection tasks. The MACS functions in any orientation, including vertical or upside-down. Under remote control or onboard computer control, the MACS can be maneuvered so that the equipment that it carries can inspect aircraft and marine structures for such defects as dents, cracks, corrosion, impact damage, delamination, fire damage, and porosity. The MACS could also perform such other tasks as removing paint and carrying hazardous materials.

The MACS includes a platform, on which are mounted two piezoelectric-motor-driven legs; a U-shaped outer leg and a round inner leg. Both legs are equipped with suction cups (see figure) to grip the surface on which the MACS crawls. A miniature onboard computer coordinates the operations of the suction cups and legs. For example, initially, the cups on the inner leg are evacuated and extended to the surface to grip the surface, while the cups on the outer leg are not evacuated and are withdrawn from the surface so that the outer leg is free to move. The outer leg is then translated to the next step position. When necessary, the platform can also be rotated on the inner leg to change the direction of translation and/or orient the platform for a specific task. Next, the cups on the outer leg are extended toward the surface and evacuated, air is admitted to the cups on the inner leg to release their grip, these cups are withdrawn from the surface, and the inner leg is translated so that it catches up with the outer leg. The cycle is then repeated.

The partial vacuums in the cups are produced by small venturi pumps that operate on shop compressed air, which is usually available at pressures from 70 to 120 psi (0.48 to 0.83 MPa). Each cup is connected to a separate pump, so that if one cup loses vacuum on a rough surface, the others on the leg still grip the surface. The same supply of compressed air used to generate suction is also used to extend the suction cups toward the surface for gripping.

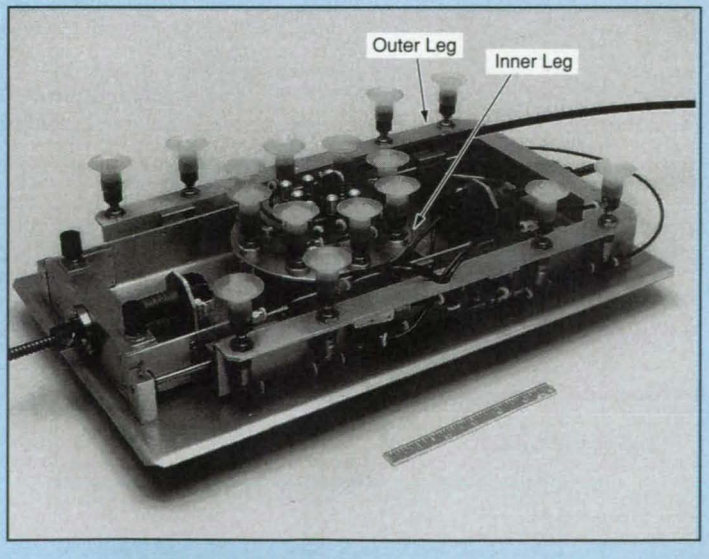
The platform can carry any of a variety of modules; for example, a video camera for visual inspection, ultrasonic or eddy-current instrumentation to detect invisible flaws, or a source of heat to remove paint. The MACS weighs about 10 lb (4.5 kg) and can carry payloads weighing up to about 100 lb (45 kg).

This work was done by Yoseph Bar-Cohen, Benjamin Joffe, and Paul Backes of Caltech for **NASA's Jet Propulsion Laboratory**. *For further information, access the Technical Support Package (TSP)* ***free on-line at www.nasatech.com*** *under the Machinery/Automation category,* ***or circle no. 156*** *on the TSP Order card in this issue to receive a copy by mail ($5 charge).*

In accordance with Public Law 96-517, the contractor has elected to retain title to this invention. Inquiries concerning rights for its commercial use should be addressed to:

Larry Gilbert, Director
Technology Transfer
California Institute of Technology
Mail Code 315 - 6
Pasadena, CA 91125
(818) 395-3288

Refer to NPO-19847, volume and number of this NASA Tech Briefs *issue, and the page number.*



MACS WITH GRIPPING SIDE UP

Suction Cups on the Outer and the Inner Leg are actuated alternately, in coordination with alternating motions of the legs. One leg grips the surface while the other is moved to a new position on the surface.

Vol. 21, No. 8 August 1997 This card expires: Jan. 31, 1998

Fast Fax Information Form

Use this form for quickest processing of your inquiry, or if the bind-in card has been removed. Fax: (413) 637-4343.

Name _____

Company _____

Address _____

City/St/Zip _____

Phone _____ Fax _____

e-mail _____

Circle the numbers below to order Technical Support Packages for briefs in this issue.

101	102	103	104	105	106	107	108	109	110	111	112	113	114
115	116	117	118	119	120	121	122	123	124	125	126	127	128
129	130	131	132	133	134	135	136	137	138	139	140	141	142
143	144	145	146	147	148	149	150	151	152	153	154	155	156
157	158	159	160	161	162	163	164	165	166	167	168	169	170
171	172	173	174	175	176	177	178	179	180	181	182	183	184
185	186	187	188	189	190	191	192	193	194	195	196	197	198
199	200	201	202	203	204	205	206	207	208	209	210	211	212
213	214	215	216	217	218	219	220	221	222	223	224	225	226
227	228	229	230	231	232	233	234	235	236	237	238	239	240
241	242	243	244	245	246	247	248	249	250	251	252	253	254
255	256	257	258	259	260	261	262	263	264	265	266	267	268
269	270	271	272	273	274	275	276	277	278	279	280	281	282
283	284	285	286	287	288	289	290	291	292	293	294	295	296
297	298	299	300	301	302	303	304	305	306	307	308	309	310

There is a $5.00 postage & handling charge for each TSP ordered, payable by check or credit card.

Method Of Payment:

❒ Check to *NASA Tech Briefs*

❒ American Express ❒ VISA ❒ Mastercard

Card No. | | | | | | | | | | | | | | | | |

Exp. Date _____

Signature _____

No. of TSPs: _____ x $5.00 each = total enclosed: $_____

Circle the numbers below to receive more information about products and services featured in this issue.

401	402	403	404	405	406	407	408	409	410	411	412	413	414
415	416	417	418	419	420	421	422	423	424	425	426	427	428
429	430	431	432	433	434	435	436	437	438	439	440	441	442
443	444	445	446	447	448	449	450	451	452	453	454	455	456
457	458	459	460	461	462	463	464	465	466	467	468	469	470
471	472	473	474	475	476	477	478	479	480	481	482	483	484
485	486	487	488	489	490	491	492	493	494	495	496	497	498
499	500	501	502	503	504	505	506	507	508	509	510	511	512
513	514	515	516	517	518	519	520	521	522	523	524	525	526
527	528	529	530	531	532	533	534	535	536	537	538	539	540
541	542	543	544	545	546	547	548	549	550	551	552	553	554
555	556	557	558	559	560	561	562	563	564	565	566	567	568
569	570	571	572	573	574	575	576	577	578	579	580	581	582
583	584	585	586	587	588	589	590	591	592	593	594	595	596
597	598	599	600	601	602	603	604	605	606	607	608	609	610
611	612	613	614	615	616	617	618	619	620	621	622	623	624
625	626	627	628	629	630	631	632	633	634	635	636	637	638
639	640	641	642	643	644	645	646	647	648	649	650	651	652
653	654	655	656	657	658	659	660	661	662	663	664	665	666
667	668	669	670	671	672	673	674	675	676	677	678	679	680
681	682	683	684	685	686	687	688	689	690	691	692	693	694
695	696	697	698	699	700	701	702	703	704	705	706	707	708
709	710	711	712	713	714	715	716	717	718	719	720	721	722
723	724	725	726	727	728	729	730	731	732	733	734	735	736
737	738	739	740	741	742	743	744	745	746	747	748	749	750
751	752	753	754	755	756	757	758	759	760	761	762	763	764
765	766	767	768	769	770	771	772	773	774	775	776	777	778
779	780	781	782	783	784	785	786	787	788	789	790	791	792
793	794	795	796	797	798	799	800	801	802	803	804	805	806
807	808	809	810	811	812	813	814	815	816	817	818	819	820
821	822	823	824	825	826	827	828	829	830	831	832	833	834

Mail in envelope to:
NASA Tech Briefs
PO Box 5077
Pittsfield, MA 01203-5077
or fax to: (413) 637-4343
Thank you for your order.

TSPs can be accessed free on-line at www.nasatech.com

Diffuse Reflectors for Far Infrared

The surfaces of metal plates can be highly roughened by EDM.

Ames Research Center, Moffett Field, California

Diffuse reflectors for far-infrared light can be made by greatly roughening of the surfaces of metal plates. The bidirectional reflectance distribution functions of these reflectors can be made very nearly isotropic at the theoretical value of $1/\pi$ steradian^{-1} and independent of wavelength in the wavelength range from 5 to 100 μm. Consequently, these reflectors are suitable for use as diffuse-reflection standards for calibration of photometric instruments operating in this wavelength range. At infrared wavelengths outside this range, reflection exhibits some dependence on wavelength and is only approximately isotropic, though it is still highly diffuse.

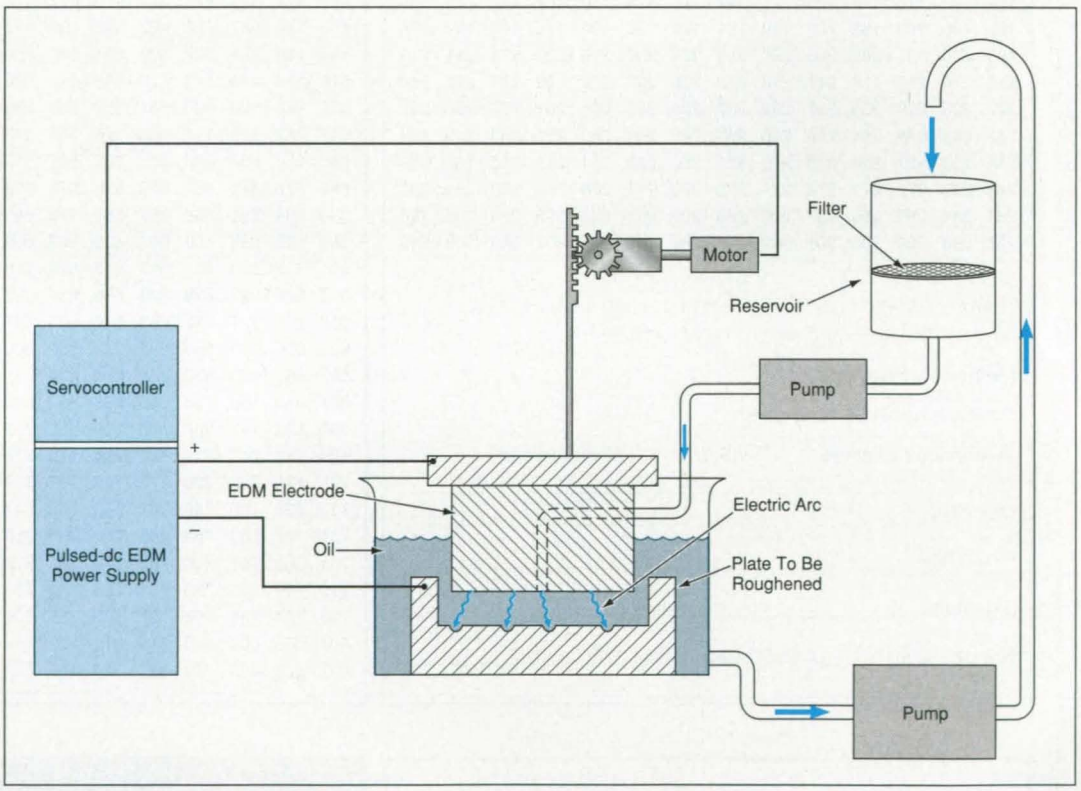
The surface roughness needed for diffuse reflectance is characterized by a random distribution of facets that have dimensions comparable to or greater than the greatest wavelength of light to be reflected. In practice, this amounts to a requirement that the root-mean-square (rms) surface roughness be at least equal to half the maximum wavelength. Thus, a metal plate with an rms roughness of about 50 μm can be expected to reflect diffusely at wavelengths up to about 100 μm.

Electrical-discharge machining (EDM) has been found to be capable of producing the needed surface texture. A plate to be roughened is placed in a container filled with an oil or other suitable dielectric liquid. The plate is connected to the negative side of a pulsed-dc EDM power supply. An EDM electrode is connected to the positive side of the power supply and is mounted on a servocontrolled translation mechanism that adjusts the gap [typically 1 to 5 mils (0.025 to 0.127 mm)] between the electrode and the plate so that the voltage across the gap is just sufficient to initiate electric arcs in the oil in the gap. These arcs move randomly about the gap, vaporizing metal from the plate. The vaporization process leaves behind numerous small craters, the aggregation of which results in the desired surface texture.

The sizes of the facets resulting from the EDM process can be adjusted by adjusting the average operating current, average voltage, pulse-repetition frequency, and duty cycle. For example an rms roughness of 56 μm on an aluminum-alloy plate can be obtained with an average-current setting between 15 and 20 A, an average-voltage setting of 66 V, and a pulse-repetition frequency of 1 kHz with an "on" time of 0.5 ms per pulse. Other settings can be chosen to obtain different rms roughnesses and thus different maximum wavelengths for diffuse reflection.

This work was done by Sheldon M. Smith of **Ames Research Center**. *For further information, access the Technical Support Package (TSP)* ***free on-line at www.nasatech.com*** *under the Manufacturing/Fabrication category, or* ***circle no. 172*** *on the TSP Order card in this issue to receive a copy by mail ($5 charge).*

This invention has been patented by NASA (U.S. Patent No. 5,543,961). Inquiries concerning nonexclusive or exclusive license for its commercial development should be addressed to the Patent Counsel, Ames Research Center; (415) 604-5104. Refer to ARC-11890.



Electrical-Discharge Machining can be used to greatly roughen a plate to make it diffusely reflective. The operating parameters of the servocontroller and EDM power supply can be adjusted to change the surface texture produced.

Why just see a tree when you can see the forest?

Datavisor 80

Experience it all with the new Datavisor 80, brought to you by n•vision, the leading producer of 3D immersive display systems.

The world's first commercially available 120-degree field-of-view head-mounted display system, the Datavisor 80 offers full color and high resolution in a lightweight housing. Its performance characteristics, previously available only on a custom basis, can now be yours at a fraction of the cost.

For defense training to surgical simulation applications, we offer a complete line of immersive display systems with logical upgrade paths. Our Datavisor HiRes and Datavisor VGA establish new levels of price and performance as do our Virtual Binoculars. And, if your needs are highly specific, our custom products division can provide just the right solution.

See the difference with n•vision

Call us today

7680 Old Springhouse Road
McLean, Virginia 22102
1.703.506.8808 voice
1.703.903.0455 fax
http://www.nvis.com
sales@nvis.com

n VISION

SIGGRAPH LOS ANGELES

The Solution Group

For More Information Circle No. 529 See us at booth #442

Lithographic Masks With π-Phase-Shift Attenuators

Diffraction at edges is adjusted to steepen intensity profiles.

Marshall Space Flight Center, Alabama

Masks with π-phase-shift attenuators have been invented for use in x-ray and optical lithography. These masks are similar to lithographic masks of older design, the major difference being that in these masks the attenuator materials and the thicknesses of the attenuators are chosen to minimize the blurring effect of diffraction at the edges.

Figure 1 illustrates a typical mask used in soft-x-ray (wavelength of the order of 1 nm) lithography. The shadowing and nonshadowing areas of the mask are used to define features in a radiation-sensitive film during exposure to illumination in a contact or proximity printing process. In the older approach to mask design, one pays no particular attention to the difference between the phase of radiation passing through the openings and the phase of the small amount of radiation that survives passage through the attenuator, or else one sets this phase shift close to zero. In practice, the mask and the film to be patterned are often mounted with a gap of the order of tens of microns between them to prevent them from damaging each other. In the presence of such a gap, diffraction at the edges of the attenuator reduces the steepness of the transition in intensity of illumination between the shadowed and nonshadowed areas of the film; this blurring effect makes it difficult or impossible to define lithographically the edges of submicron features that one seeks to fabricate.

The present approach to mask design is based on the dependence of diffraction upon the open-area/attenuator phase difference. The dependence is such that one can maximize the steepness of the intensity transition at an edge by choosing the attenuator material and thickness such that the phase difference is an odd integer multiple of π radians. Contrary to intuition, the steepening effect is greater with partial than it is with total attenuation. A typical useful, though not necessarily optimal, value of attenuation is about 10 dB; the optimum value depends on the specific application. In practice, the spectrum of x-rays used in lithography usually spans a band of wavelengths, so that it is necessary to select a dominant or representative wavelength in the band for which the phase shift is to be set to an integer odd multiple of π radians. The attenuator thickness and composition are then chosen together to obtain the required phase shift and degree of attenuation: the attenuator can be tailored by choice of thicknesses and compositions of multiple layers and/or by choice of the thickness and composition of an alloy.

Figure 2 illustrates the beneficial effect of a π-phase-shift attenuator in the case of a mask with a slit 250 nm wide in a 10-dB attenuator and illumination in the wavelength band of 1.2 ± 0.036 nm. The top graph shows the relative intensity *I* of illumination on the film as a function of position *x* across the slit in the case of contact printing (zero gap between the mask and the film); this is close to the ideal *I(x)* with steep edge transition that one would like to achieve but cannot achieve in the presence of a gap. The middle graph shows *I(x)* in the presence of a 20-μm gap and zero phase shift to depict the situation that obtains with a typical mask of older design. The bottom graph shows *I(x)* in the presence of a 20-μm gap and a phase shift of π produced by the attenuator.

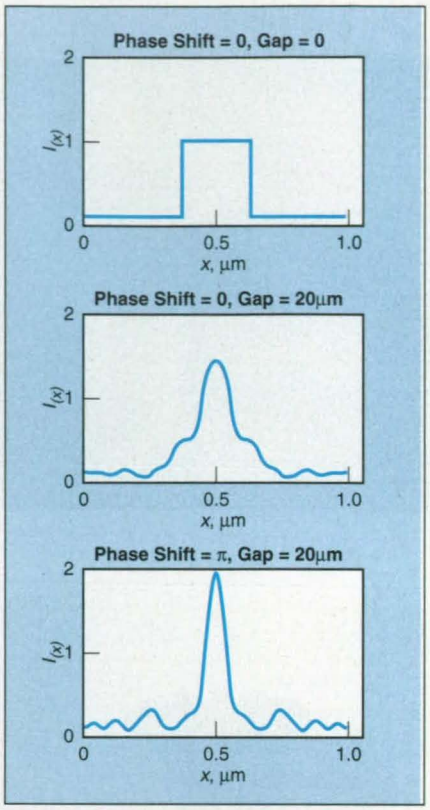


Figure 2. The **Edge Transition in I(x)** is steepened by use of the π-phase-shift attenuator.

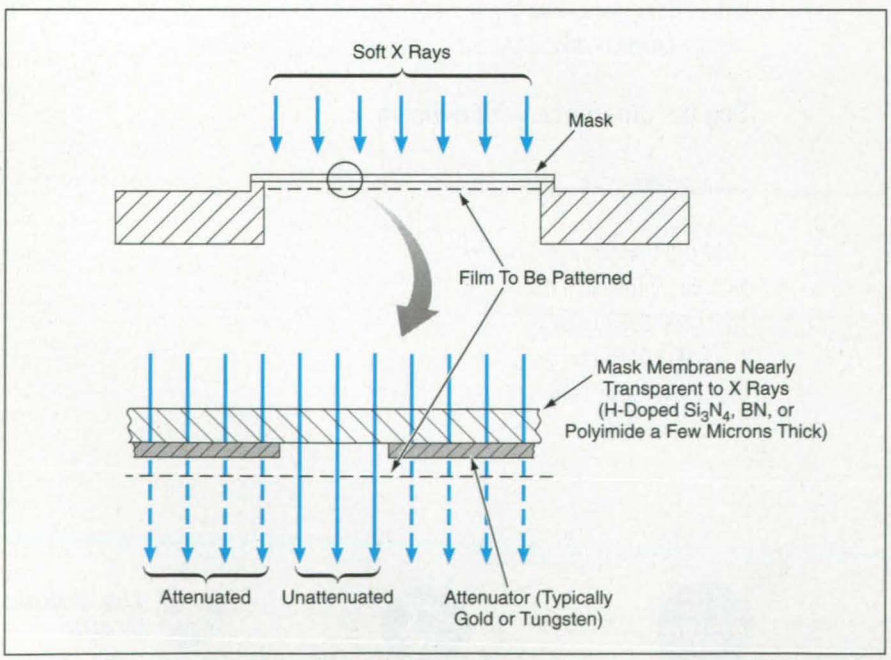


Figure 1. **Diffraction at the Edges of the Attenuator** softens the transitions between full illumination and shadows. This effect of diffraction can be reduced by introducing a phase shift of π radians between the unattenuated and attenuated portions of the radiation.

This work was done by Henry I. Smith, Erik H. Anderson, and Mark L. Schattenburg of Massachusetts Institute of Technology for **Marshall Space Flight Center.** *For further information, access the Technical Support Package (TSP)* ***free on-line at www.nasatech.com*** *under the Manufacturing/Fabrication category,* ***or circle no. 166*** *on the TSP Order card in this issue to receive a copy by mail ($5 charge).*

In accordance with Public Law 96-517, the contractor has elected to retain title to this invention. Inquiries concerning rights for its commercial use should be addressed to

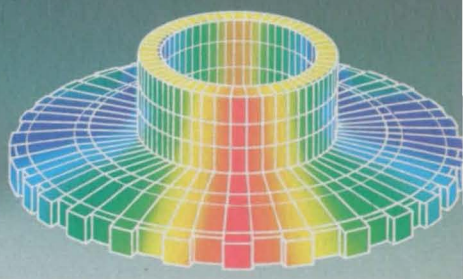
Massachusetts Institute of Technology
77 Massachusetts Avenue
Cambridge, MA 02139

Refer to MFS-26298, volume and number of this NASA Tech Briefs *issue, and the page number.*

CONSIDER THE FUTURE WITH POWDER METALLURGY

Auto Engine Main Bearing Cap

Submersible Pump Motor Coupling & Adaptor



Your Next Part Design Challenge

VALUE

Applications of P/M which combine precision and durability — like this automotive main bearing cap — represent extraordinary value. P/M's net shape characteristic lowers cost and eliminates major capital investments.

Features attainable only via the P/M process, like the "Double-D" main bolt hole, ease assembly.

A special material developed for this part combines ductility and strength to improve fatigue resistance over gray cast iron... simply, P/M produces more value for the dollar.

VERSATILITY

For making precision parts, P/M is today's most versatile process.

Desirable performance properties can be designed into a part through variation in the material. This 316 stainless steel motor coupling used in a Jacuzzi pump is an excellent example. It replaced a machined part and eliminated several costly machining operations.

Big parts or small. Short runs or large. Simple shapes to complex ones which require little or no additional finishing. This is the versatility of P/M.

VISION

Visualize some of the exciting new developments in P/M and how they can help solve your next design challenge.

New materials and new techniques such as warm pressing and metal injection molding result in parts with enhanced properties... in even more complex shapes.

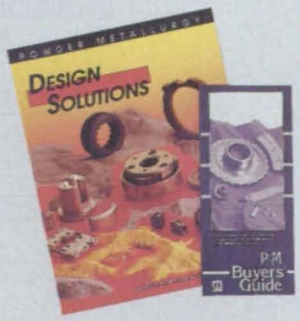
New automated design/fabrication methods are compressing lead time from design through production to save development costs.

Value. Versatility. Vision. P/M belongs in your future.

New FREE Brochures

For a free copy of the latest P/M Design Solutions Brochure and a P/M Buyers Guide, send in the readers service card or write Metal Powder Industries Federation at 105 College Road East, Princeton, NJ 08540. Or call 609/452-7700; FAX 609/987-8523.

http://www.mpif.org/mpif



P/M POWDER METALLURGY

The bonding of innovation and quality

For More Information Circle No. 537

Software for Mining Data for Diagnosis of Complex Systems

This software automates the development of diagnostic models.

Dryden Flight Research Center, Edwards, California

A computer program reduces the time and cost of validation and diagnosis of complex analog systems, increases confidence in the validity of the systems, and automates the development of superior system-level diagnostic mathematical models. The program was developed initially to aid system engineers in validating an automated research flight-control system in the F-18 High Alpha Research Vehicle (HARV), shown in Figure 1.

This software, called the "ModelQuest System Validator" (SV), is depicted schematically in Figure 2. It applies the mathematical-modeling techniques of the Statistical Network™ (a trademark of AbTech Corp., Charlottesville, VA 22911) software to "overplots" of hundreds of simulated anomalous signals with "truth" signals to learn automatically the differences between normal and anomalous systems. Given recorded signals from a system being evaluated, the resulting ModelQuest SV overplot analysis models identify the probability that a design anomaly or a failure exists, estimate the level of degradation of performance, and attempt to isolate the cause of the anomaly or failure. The highly automated capability of this software can dramatically reduce the time needed to validate critical systems or substantially increase the level of detection and isolation of faults.

ModelQuest SV augments the probability of discovering a problem during the validation process, increases the number of variables that can be monitored during each simulation run, and reduces the risk of missing detection because of the repetitive and complex nature of the manual validation task.

One of the outcomes of the system-validation project in which ModelQuest SV was developed was the further advancement of a data-mining software tool that is embedded within ModelQuest SV. This tool enables users to generate powerful models that:

- Predict important parameters and
- Validate sensor readings and that, in comparison with other such tools,
- Detect subtle anomalies much earlier,
- Reduce the incidence of false alarms and false dismissals, and

Figure 1. The **F-18 High Alpha Research Vehicle (HARV)**, with its automated flight-control system, is the original complex system to which the innovative software was applied.

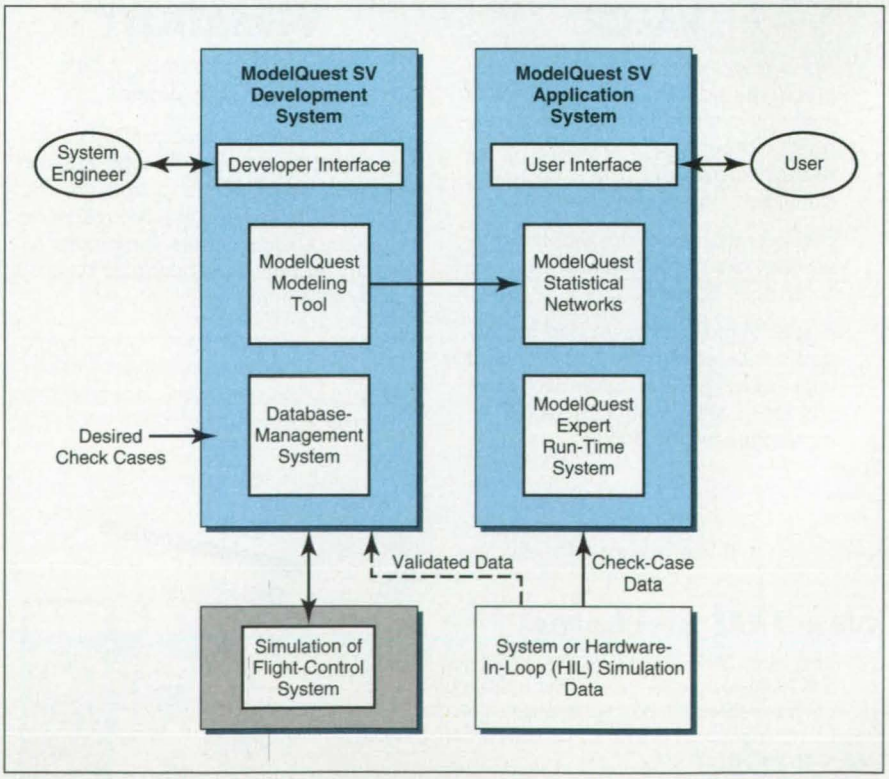
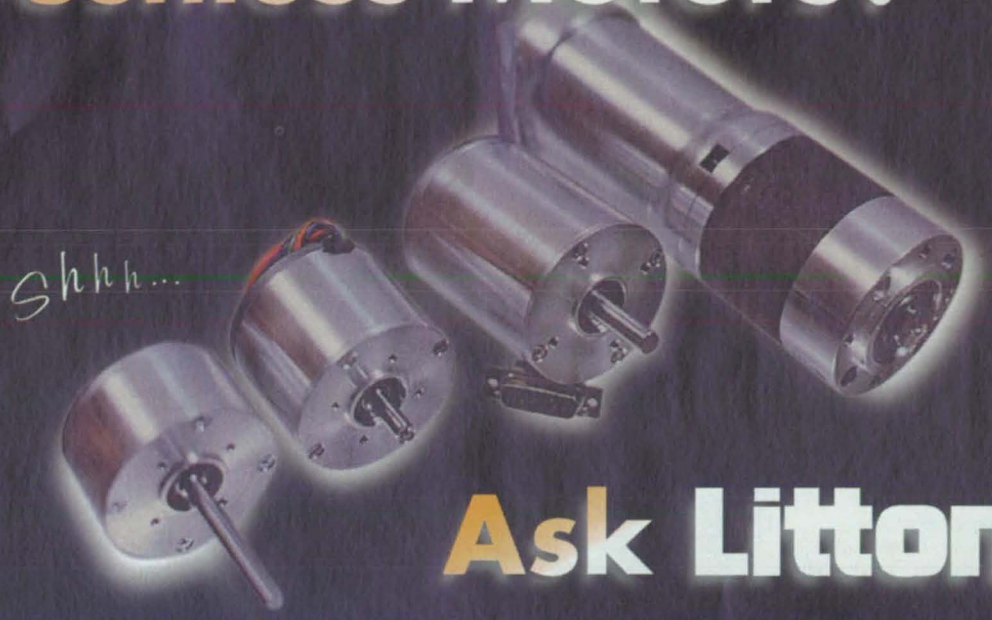


Figure 2. The **ModelQuest SV Computer Program** affords powerful capabilities for predicting parameters, validating sensor readings, detecting subtle anomalies, and isolating equipment failures.

Looking for Quiet, Brushless Motors?



Ask Litton.

The Silencer™ series of brushless DC motors provides strong, quiet operation. In fact, Silencer motors offer such low acoustical noise you can hardly tell they're running.

Call us with your motor requirements. We'll speed prototyping and slash design/manufacturing cycle times by faxing you a **free** computer model of your motor.

Clifton Precision® DC Brushless Motors

- *2.25" diameter housings*
- *Lengths from 1.3" to 2.8"*
- *Continuous torques range from 7.5 to 56 oz-in*
- *Speeds up to 20,000 rpm*
- *Standard options include gearheads, resolvers, encoders and electronic drivers*
- *Coming soon are size 12, 34 and 42 NEMA frame brushless motors*

800-336-2112
ext. 279

Litton
Poly-Scientific

Blacksburg, VA
540-953-4751
FAX 540-953-1841
http://www.litton-ps.com
e-mail: msg@litton-ps.com

For More Information Circle No. 512

- Isolate equipment failures more accurately (given sufficient failure data and/or fault simulations).

The data-mining tool, called ModelQuest Enterprise, takes advantage of a number of useful approaches, including those embodied in its Statistical Network and Expert Mining Strategies modules, to automate the development of superior diagnostic, decision, and prediction models based on operational, simulated, and historical data. Statistical networks combine the powers of neural networks and advanced statistical techniques to outperform both in many applications by using networks of mathematical functions to capture the complex, nonlinear relationships in data. The Expert Mining Strategies module provides a high level of automation in data-mining software tools. The Statistical Network algorithms in ModelQuest Enterprise are among the most automated and useful data-analysis software components for developing accurate detection, classification, estimation, and prediction models.

This work was done by AbTech Corp. for **Dryden Flight Research Center.** *For further information, access the Technical Support Package (TSP)* ***free on-line at www.nasatech.com*** *under the Mathematics and Information Sciences category,* ***or circle no. 167*** *on the TSP Order Card in this issue to receive a copy by mail ($5 charge).*

In accordance with Public Law 96-517, the contractor has elected to retain title to this invention. Inquiries concerning the rights for its commercial use should be addressed to:

Andrea Davis, Media Relations Specialist, 1575 State Farm Blvd., Suites 1 & 2, Charlottesville, VA 22911; Telephone No.: (804) 977-0686.

Refer to DRC-097-25, to the volume and number of this issue of NASA Tech Briefs, *and to the page number.*

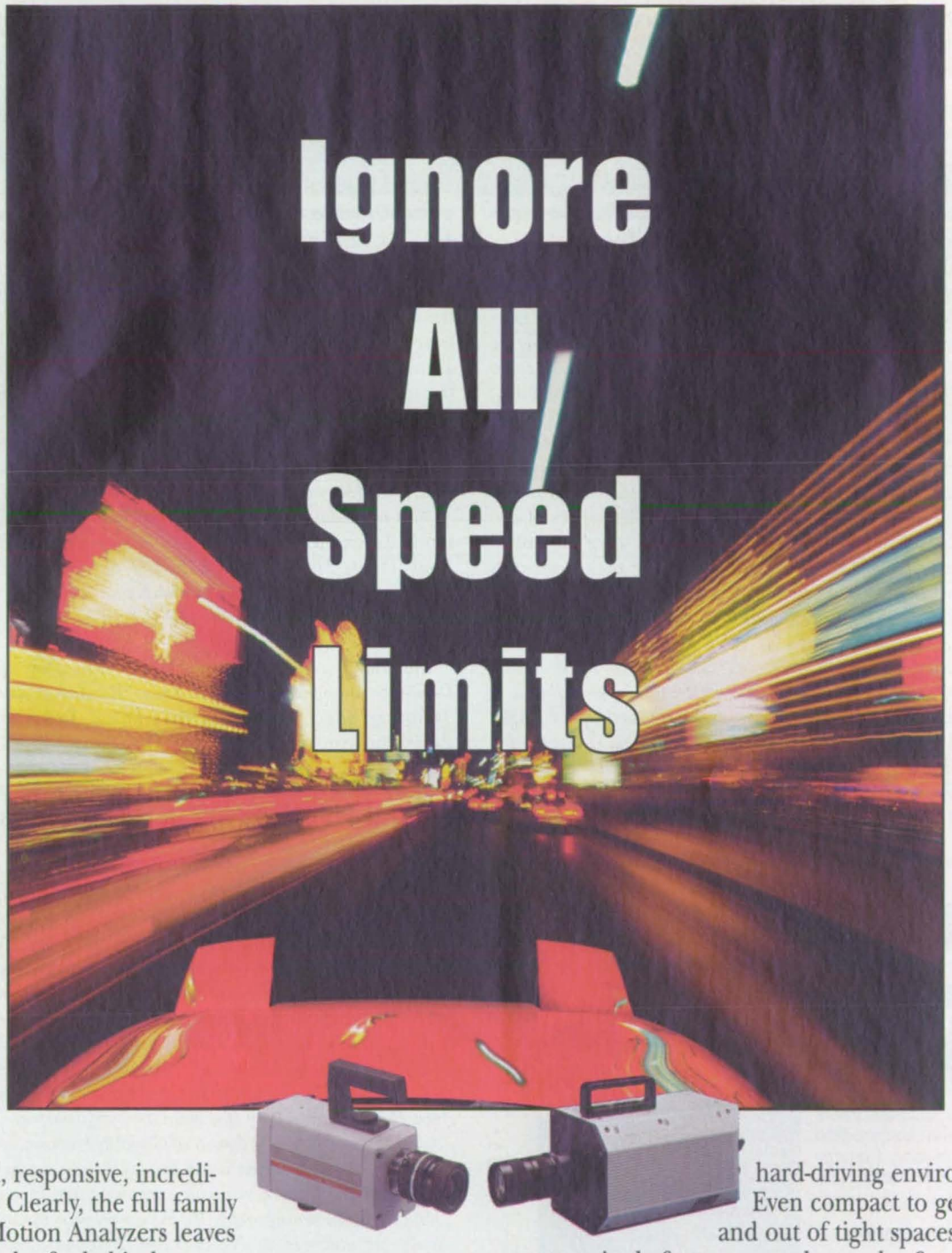
On-Line System for Specifying and Executing Equipment Tests

John F. Kennedy Space Center, Florida

A computerized system for writing and executing equipment-test procedures has been developed to replace a cumbersome paper-based system. The heart of the system is software on a server that posts test procedures on the World Wide Web (WWW), receives comments from reviewers via the WWW, and supports a paperless engineer's notebook for test-monitoring operations. Because the creation, organization, execution, verification, and documentation of test procedures often involves collaboration among geographically or organizationally dispersed individuals, and because WWW offers a ready-made infrastructure for communication among such individuals, the system can be implemented easily, at relatively low cost, on the WWW. At a test site, a test engineer or technician using this system carries a portable pen-based computer that communicates by radio with the computer network. From a web-browser session on the portable computer, the user checks off steps as they occur. Enhancements that were about to be made at the time of reporting the information for this article include a capability for direct posting of data from test equipment to the WWW server, a security mechanism, and support for multiple concurrent tests.

This work was done by Steven R. Beltz of I-NET Space Services for **Kennedy Space Center.** *For further information, access the Technical Support Package (TSP)* ***free on-line at www.nasatech.com*** *under the Mathematics and Information Sciences category,* ***or circle no. 190*** *on the TSP Order Card in this issue to receive a copy by mail ($5 charge).*

Inquiries concerning rights for the commercial use of this invention should be addressed to the Patent Counsel, Kennedy Space Center; (407) 867-2544. Refer to KSC-11885.



Powerful, responsive, incredibly fast. Clearly, the full family of Kodak Motion Analyzers leaves everything else far behind.

So whatever your application — solving a high speed production line glitch, testing airbags, product R&D, you name it — the possibilities are unlimited.

Kodak Motion Analyzers come souped-up with your favorite features. Or ruggedized for tough, hard-driving environments. Even compact to get you in and out of tight spaces. You can capture a single frame or reach speeds of over 40,000 frames per second. Plus you get stop-on-a-dime instant replay and ample memory for long record times.

Call 619-535-2908 or e-mail us today for more information. Then go as fast as you like. Wherever the road leads you.

800-462-4307, ext. 9015 • *www.masdkodak.com* • *e-mail: masdkodak@aol.com*

KODAK

EASTMAN KODAK COMPANY, MOTION ANALYSIS SYSTEMS DIVISION

For More Information Circle No. 511

Books & Reports

Evaluation of Anechoic Materials for Submillimeter Wavelengths

A report presents an evaluation of four specimens of lossy dielectric materials with respect to their effectiveness in suppressing reflections of electromagnetic waves at submillimeter wavelengths. Two of the specimens were made of a silicone elastomer, with surfaces of incidence patterned (by injection molding) into V-grooves of 22.5° apex angle. One of the specimens was an array of machined acrylic strips assembled to form V-grooves of 30° apex angle. The remaining specimen was an assembly of carbon-loaded polypropylene tiles with surfaces textured with arrays of pyramids. The reflectivities of the specimens (plus that of a flat calibration plate) were measured at a frequency of 500 GHz. The results of the measurements showed that with proper orientation of specimens, reflectivities were reduced by at least 60 dB, yielding net reflectivities of the order of –80 dB and less.

This work was done by R. H Giles, J. C. Dickinson, and J. Waldman of the University of Massachusetts and William E. Nixon of the U. S. Army National Ground Intelligence Center for **Goddard Space Flight Center.** *To obtain a copy of the report, "Evaluation of Submillimeter-Wave Anechoic Materials at 500 GHz," access it* ***free on-line at www.nasatech.com*** *under the Materials category,* ***or circle no. 160*** *on the TSP Order Card in this issue to receive a copy by mail ($5 charge). GSC-13724*

Dynamic Strains in Modified Gear Teeth

A report describes an experimental study of the effects of selected modifications of the profiles of spur-gear teeth on dynamic strains in the teeth. Such modification, called "tip relief" in the art, typically involves the removal of material to a depth of as much as few tens of microns below the ideal involute profile at the tip of the tooth. The modification can have a linear, parabolic, or other taper. In this study, strain gauges were used to measure both static and dynamic gear-tooth strains at various test conditions (several combinations of speeds and torques) on six sets of low-contact-ratio spur gears in a gear-noise test rig.

This work was done by Fred B. Oswald and Dennis P. Townsend of **Lewis Research Center.** *To obtain a copy of the report, "Influence of Tooth Profile Modification on Spur Gear Dynamic Tooth Strain," access it* ***free on-line at www.nasatech.com*** *under the Mechanics category,* ***or circle no. 150*** *on the TSP Order Card in this issue to receive a copy by mail ($5 charge).*

Inquiries concerning rights for the commercial use of this invention should be addressed to NASA Lewis Research Center, Commercial Technology Office, Attn: Tech Brief Patent Status, Mail Stop 7–3, 21000 Brookpark Road, Cleveland, Ohio 44135. Refer to LEW-16468.

Detecting Gear-Tooth Fatigue Cracks Before Complete Fracture

A report describes tests of the usefulness of six vibration-monitoring methods for detecting gear-tooth fatigue cracks in advance of complete fracture. In each of the methods, measurements of vibrations in gear trains are digitized and processed as they are collected. The vibration-data-processing algorithms used in the methods perform synchronous averaging and resampling followed by various types of filtering, statistical analysis, spectral analysis and/or other operations.

This work was done by James J. Zakrajsek of **Lewis Research Center** *and David G. Lewicki of the Vehicle Propulsion Directorate of the U.S. Army Research Laboratory. To obtain a copy of the report, "Detecting Gear Tooth Fatigue Cracks in Advance of Complete Fracture," access it* ***free on-line at www.nasatech.com*** *under the Mechanics category,* ***or circle no. 157*** *on the TSP Card in this issue to receive a copy by mail ($5 charge).*

Inquiries concerning rights for the commercial use of this invention should be addressed to NASA Lewis Research Center, Commercial Technology Office, Attn: Tech Brief Patent Status, Mail Stop 7–3, 21000 Brookpark Road, Cleveland, Ohio 44135. Refer to LEW-16433.

Laser Measurement of Hypervelocity Projectiles

A document describes an optical approach for the measurement of the speed of a projectile. The essence of the method is to project two laser beams across the anticipated trajectory at two different down-range positions, to optoelectronically detect the passage of the projectile through each beam, and to measure the time interval between these two passages. The speed then equals the distance between the laser beams divided by the time interval.

This work was done by Thomas M. Crawford of Lockheed Engineering and Science Company for **Johnson Space Center.** *To obtain a copy of the report, "A Laser Intervalometer System for Measuring the Velocity of Hypervelocity Projectiles," access it* ***free on-line at www.nasatech.com*** *under the Physical Sciences category,* ***or circle no. 125*** *on the TSP Order Card in this issue to receive a copy by mail ($5 charge). MSC-21821*

SPECIAL ADVERTISING SUPPLEMENT TO NASA TECH BRIEFS

TECHNOLOGY LEADERS

Profiles Of Pathsetting Companies Serving The Engineering Field

INTEGRATED ENGINEERING SOFTWARE

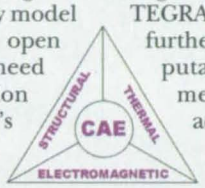
Alternative CAE Simulation Tools—No FEM Required

Computer Aided Engineering (CAE) software tools that simulate electromagnetic, thermal, and structural systems (e.g., electric motors, high-voltage applications, sensors, induction heating problems, etc.) have been around for years and have traditionally been based on the Finite Element Method (FEM). Now, for the first time, one organization, Integrated Engineering Software (INTEGRATED), is providing an alternative CAE solution based on the innovative and extremely user-friendly Boundary Element Method (BEM). Not only are electromagnetic, thermal, and structural solutions available using the easy-to-learn and easy-to-use BEM, but these solutions are available in coupled forms such as eddy current-thermal, electrostatic-thermal, thermal-structural, and magnetic-structural.

Innovative BEM vs. Traditional FEM

The Boundary Element Method (BEM) approach is rapidly gaining in popularity as an alternative to FEM, and it is an ideal solution to electromagnetic, thermal, and structural CAE design needs.

The BEM approach has an inherently short learning curve and a number of other advantages. Unlike the FEM approach, when using the BEM to parametrically model moving objects with open regions, there is no need to re-mesh the region between the system's moving objects (e.g., the stator-rotor air gap of a motor's rotating rotor). Also, 3D BEM models permit effective and complete viewing of the element distribution, which is impossible to view to the same extent in 3D FEM models. A library of predefined or user-defined materials is available, including nonlinear BH and EJ curves for electromagnetic systems. Built-in CAD features along with IGES and DXF input/output capabilities simplify 2D and 3D modeling. Periodic and symmetric modeling capabilities of INTEGRATED's BEM software further enhance the computational speed and memory requirement advantages relative to current FEM solutions. INTEGRATED offers a 30-day evaluation of all our CAE software tools.



For more information, contact Integrated Engineering Software, 46-1313 Border Place, Winnipeg, Canada R3H 0X4; Tel: 204-632-5636; Fax: 204-633-7780; e-mail: info@integrated.mb.ca; web site: www.integrated.mb.ca/ies

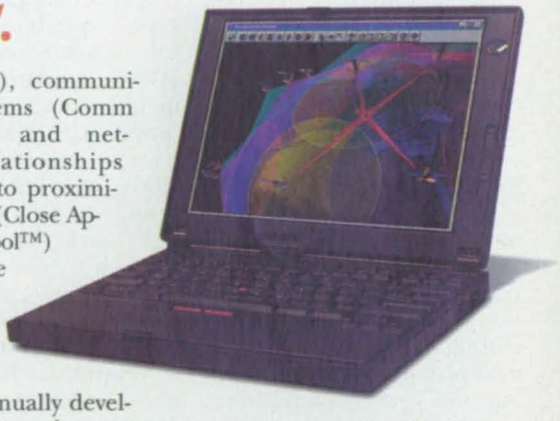
For More Information Circle No. 750

ANALYTICAL GRAPHICS, INC.

Analytical Graphics, Inc. (AGI) is the market leader in commercial off-the-shelf satellite analysis software. Headquartered in King of Prussia, PA, the company was founded in 1989 to develop a comprehensive suite of software products that would bring increased productivity and cost-effectiveness to satellite systems analysis.

AGI produces the Satellite Tool Kit (STK)® software suite, a complete line of productivity tools that support end-to-end satellite mission processes, from design and build to launch and operations. Major application areas include: Communication, Mapping, Intelligence, Navigation, Weather, Space Exploration & Sciences, and Military Operations. STK users span all major organizations involved in space.

STK, AGI's flagship product, is an interactive software tool designed for complete satellite mission planning, design, and analysis. Available on UNIX® and PC platforms, STK's core functions allow users to propagate vehicles, visualize geometric effects over time, compute access, determine angles and view results graphically or in textual formats. Users can extend these basic functions with STK's add-on modules, which address specialized analysis needs, from 3-D visualization (STK/VO™), communication systems (Comm Module™), and network relationships (Chains™) to proximity concerns (Close Approach Tool™) and coverage questions (Coverage Module™).



AGI continually develops product enhancements and new offerings designed to meet the specific needs of its diverse customer base. Over the past eight years, STK's flexibility, ease of use, and customer support have made it the accepted standard among thousands worldwide.

For more information, call 1-800-220-4STK (610-337-3055); e-mail: info@stk.com; or visit the AGI web site at http://www.stk.com

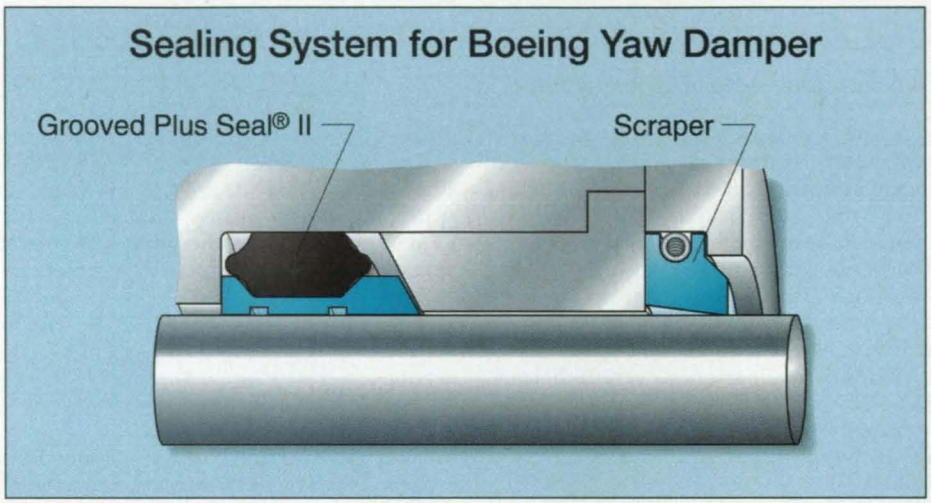
For More Information Circle No. 751

BUSAK+SHAMBAN

B+S Aerospace Responds to Boeing Challenge

Today's most advanced hydraulic flight control systems are designed to provide the pilot with ultimate directional control of the aircraft's flight path and to compensate for the aerodynamic forces affecting the aircraft. The Boeing 757/767 has three hydro-mechanical rudder power control actuators (PCAs) just to position a single rudder surface. Then, to improve handling, yaw damper actuators are incorporated into the rudder control system to provide turn coordination and to reduce passenger discomfort sometimes caused by short-duration "Dutch rolling," a combination of rolling, slipping, and yawing that occurs during normal flight. The yaw damper actuator is subjected to demanding high-frequency cycles and short stroke lengths, requiring the hydraulic seals to perform properly for millions of cycles.

The Busak+Shamban Grooved Plus Seal® II was chosen by Boeing to work in their yaw damper system. Under endurance test conditions, the Grooved Plus Seal® II completed over 92 million cycles without leakage failure. The endurance test conditions were based upon actual flight test data, operating at 3000 psi with short dither strokes up to 0.031 in. at a frequency of 4 Hz. These are very demanding operating conditions that typically lead to failure of most dynamic rod seals. Other seal candidates evaluated in this test failed the leakage requirement between 30 and 60 million cycles.



Due to Busak+Shamban's success with the yaw damper application, Boeing is considering our seal technology for other primary flight controls and actuators. The next time you board an aircraft, you will know that B+S seals are flying along with you for your comfort and safety.

For More Information Circle No. 752

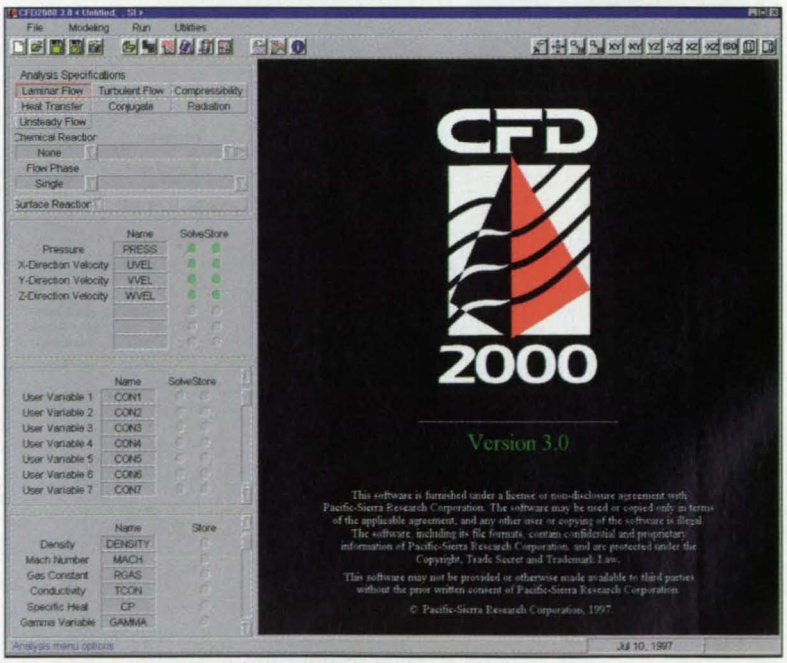
ADAPTIVE RESEARCH

Leaders in Computational Fluid Dynamics (CFD)—Software and Engineering Services

Adaptive Research offers an advanced computational fluid dynamics system for Windows NT/95 workstations, UNIX workstations, and mainframe super-computers. CFD2000 provides flexibility and expandability like no other CFD software on the market. CFD2000 has been designed to facilitate inclusion of any user-specific features through its open architecture.

CFD2000 incorporates the most advanced scientific field data visualization software on the market: Stormview. With flow visualization tools such as cutting planes, isosurfaces, data problems, particle tracking, and keyframe animation, your CFD2000 license provides seamless integration to interactive, multidimensional visualization capability. The CFD2000 software's scientific visualization ensures full-capability post-processing power across all platforms.

With CFD2000, you have a powerful CFD solution for simulating aerodynamics, electronics cooling, chemical and combustion processes, metallurgical applications, HVAC, environmental flows, and more. CFD2000 users enhance their competitive posture in the global marketplace through increased productivity, advanced capability, and reduced cost.



Adaptive Research also provides expert engineering services. Adaptive's expert team of engineers and fluid dynamicists possesses a combined 100+ years of experience in modeling a wide range of fluid-flow problems for various industries.

For more information contact Adaptive Research, 2901 28th St., Santa Monica, CA 90405; Tel: 800-326-5155; Fax: 310-314-2323; e-mail: sales@adaptive-research.com; www.adaptive-research.com

For More Information Circle No. 753

ANSOFT CORPORATION

Ansoft Corporation develops, markets, and supports EDA software solutions that enable leading-edge performance and miniaturization of electronic, communication, and electromechanical systems. Ansoft products benefit users by enabling them to aggressively reduce time to market and maximize product performance. Significant savings are achieved by eliminating physical prototypes and optimizing size, material, and yield.

Ansoft delivers the best tool in its class because of its technology leadership. Ansoft has a history of creating significant technology breakthroughs. Zoltan Cendes, Ph.D., founder of Ansoft, conducted over 15 years of R&D prior to the company's inception in 1984. Since that time, over a decade of R&D by Ansoft research and development staff pioneered the notion of automatic and adaptive convergence to solutions, asymptotic waveform evaluation (AWE) for spectral domain solutions, transfinite elements, basis evaluation state space techniques, and fast multiple acceleration algorithms.

These advances meet the growing needs of engineers as the market demands require smaller and faster devices with tighter design and compliance requirements. Ansoft continues to lead the technology in the industry with upgrades of its Maxwell products and the introduction of new products for both UNIX workstations and PCs.

Ansoft directly markets its products worldwide with a sales force and a network of distributors. Customers include leading electronics, telecommunications, and automotive companies including Motorola, Intel, Texas Instruments, Samsung, Hitachi, Sony, Sharp, Ericsson, SGS Thomson, General Motors, Ford, and BMW.

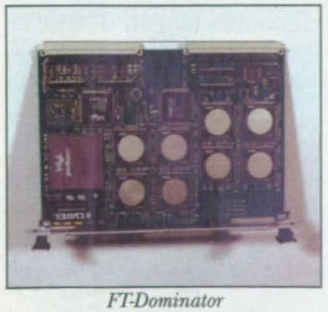
For more information, contact Ansoft Corporation, Four Station Square, Ste. 660, Pittsburgh, PA 15219-1119; Tel: 412-261-3200; Fax: 412-471-9427; e-mail: info@ansoft.com

For More Information Circle No. 754

ALACRON

Alacron is a leader in the design, development, and manufacture of high-performance coprocessor subsystems for demanding real-world imaging and DSP applications. Alacron offers a comprehensive line of coprocessors for PCI, CompactPCI, VME, and ISA bus computers, based on state-of-the-art microprocessors.

Alacron's coprocessors are supported by an extensive array of interchangeable I/O modules, including framegrabbers, hi-res graphics interfaces, SCSI, VSB high-performance digital I/O, and PMC modules.



FT-Dominator

Alacron's solutions include extensive libraries of microcoded image and signal processing algorithms.

Alacron's customers include a wide range of OEMs, government agencies, research institutions, and universities.

Markets Served

Markets served include: Machine Vision, Optical Character Recognition, Document Processing, Real-Time Inspection, Laser Radar, Real-Time Signal Processing, Digital Audio Processing, Spectral Analysis, Vibration and Noise Analysis, Robotic and Servo Control, Pattern Recognition, ADPCM Coding/Decoding, Video Data Compression, Medical Imaging, Radar/Sonar, Multimedia, Numerical/Array Processing, Speech Processing/Recognition, Communications, CAD/CAM, Signal Intelligence, and Seismology.

Customer/Technical Support

Alacron's application engineering team assists OEMs and end-users to optimize the design of the products and applications, making full use of Alacron's high-performance coprocessing and I/O systems.

SHARCs

Product Lines

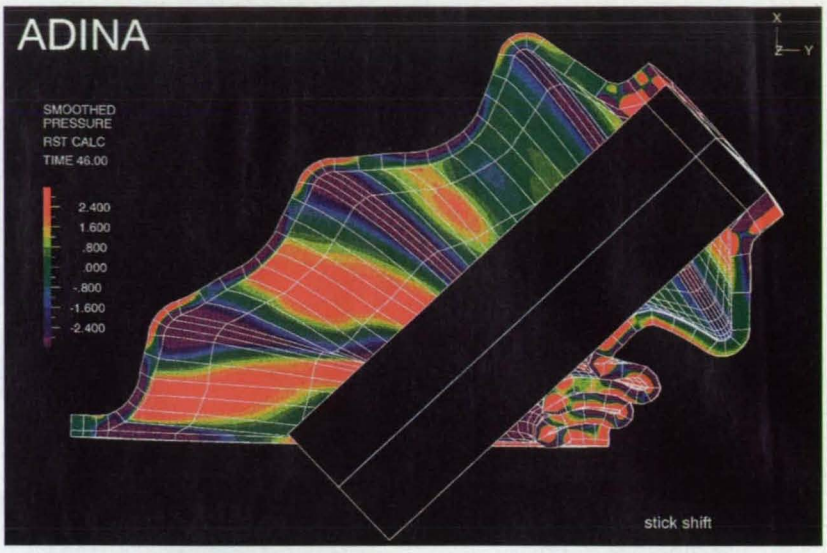
Alacron's FT-Dominator series of scalable high-performance computing subsystems, incorporating an array of up to 8 ADI-2106x SHARC microprocessors and an Intel Pentium controller, are designed for distributed, compute-intensive applications. A single FT-Dominator provides nearly one-GigaFLOP performance in a desktop environment. Interconnected using PMC-compatible FastTrack™ II dataports, Alacron's FT-Dominators serve as nodes on Myrinet System or Local Area Networks.

Alacron's FT-2106x processor boards also incorporate a scalable array of up to 8 Analog Devices' ADSP2106x SHARC processors, delivering very high floating-point performance for the most demanding real-time DSP and imaging applications. Alacron's FT-2106x systems support a wide array of interchangeable I/O modules and framegrabbers.

For more information, contact Alacron, 71 Spitbrook Rd., Suite 204, Nashua, NH 03060; Tel: 603-891-2750; Fax: 603-891-2745.

For More Information Circle No. 755

ADINA R&D, INC.



ADINA R&D, Inc. was founded in 1986. The mission of ADINA R&D is to provide one effective finite element program system–the ADINA System–that can be used to perform comprehensive finite element analyses of structures, fluids, and fluid-structure interactions.

The use of one program system that is fully integrated for structural, thermal, and fluid-flow analyses, and that therefore can be used instead of a series of other analysis codes, provides for a tighter integration of the complete analysis process in the CAE environment, less cost, and higher reliability and effectiveness.

The ADINA System is unique because of its wide range of analysis capabilities. Structures can be modeled as linear or highly nonlinear, including material nonlinearities, thermal effects, large deformations, and contact. Static analysis, frequency solutions, or transient analysis using mode superposition, explicit or implicit time integration, can be performed. Restart from one type of analysis to another is directly possible.

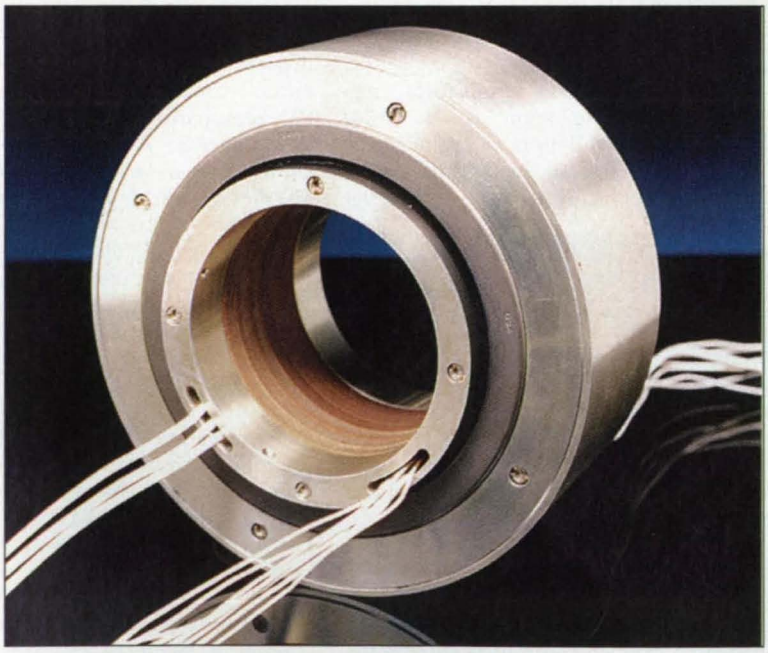
Fluids can be modeled as acoustic fluids, or incompressible or compressible fluids governed by the full Navier-Stokes equations. In fluid flows with structural interactions, completely different mesh discretizations can be employed for the structure and the fluid.

The solvers of the program system are fully supported by the ADINA System pre- and post-processing, including automatic meshing, and the System can also directly be employed with CAD programs such as Pro/Engineer by accessing the geometry, and I-DEAS or PATRAN by using their databases.

The generality, effectiveness, and reliability of the ADINA System are due to the specific finite element procedures, the sparse matrix solution techniques, and parallel processing used. Many of the techniques are described in the textbook *Finite Element Procedures,* by K.J. Bathe (Prentice Hall, 1996).

For More Information Circle No. 756

LITTON POLY-SCIENTIFIC



Litton Poly-Scientific has introduced a new commercial slip ring with a 4-in. through-bore. Advanced manufacturing techniques allow for quick assembly of the exact number of circuits required at a very competitive price.

A slip ring is an electromechanical device for use in any system that requires unrestrained, continuous rotation while transmitting power and/or data from a stationary to a rotating structure.

The AC6098 slip ring is cut to length in groups of three circuits. It can be manufactured with one to 72 signal circuits and one to 24 power circuits. This "stacked module" approach allows for quick assembly of the exact number of circuits required. Unlike most competitive units, the AC 6098 is designed to handle controller signals. In addition, signal/data circuits can be combined with power circuits all in the same assembly. The slip ring can run up to 60 rpm continuous and is sealed against dust and water splash. It's available in single units up to high-volume OEM quantities.

The AC6098 features a 4-in. through-bore that provides routing space for hydraulics or pneumatics, or for a concentric shaft mount, and is particularly well-suited to industrial machinery, medical equipment, exhibit/display equipment and amusement rides, but the applications are endless.

Litton Poly-Scientific is an innovative motion technology products company with design and manufacturing capabilities for slip rings, resolvers, DC motors, and higher-order actuator assemblies.

For more information on the AC6098 or other Poly-Scientific slip rings, call toll-free at 800-336-2112, ext. 279; Fax 540-953-1841; or visit our web site at www.litton-ps.com

For More Information Circle No. 757

DUPONT

Technology Transfer: Too Many Options?

by Randy Guschl, Director, Corporate Technology Transfer, DuPont

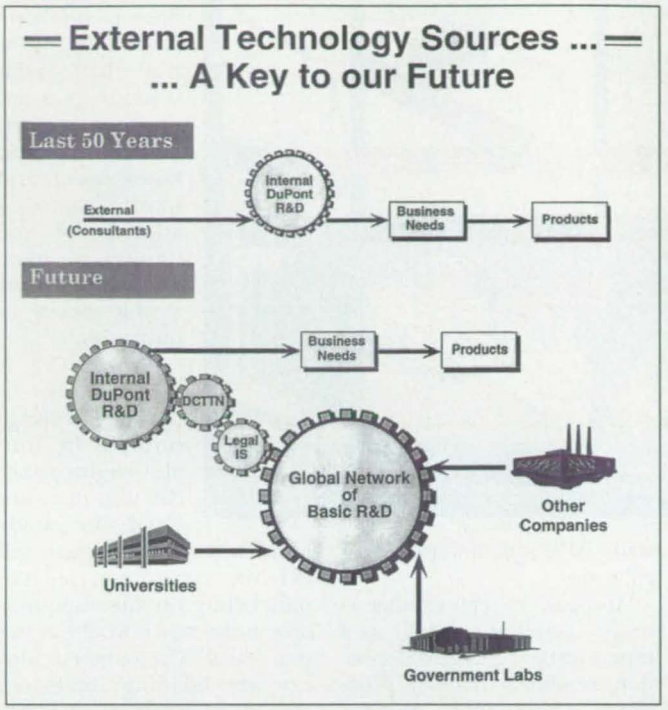
One of the most daunting aspects of the world of external technology is the sheer size of it. I call this the "too many options" syndrome. A company must have a logical sorting process by which it chooses its partners and decides where it is going to work and on what.

Today, corporations cannot afford to have a standing army in every area. No one has a monopoly on expert technology anymore. When all is said and done, however, forget the cost and speed of development. Joint technology development simply yields results neither group could have achieved alone. This argument is probably not being used enough in the context of government-industry-university interface.

The universal ingredient for successful technology transfer is the commitment of management, both technical and business, because building tech transfer relationships takes a long time. Once the process has been started, it needs continuous support from all involved parties. The next key is the scientist-scientist interface. Scientists must get into laboratories, working one-on-one with other scientists, looking for opportunities for tech transfer.

External technology comes from three sources. Universities form one large group, and as a global company, we look to universities worldwide. Government laboratories are the second group. Other companies, discovering the same technologies that we are, make up the third source group.

One way to address the problem of too many options among universities is to pick a few key partners with whom the company does most of its work. Although DuPont will continue to work with almost any university that has a project on which we want to collaborate, we have narrowed our work down to about two dozen "technology partners," targeting areas of research that are of mutual interest.



The problem of too many options pops up again with government labs, which number more than 700 in the U.S. alone. To narrow the field, a company must identify those labs that, from a technology-core competency base, are most like itself. DuPont has done that, and we spend most of our time with about 14 labs. We have had more than 30 Cooperative Research & Development Agreements at one time, mostly with those 14 labs.

A company-company interface works well when one company has already developed a technology that another wants and needs. In this interface, companies share both the research and much of the subsequent development. So, you gain both "R" *and* the "D," instead of only research, which is traditionally the product from a university or government lab.

It's important to talk about success stories. One of my favorites involves our new refrigerants business. DuPont made the switch from its Freon® line of refrigerants to a new family of Suva® refrigerants–from a blank slate to commercial sales from entirely new processes and plants–in four years. That's about half the normal time.

That business faced many obstacles: screening hundreds of compounds, determining which ones to make, testing all of them, creating the flowsheets, building the pilot plants. It worked heavily with government agencies, especially the National Institute of Standards and Technology and the U.S. Department of Energy labs, to decide mathematically which compounds were viable candidates. The chemistry and chemical engineering departments of several universities also did part of the work, identifying the best compounds and drawing up the flowsheets. The question at the end of the day isn't "Why did this work so well?" but "Why can't we do this more often?"

The other side of tech transfer–and the part that's much newer for DuPont–is the licensing out or selling of our underused technologies. DuPont has more than 18,000 active patents, only one-third of which make up the core technologies we use to run our company. We are actively marketing our unused technologies.

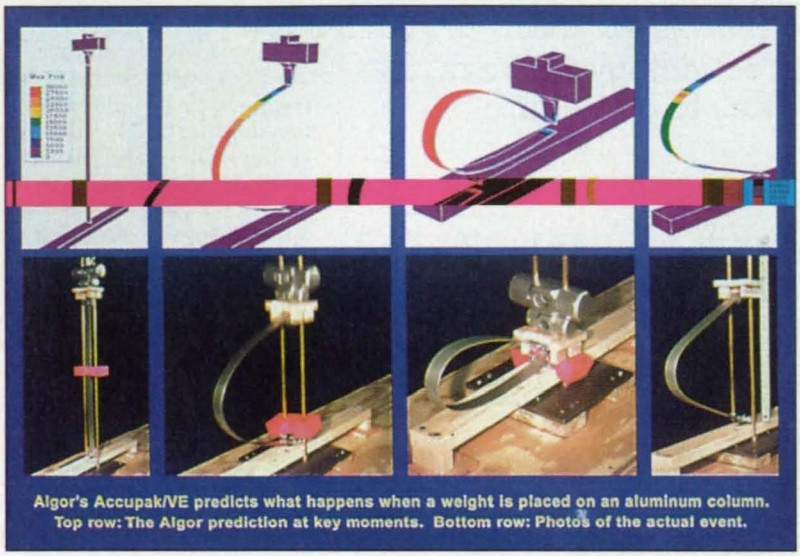
DuPont has doubled our tech transfer activities in the past two years, and we plan to do even more if the right opportunities come around. Our partners must accept the fact that they are competing with others. We are going to work with people who are easy to deal with, can respond quickly, and keep the strategic focus on the partnership. The model we follow favors a global, collaborative approach to R&D in order to extract as much value as possible from all of our intellectual assets.

For more information, contact DuPont Co., Corporate Technology Transfer, P.O. Box 80356, Wilmington, DE 19880-0356.

For More Information Circle No. 758

ALGOR, INC.

Engineers Now Can Conduct Kinematics, Rigid/Flexible Body Dynamics & Nonlinear FEA With One Program



Algor's Accupak/VE predicts what happens when a weight is placed on an aluminum column. Top row: The Algor prediction at key moments. Bottom row: Photos of the actual event.

Algor, Inc. is a leading maker of mechanical engineering finite element analysis and event simulation software for Windows NT/95 and UNIX operating systems, as well as DEC Alpha running Windows NT. More than 16,000 engineers in more than 60 countries use Algor software.

Accupak/VE can simultaneously analyze mechanical events involving large deformation, nonlinear material properties, kinematic motion, forces caused by motion, and stress prediction. Because Accupak/VE does in one program what up to now has taken software from two or more vendors, it will lead to faster, easier, and more accurate analysis of the designs of parts and products for a wide variety of industries.

Accupak/VE is the first ever "virtual engineering" software. In virtual engineering, the user does not need to study numbers to know if a part will fail but, rather, can see the part failing on the computer screen the way it would in the real world. The engineer also can see bending, breaking, contact in a critical or unexpected location, and other mechanical failure.

Before Accupak/VE, an engineer would use separate kinematic, "rigid body" analysis software to predict or determine the loads in a model. These loads would then be transferred to a finite element model for finite element stress analysis. Additionally, if the loads affected the shape of the mechanism, the engineer would have to go back and forth between two programs and two models of the same mechanism. Accupak/VE enables the user to accurately predict motion and conduct stress analysis in the same program at the same time.

For more information on Algor's free VHS video tape featuring Algor software in action, visit Algor on the World Wide Web at http://www.algor.com or send e-mail to info@algor.com; Tel: 412-967-2700; Fax: 412-967-2781.

For More Information Circle No. 759

TEKNOR INDUSTRIAL COMPUTERS INC.

Industrial Computers for Hi-Tech Applications

Teknor is regarded as the most technologically advanced and reliable company in the design and development of industrial single-board computers and systems in the world. In fact, Teknor is the largest manufacturer of highly integrated, high-performance industrial computers aimed at major OEMs and system integrators in the industrial equipment, telecommunication systems, and medical devices markets. With headquarters in Montreal, Canada, and in Florida, and with regional offices in Germany and the USA, Teknor has technical sales representatives and distributors across the globe. Teknor's success stems from unmatched technical support and dedicated customer service, together with superior engineering and excellence in manufacturing at its state-of-the-art ISO-9001-certified facility.

Current Products

Compact PCI Boards & Systems — Compact PCI is going to explode the standard platform in the telecom mega-market and Teknor is there to conquer it. Teknor's Compact PCI computers combine the versatility and reliability of the Eurocard form factor. This unique architecture has built-in power to process real-time data, maintain high availability in mission critical applications, and best of all, it's very affordable.

Pentium Processor-based PCI-ISA Bus Industrial Single-Board Computers — The most recent addition to the industrial SBC line is the Pentium-based PCI series. The PCI single-board computer and passive backplane series offer the telecom and medical systems companies the high throughput offered by PCI bus technology at prices competitive with off-the-shelf PC products.

VIPer 820

Half-Size 386 to Pentium Processor-based ISA Bus Industrial Single-Board Computers — The VIPer SBC series takes integration one step further by adding PC/104 expansion ability, SCSI, Enhanced IDE, Flash & Ethernet options, and local bus SVGA video with simultaneous flat panel and CRT operations. The VIPer series is ideal for embedded or small passive backplane applications that require full PC functionality in a compact package. Typical applications include mobile data acquisition systems and in-vehicle GPS systems.

High-Integration Real-Time Video Interface Module — The VIPer Vision TEK-380 adds real-time imaging functionality to Teknor's industry-leading VIPer single-board computers. It produces high-quality video for LCDs and analog CRT screens while occupying no bandwidth at the system bus level.

VIPer Vision TEK-380

For more information, contact Teknor Industrial Computers Inc., 7900 Glades Road, Boca Raton, FL 33434; Tel: 561-883-6690 or 800-387-4222; Fax: 561-883-6690; www.teknor.com.

For More Information Circle No. 760

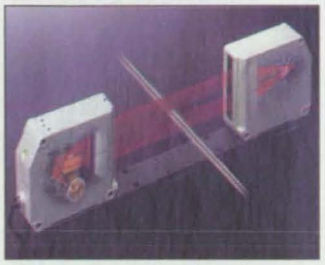
KEYENCE CORPORATION OF AMERICA

New Laser Scan Technology Provides High-Speed, Sub-Micron Measurements

The recently introduced Keyence LS-5000 Series Laser Scan Micrometer Systems set new standards in precision laser measurement. By employing a newly developed 12-sided polygon mirror and a high-precision motor, Keyence has achieved a high-speed, precision measurement system with a 1200 cps scan rate – three times that of conventional designs.

The new design provides the extra performance required to continuously measure extruded, moving, and vibrating products such as diameter measurement of wire drawn from extrusion dies, measurement of surface vibration and runout of magnetic and optical disk storage devices, and diameter of transparent objects on fast-moving production and inspection lines.

Together with increased calculation speed and precision, the new LS-5000 series achieves a resolution of 0.05 µm, twice that of conventional systems, making it possible to offer stable, precise measure-



ments in the sub-micron range. The measurement area (beam width) of the LS-5000 extends from 0.2 mm to 40 mm, allowing precision measurements throughout a wide range of target sizes and shapes. Additionally, Keyence recently introduced a modified version of the LS-5000 with a super-wide beam which extends the measurement area to 120 mm.

Touch Screen, Menu-Driven User Interface

A unique touch screen display employing a menu-driven user interface (an industry first) simplifies setup and operation. A HELP facility guides the user. The LS-5000 Series Controller processes data from up to 4 sets (transmitter and receiver) of scan heads, permitting great application flexibility. The Controller Module stores settings for up to 16 measurement programs.

How the LS-5000 Laser Scan Micrometer Works

In each LS-5000 transmitter head, a semiconductor laser projects a beam onto a 12-sided, rotating cylindrical mirror. An object in the path of the beam reflected off the mirror causes a "shadow," thus reducing the quantity of light entering the receiver sensor head. The total amount of light is focused onto a photodiode, creating a signal proportional to the light quantity.

LS-5000 Measurement Modes and Functions

Five measurement modes are built into the LS-5000. Included are DIAMETER (measurement of outside diameter); GAP (measurement of gap between objects); PITCH (measures the center pitch or alignment of connector pins or similar objects, up to a maximum of 100 objects); HEIGHT (measurement of object height); and EDGE (measurement of edge position).

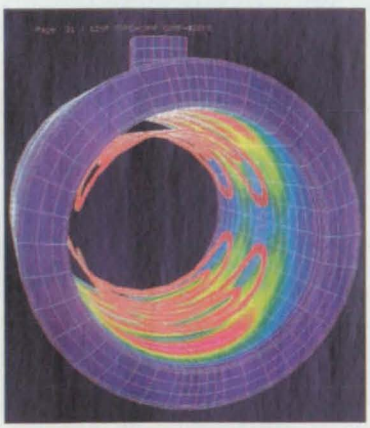
For more information, contact Keyence Corporation of America, 50 Tice Boulevard, Woodcliff Lake, NJ 07675; Tel: 201-930-1400; Fax: 201-930-0088; e-mail: keyence@keyence.com; http://www.keyence.com

For More Information Circle No. 761

VECTOR FIELDS INC.

Software for Electromagnetic Design

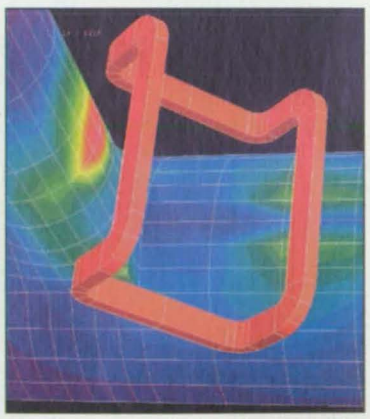
Vector Fields is a leading independent specialist company dedicated to the development and application of



computer software for the design and analysis of electromagnetic devices and systems. The unique expertise within the company has been built up over many years by research, software development, and the application of computer-aided engineering in industry. Users of the Vector Fields OPERA suite of software include many of the world's largest corporations, government research laboratories, and successful companies. They all have one thing in common: the need to use the best available techniques for electromagnetic design.

Although Vector Fields software is at the forefront of technology, it is in daily use in design offices and research laboratories around the world. Many of the leading corporations in the USA have recognized the benefits of using advanced analysis techniques and are using Vector Fields software for the design of products as diverse as proximity sensors, magnetic recording heads, electrical machines, N.D.T. equipment, loudspeakers, MRI body scanners, X-ray tubes, CRTs, thin-screen displays, and klystrons. The ability to compute electromagnetic performance with confidence using Vector Fields software allows the evaluation of alternative designs at the conceptual stage before committing further resources to a project.

The G.U.I. of the OPERA pre- and post-processor is dedicated to electromagnetic computation and provides efficient, user-friendly data input with versatile results display. When combined with well-proven analysis modules such as TOSCA, ELEKTRA, SOPRANO, and SCALA, OPERA offers designers a powerful analysis environment. The software is accompanied by a technical support service, which is recognized as being second to none. Versions of all software are available for most computer systems, including PCs and



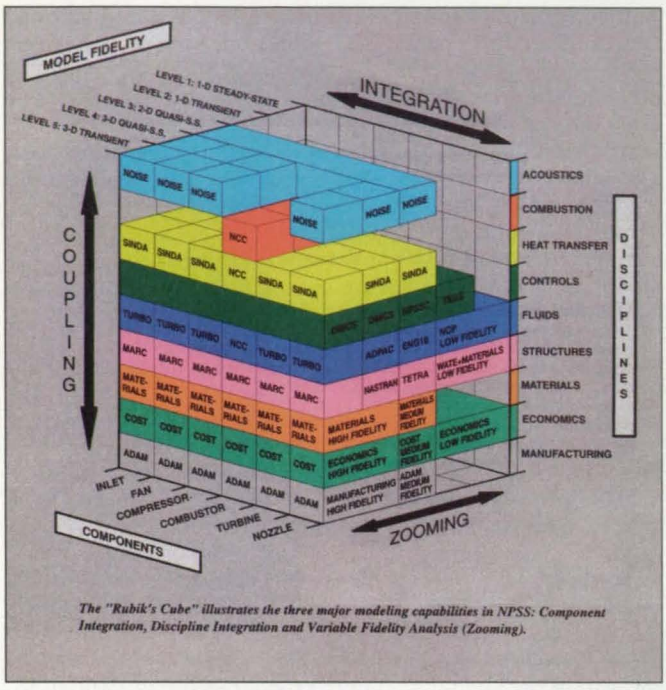
workstations, providing users with a most effective tool for accurate electromagnetic design today, for tomorrow's products.

For more information, contact Vector Fields, 1700 North Farnsworth Ave., Aurora, IL 60505; Tel: 630-851-1734; Fax: 630-851-2106; e-mail: info@vectorfields.com; http://www.vectorfields.com

For More Information Circle No. 762

MARC ANALYSIS RESEARCH CORPORATION

MARC Analysis Enables Virtual Manufacturing



The "Rubik's Cube" illustrates the three major modeling capabilities in NPSS: Component Integration, Discipline Integration and Variable Fidelity Analysis (Zooming).

In a recent article in *NASA InSights,* this diagram illustrated the methodologies used by aircraft engine manufacturers for the numerical simulation of propulsion systems in a high-performance computing environment. The diagram shows a matrix of engine components, model fidelity, and disciplines used in the simulation of these complex systems.

Once again, NASA and its suppliers are leading the way. This time, it is the Virtual Manufacturing revolution. As defined in a MARC white paper on the topic, Virtual Manufacturing involves the use of a computer to simulate not only a product, but the processes involved in its fabrication. This is a major change that eventually will affect all companies involved in design and manufacturing. But the NASA experience shows that this is not just a dream, but a reality in a wide variety of complex engineering simulations.

MARC is leading the way in the Virtual Manufacturing revolution. The ability to provide accurate simulations of complex, nonlinear phenomena is helping this revolution to take place. The broad structural analysis capabilities of MARC make this possible with features ranging from automated three-dimensional contact between components and even self-contact, to coupled analysis of structures involving large deformations, thermal analysis, and fluid flow. Providing this level of computational power in a parallel processing scalable environment means that simulations never before possible are now becoming a standard part of the design process for many companies.

Today's designers require simulation tools to fully understand the implications of design tradeoffs. MARC is working to provide these tools. Visit MARC Analysis Research Corp. at www.marc.com

For More Information Circle No. 763

NATIONAL TECHNOLOGY TRANSFER CENTER

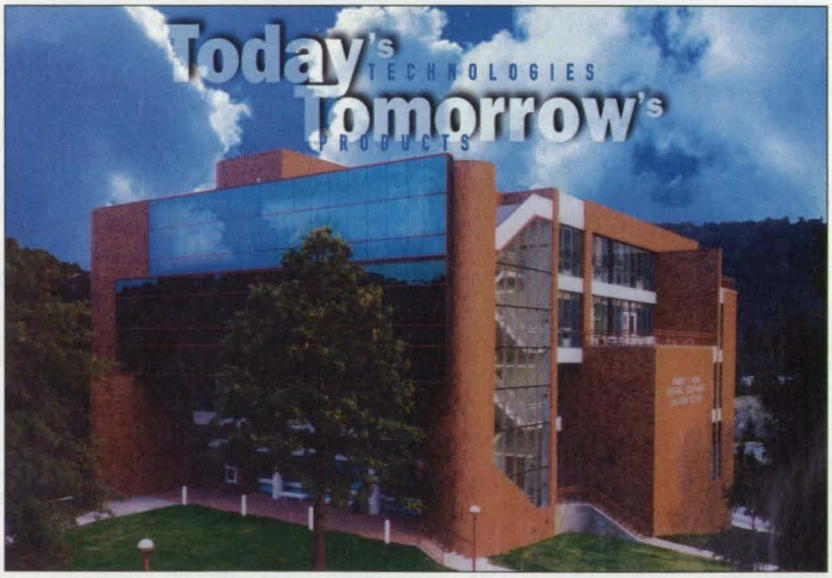
The National Technology Transfer Center, part of the NASA Commercial Technology Network since 1991, is a full-service technology commercialization center that transforms today's technologies into tomorrow's products by presenting effective ways to help U.S. corporations and taxpayers get access to and use federally-financed technologies.

NTTC helps federal laboratories and companies identify technologies with market potential and match these technologies with companies that can turn them into new products and processes for America.

NTTC assists in the assessment of the commercial potential of research. NTTC builds integrated commercial assessment teams; applies a systematic approach to technology assessment; identifies the most commercially-viable technologies; and helps license and market technologies targeted for commercialization.

NTTC maintains the largest database of federally-funded technologies in the U.S. This information retrieval system gives access to more than $70 billion in federally-funded research and 100,000 researchers at more than 700 federal laboratories and more than 100 universities. NTTC's Gateway Services links clients to the federal laboratory system resources that best match their needs and updates them on the hottest technologies.

NTTC courses and information products focus on the entire technology transfer and commercialization process or any piece of that process. Taught by nationally-recognized experts, they cover a variety of topics from the basics of technology transfer, to assessing technologies, to negotiating deals, to finalizing licensing agreements.



NTTC works with many federal entities as well as universities, entrepreneurs, and Fortune 500 companies.

For more information, call 800-678-6882 or visit the NTTC web site at http://www.nttc.edu

For More Information Circle No. 764

DIGI-KEY CORPORATION

It started in 1972—an idea—a new concept in distribution. Today, Digi-Key represents one of the fastest-growing electronic component distributors in the United States. At Digi-Key, service is the key! This customer-centered business philosophy has positioned Digi-Key as the industry-recognized leader among distributors when it comes to service.

Serving the customer ultimately begins with the Digi-Key catalog. It is updated and expanded every 60 days to accommodate constant product-line expansion and provide accurate, up-to-date pricing.

Complementing this printed catalog is an electronic media presence that will continue to make the customer's job more efficient. Digi-Key's World Wide Web site has earned recognition by *Electronic Business Today* as one of the best among distributors.

Digi-Key customers are provided with real-time stock status and order entry. An intelligent conveyor system is the basis for an order fulfillment system among the most efficient in the entire world. Fully supervised by Digi-Key's host computer, the conveyor flawlessly routes orders through more than a mile of conveyor. This highly automated approach to order fulfillment allows orders to be processed in as little as 30 minutes! And the entire process—from order entry to shipping—is ISO 9002 certified. Based on independent research conducted by several well-respected trade publications, Digi-Key is the industry's consistent leader when it comes to service!

We believe Digi-Key provides the best service in the industry with a 30% compound annual rate of sales increase over the past 20 years—not as a result of acquisition. There is perhaps no greater testimony to the quality Digi-Key provides its customers. We feel it is this unparalleled level of service that differentiates Digi-Key from other distributors.

For your free catalog, call, write, fax, or visit us on the Internet. Digi-Key Corporation, 701 Brooks Ave. South, Thief River Falls, MN 56701; Tel: 800-344-4539; Fax: 218-681-3380; http://www.digikey.com

For More Information Circle No. 765

BENTLEY SYSTEMS, INC.

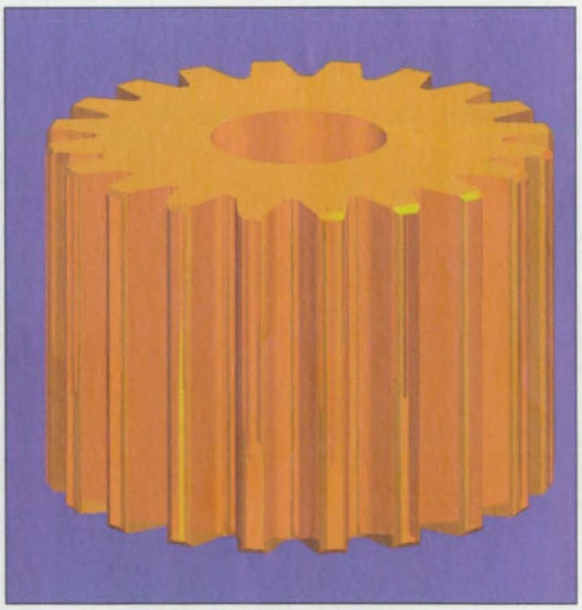
A Stream of Continuous Improvements

Installing a major software upgrade often causes a severe drop in productivity. Bentley, a worldwide leader in engineering software and user services, now delivers software enhancements in a stream of continuous improvements: more frequent upgrades that improve software without interrupting ongoing work. For example, Bentley's MicroStation Modeler, a comprehensive tool for the fast production of 2D and 3D mechanical engineering models, was recently enhanced with an analysis package.

More than 100,000 of the 250,000 users of Bentley software are subscribers to Bentley SELECT℠, the industry's first technology and service subscription program. They receive continuous improvement software enhancements delivered through quarterly CD-ROMs–and on Bentley's SELECT Stream℠ Web pages the day they are certified. Subscribers avoid the hassle of implementation of a monolithic new version, the weighty investment and the delay in implementing small innovations.

For example, design engineers using MicroStation Modeler, without interrupting their work, can now add SRAC's new COSMOS/M DESIGNER ONE™ design analysis software for stress problems with automatic meshing, full visualization with animation, and the fastest analysis solution technology available—COSMOS/FFE® (Fast Finite Element).

Another feature recently delivered in the SELECT Stream is integrated surface modeling, which lets industrial designers and mechanical designers in the automotive and aerospace industries sketch free-form, rather than having to specify details as they draw.



Other improvements to MicroStation Modeler delivered in the SELECT Stream are an integrated Web browser, enhanced editing of parametric profiles, assembly sectioning, advanced blending, enhanced bill of materials generation, and many more.

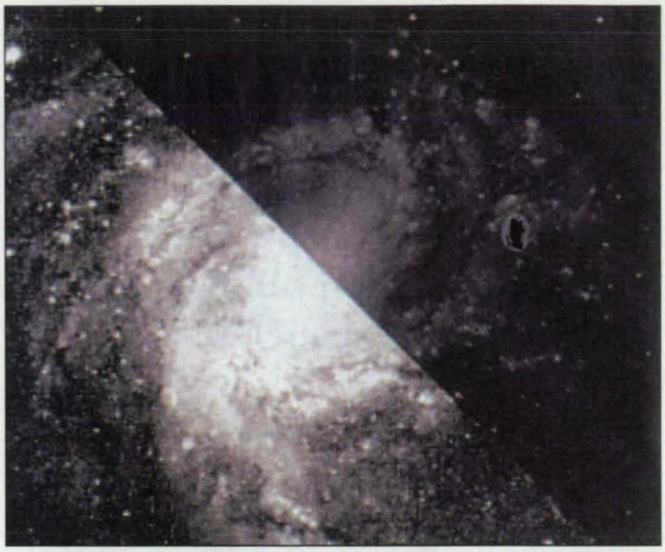
For more information about Bentley SELECT, MicroStation Modeler, or other Bentley products, call Bentley at (800) BENTLEY, visit Bentley's Web site at www.bentley.com, or send e-mail to family@bentley.com

For More Information Circle No. 766

THE MATHWORKS, INC.

The MathWorks, Inc., located in Natick, Massachusetts, was established in December 1984 to develop and market interactive engineering and scientific software products. The founders of The MathWorks recognized the need among engineers and scientists for more powerful computing environments beyond those represented by Fortran and C. In response to that need, they combined their expertise in mathematics, engineering and computer science to develop MATLAB®. MATLAB is a high-performance, technical computing environment that provides comprehensive math and graphics, specialized application toolboxes, and a powerful structured programming language. MATLAB offers hundreds of convenient, built-in functions that users can customize and extend as needed. Users can also link in their existing C, C++, and Fortran programs. The MATLAB Compiler, and C and C++ Math Libraries allow users to automatically convert their MATLAB programs into portable C or C++ code for stand-alone applications that run outside of the MATLAB environment. MATLAB files and user-written applications are portable across PC, Macintosh, and UNIX workstation platforms.

Simulink®, built on the MATLAB technical computing environment, is an interactive system for analyzing, modeling, and simulating dynamic nonlinear systems. Stateflow™, a major new product addition to the Simulink environment, is a graphical tool for designing complex reactive, event-driven systems based on finite state machine theory. The combination of Simulink and Stateflow offers practical design and analysis tools for such industries as automotive, aerospace, and communications.



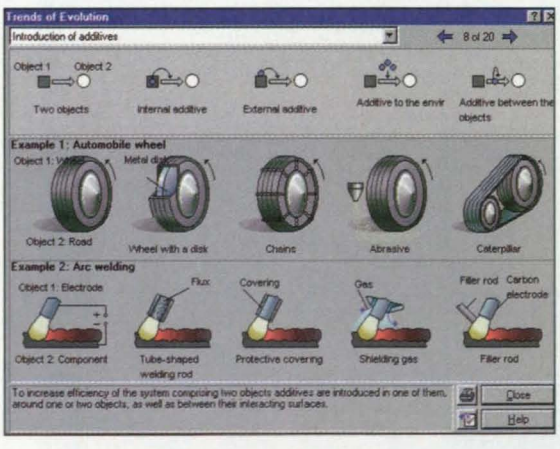
MATLAB Toolboxes and Simulink Blocksets extend the power of MATLAB by providing algorithms and functions developed by experts in digital signal processing, control system design, image processing, symbolic math, finance, statistics, mapping, neural networks, system identification, optimization, and other application areas.

NASA engineers and scientists nationwide have adopted MATLAB for several mission-critical research and design projects, including the next-generation High Speed Civil Transport.

For More Information Circle No. 767

INVENTION MACHINE CORP.

Founded in 1992, Boston-based Invention Machine Corporation is the leading provider of software tools which enable engineers, scientists, and technologists to extend their knowledge and capability to solve technical problems by generating innovative ideas. Invention Machine's revolutionary software tools provide users with a standardized approach for the development of high-quality, well-designed products and processes.



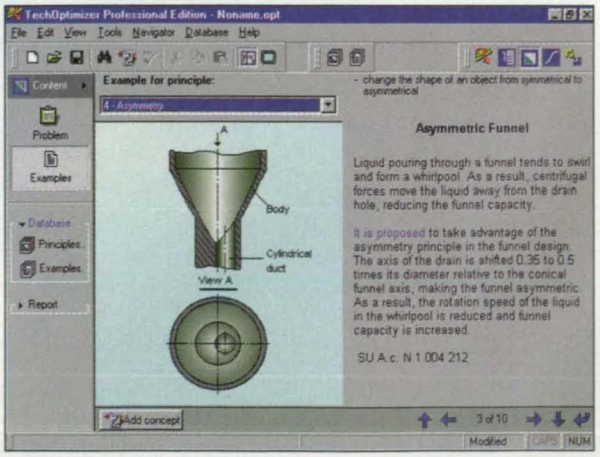
By providing innovative software applications, Invention Machine Corporation has a vision to be the technological leader that changes the way companies develop products and processes.

Invention Machine Corporation also offers training courses on the software, and engineering consulting to corporate clients who wish to obtain value in new technology ownership, cost reductions, and new product/process development.

TechOptimizer Professional Edition is an innovative software tool that is designed to work with engineers in the conceptual stages of product and process development. TechOptimizer Professional Edition defines a new category of engineering software–Computer Aided Innovation (CAI). This software tool offers the user a standardized way to state and solve technical problems in the conceptual stage of product/process development. This software application gives a breakthrough process for strategic and guided thinking to create innovative and cost-conscious solutions.

For more information, contact Invention Machine Corporation, 200 Portland Street, Boston, MA 02114-1722; Tel: 617-305-9250; Fax: 617-305-9255; e-mail: info@invention-machine.com; Web site: www.invention-machine.com

For More Information Circle No. 768



ENTERPRISE SOFTWARE PRODUCTS, INC.

Overview

Enterprise Software Products, Inc. (ESP) develops, markets, supports and provides training for FEMAP, the price-performance leader in CAE modeling and results evaluation for the engineering desktop. The FEMAP product line has built a reputation as an easy-to-use finite element pre- and post-processor that performs effectively on personal computers. Finite element models can be prepared quickly and easily to be analyzed by a large number of commercial finite element solvers. Resulting product performance in terms of stress, deflection, temperature, and dynamic response can be evaluated to improve product reliability and cost factors. The company works closely with its CAD and FEA technology partners to provide easy-to-use and sophisticated tools for the CAE professional. As the value leader in finite element pre- and post-processing, FEMAP can also help reduce software costs. With a commitment to ongoing improvements in CAD data transfer and support of advanced simulation technologies, FEMAP is increasingly being regarded as a company-

ion to the high-end FE systems traditionally available on UNIX workstations and supercomputers.

Functionality

FEMAP provides a consistent working environment to enable technical professionals to develop sophisticated simulation of mechanical product performance quickly and efficiently on the engineering desktop.

Geometry or finite element models can easily be created using the bottom-up construction techniques popular for many conceptual modeling applications. As a complement, complex CAD geometry may be accessed directly in Parasolid, ACIS, or IGES formats.

To support conceptual-level analyses, a powerful beam cross-section library is included. This library improves productivity and accuracy by enabling the user to automatically calculate inertial properties and also provides visual feedback for beam orientation.

A material library is included, which users may also customize to meet their specific applications.

The finite element mesh can be developed using direct generation of elements, mapped automatic meshing, or free meshing of surfaces and solids.

Once the finite element model is prepared in FEMAP, stress, deflection, temperature, heat flow, and dynamic performance can be solved by a wide range of commercial FEA solvers. As application requirements change and as new solver technologies emerge, you can easily integrate these technologies while remaining in the familiar FEMAP environment. FEMAP supports a very broad range of commercial FEA solver technologies, including many advanced features for market-leading codes such as ABAQUS, ANSYS, or MSC/NASTRAN. A neutral file and customization scripting language are also available to support the integration of company- or industry-specific solver technologies into a single, consistent CAE environment.

For more information, contact Enterprise Software Products, Inc., 415 Eagleview Blvd., Suite 105, PO Box 1172, Exton, PA 19341; Tel: 610-458-3660; Fax: 610-458-3665; e-mail: femap@entsoft.com

For More Information Circle No. 769

LITERATURE SPOTLIGHT

Free catalogs and literature for NASA Tech Briefs' readers. To order, circle the corresponding number on the Free Information Request Card following page 80.

CHANNEL K DATA ACQUISITION CATALOG

Keithley MetraByte's 1997-1998 Channel K Data Acquisition Catalog and Reference Guide offers 288 pages of product descriptions, technical information, and applications. Features data acquisition products such as the new USB-compatible high-accuracy data modules, high-speed multifunction ISA and DSP-equipped PCI boards, PCMCIA cards, serial and IEEE-488 communications interfaces, board-level instruments, software, and accessories. Keithley Instruments, Inc., 28775 Aurora Rd., Solon, OH 44139-1891; 1-888-KEITHLEY; Fax: 216-248-6168; http://www.keithley.com

Keithley Instruments, Inc.

For More Information Circle No. 461

MOTION CONTROL

Oregon Micro Systems' new motion control product guide – a full line of multi-axis controllers with up to 8 axes on a single board. Thanks to exclusive patented technology, OMS motion controllers have higher reliability and lower costs. Shipment is from stock for immediate delivery. Oregon Micro Systems Inc., 1800 NW 169th Place, Ste. C100, Beaverton, OR 97006; Tel: 503-629-8081; Fax: 503-629-0688.

Oregon Micro Systems Inc.

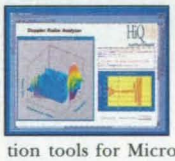
For More Information Circle No. 462

NEW SENSORS CATALOG

New catalog describes load, force, and torque sensors. Gram Sensors: from 10 to 1K grams; Load Cells: to 400K lbs.; Load Buttons: to 50K lbs.; Thru Hole Load Cells: to 30K lbs.; Torque Sensors: to 50K in/lbs.; and Load Pins. Transducer Techniques Inc., 43178 Business Park Dr., Temecula, CA 92590; Tel: 909-676-3965; Fax: 909-676-1200; e-mail: tti@ttloadcells.com; http://www.ttloadcells.com

Transducer Techniques Inc.

For More Information Circle No. 463



FREE HIQ EVALUATION SOFTWARE

National Instruments offers HiQ® for Windows, featuring ActiveMath™ and visualization tools for Microsoft Office. HiQ on Windows NT or Windows 95 uses ActiveX™ (OLE) for integration with Microsoft Office and Microsoft's OpenGL 3D graphics library making advanced technical calculation, data visualization, and documentation solutions more cost-effective and simpler for technical professionals. Call for free HiQ evaluation software. National Instruments, 6504 Bridge Point Pkwy., Austin, TX 78730; Tel: 512-794-0100 or 800-433-3488; Fax: 512-794-8411; e-mail: info@natinst.com; http://www.natinst.com

National Instruments

For More Information Circle No. 464

QUALITY ALUMINUM CASTINGS

This newly updated, full color brochure illustrates permanent mold aluminum casting, a process best suited for high-strength, high-quality products ranging from a few ounces to several hundred pounds with yearly production runs of 3000 or more. Explanations of the complete in-house machining, engineering and tooling Stahl can provide are also included. Stahl Specialty Co., Kingsville, MO 64061; Tel: 800-821-7852.

Stahl Specialty Company

For More Information Circle No. 465

S-VHS CASSETTE DATA RECORDERS

New datapack on Avalon's 1997 range of high-performance recorders. Analog recording to 12 MHz. Digital recording to 8 Mbps. Single- and multi-channel units for static, mobile, and MIL-SPEC applications such as intelligence gathering, ASW, wideband telemetry, radar signature recording, etc. Avalon Electronics, Inc., 98 Blacks Mill Drive, Dawsonville, GA 30534; Tel: 800-797-1337; Fax: 706-216-2485; e-mail: avelinc@stc.net; http://www.aval.demon.co.uk/avalon

Avalon Electronics, Inc.

For More Information Circle No. 466

PC-BASED JTFA TECHNIQUES

Learn how to use PC-based joint-time-frequency analysis (JTFA) techniques with the National Instruments Joint Time-Frequency Analysis Application Note, to achieve more precise time and frequency domain resolution than traditional FFT-based measurements. PC-based JTFA techniques solve diverse signal processing, biomedical, vibration, sound, and noise analysis applications. National Instruments; Tel: 512-794-0100 or 800-433-3488; Fax: 512-794-8411; e-mail: info@natinst.com; http://www.natinst.com

National Instruments

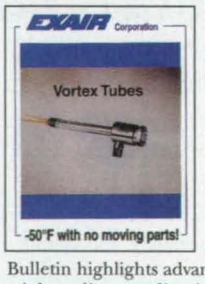
For More Information Circle No. 467

SENTRY™ SERIES BRUSHLESS SERVOMOTORS

New selection guide provides detailed specifications and selection information for these high-performance servomotors. SENTRY servomotors feature the industry's highest torque per frame size. Available in NEMA 23 and 34 frame sizes, SENTRY servomotors meet the most demanding torque, velocity, and/or positioning applications with a medium inertia design for improved load matching. Pacific Scientific, Motor Products Division, Rockford, IL; Tel: 815-226-3100; Fax: 815-226-3080.

Pacific Scientific, Motor Products Division

For More Information Circle No. 468



VORTEX TUBES

Data sheet describes how EXAIR Vortex Tubes produce up to 10,000 Btu/hr. with no moving parts. Tubes convert an ordinary supply of compressed air into two streams: one hot and one cold. Temperatures are adjustable from -50° to +250°F. Bulletin highlights advantages for a variety of industrial cooling applications. EXAIR Corporation, 1250 Century Circle North, Cincinnati, OH 45246; Tel: 800-903-9247; Fax: 513-671-3363; e-mail: techelp@exair.com; http://www.exair.com

EXAIR Corporation

For More Information Circle No. 469

IMAGINATION SYSTEMS' HYPERKERNEL

The Hyperkernel is the first product that enables software developers to implement deterministic real-time system applications that execute with Windows NT. Supporting Windows NT 4.0 and 3.51, Hyperkernel enables devices such as robots, process controllers, and machine control systems to be configured as application servers on any standard network system, reducing software development time. Imagination Systems Inc., 5752 Princess Anne Rd., Virginia Beach, VA 23462; Tel: 800-331-2565 or 804-497-8200; Fax: 804-497-2062; http://www.imagination.com

Imagination Systems Inc.

For More Information Circle No. 476

OPENCONTROL

OpenControl is machine control software that replaces proprietary PLCs while enabling enterprise access to the factory floor. The flexibility and high performance provide a competitive advantage by reducing overall life-cycle costs of control equipment and optimizing productivity. NemaSoft, 55 West St., Walpole, MA 02081; Tel: 800-636-2876 or 313-994-0591; Fax: 313-994-8074.

NemaSoft

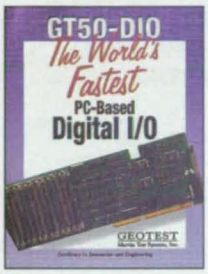
For More Information Circle No. 477

ADVANCED COMPOSITE TRAINING

The industry leader in advanced composite training since 1983, Abaris Training offers engineering-level courses in design and analysis of composites: Introduction to Laminate Design, Structural Analysis and Repair Design, Design and Analysis of Composite Structural Joints, and Composite Crack Patching of Aluminum Airframes. We also offer introductory-level courses and practical workshops in fabrication and repair. Abaris Training Resources Inc.; Tel: 800-638-8441; Fax: 702-827-6599; e-mail: cn@training.abaris.com; www.training.abaris.com

Abaris Training Resources, Inc.

For More Information Circle No. 478



GT50-DIO DYNAMIC DIGITAL I/O

Now, for the first time, PC-based high-speed digital testing is possible. The GT25/50-DIO provides the latest state-of-the-art digital testing capability for PC-based systems. Main features include: programmable test rates up to 50MHz, 32 to 256 bidirectional I/O pins, up to 1 Mbit memory behind each pin, powerful sequencer, and triggering mechanism. Geotest; Tel: 800-330-9774; www.geotestinc.com

Geotest, Inc.

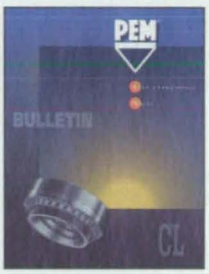
For More Information Circle No. 479

AVIONICS COMMUNICATIONS SOLUTIONS

Request your FREE info-pack on Systran's complete line of avionics communications solutions. Board-level products include replicated shared-memory network interfaces, Fibre Channel host bus adapters and switches, I/O IP modules, and 1553 products. Support is available for various buses such as VMEbus, VXIbus, Sbus, GIO, EISA, ISA, PCI, PMC, and PCMCIA. Systran Corp.; Tel: 937-252-5601 or 800-252-5601; Fax: 937-258-2729; e-mail: info@systran.com; http://www.systran.com

Systran Corp.

For More Information Circle No. 480



SELF-CLINCHING NUTS (BULLETIN CL)

PEM® self-clinching nuts provide load-bearing threads in thin sheets of aluminum, steel, or other ductile materials. Installation is simple, quick, and convenient. Just insert them in punched or drilled holes, then apply a squeezing force to embed the clinching ring completely in the thin sheet material. Penn Engineering & Manufacturing Corp., Danboro, PA; Tel: 800-237-4736; http://www.pemnet.com

Penn Engineering & Mfg. Corp.

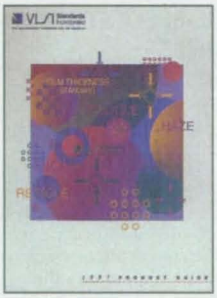
For More Information Circle No. 481

INSTRUMENT DATA ACQUISITION

The SoftwareWedge™ directs serial (RS-232, RS-485, RS-422) data from any instrument into any Windows 3.x, 95, or NT application such as Excel, MMIs, VB, Control, and Statistical applications. This configurable driver provides full data acquisition and control of PLCs, data loggers, scales, flow meters, lab instruments, etc. Please contact TAL Technologies, Inc., 2027 Wallace St., Philadelphia, PA 19130; Tel: 800-722-6004 or 215-763-7900; Fax: 215-763-9711; http://www.taltech.com

TAL Technologies, Inc.

For More Information Circle No. 482



1997 CALIBRATION STANDARDS CATALOG

All new free 1997 catalog of metrology calibration standards for surface contamination, critical dimensions, film thickness, surface profiling, roughness, resistivity, and much more. All important for ISO 9000 certification. Also, valuable information on calibration science and services. VLSI Standards, 3087 North First St., San Jose, CA 95134; Tel: 408-428-1800; Fax: 408-428-9555.

VLSI Standards

For More Information Circle No. 483

VXI PRODUCTS

The new HP Systems Builder's Source includes comprehensive technical information for the most complete selection of test system components available. Test system and VXI components, HP VEE - the graphical programming language for test engineers - and custom system integration services are detailed for solutions in electronic manufacturing test and data acquisition applications ranging from telecommunications to automotive. For a FREE catalog and CD-ROM, call Hewlett-Packard at 800-452-4844, ext. 1803.

Hewlett-Packard

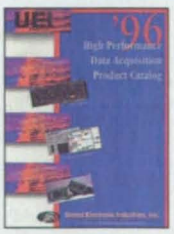
For More Information Circle No. 484

VESPEL® POLYIMIDE PARTS & SHAPES

DuPont Vespel® parts offer reliability and durability for semiconductor manufacturing. These high-performance components can reduce costs through longer life and extended maintenance intervals versus quartz and ceramics. Vespel® parts perform at high temperatures, resist chemical attack, and exhibit superior cleanliness, dimensional stability, and dielectric performance. Applications include clamping rings and other "in chamber" applications, wafer handling and processing, and IC handling and testing. DuPont Engineering Polymers, Barley Mill Plaza, Bldg. 22, PO Box 80022, Wilmington, DE 19880-0022; Tel: 800-972-7252.

DuPont Engineering Polymers

For More Information Circle No. 485



FREE DATA ACQUISITION CATALOG

UEI's catalog gives you full specs for data acquisition boards that are DSP-enhanced and provide 16 channels at 1 MHz continuous A/D. Options include on-board simultaneous sampling and individual prog. gain amplifiers for all channels. Also available: 16 bits at 200,000 samples/sec. Describes UEI's new PowerDAQ™ boards for the PCI bus, incorporating a 66 MHz DSP and bus-mastering data transfer. UEI, 10 Dexter Ave., Watertown, MA 02172; Tel: 800-829-4632; Fax: 617-924-1441; www.ueidaq.com

United Electronic Industries

For More Information Circle No. 486

EXTERNAL SURFACE AREA ANALYSIS

PMI's Windows-based Envelope Surface Area Analyzer (WESA) offers a simple, fast, and reliable technique for external surface area measurement - a measurement not readily achieved by static nitrogen adsorption (BET) methods. The WESA's innovative use of flow permeametry, combined with its sophisticated, self-adjusting viscous-flow controller, enables testing of a wide range of powder samples, including materials with surface areas of only several square meters per gram. Porous Materials, Inc., 83 Brown Rd., Ithaca, NY 14850; Tel: 800-TALK-PMI; www.pmiapp.com

Porous Materials, Inc.

For More Information Circle No. 487

WORKBENCHES & SYSTEMS CD-ROM CATALOG

This interactive multimedia presentation covers Teclab's complete line of workbenches and laboratory systems furniture. Designed for Windows™, the CD-ROM presentation features hundreds of benches, including complete product specifications. Meeting the Challenge, Teclab's introductory video presentation, highlights unique features and benefits of a Teclab bench. You select what you want to see by simply clicking on the icons that interest you. Teclab, 6450 Valley Industrial Drive, Kalamazoo, MI 49009; Tel: 800-832-5227; Fax: 616-372-6116; http://www.teclab-bench.com

Teclab

For More Information Circle No. 488

THE SPECIALTY BULB CO. INC.

Call us to interchange and identify any lamp. We are a highly specialized light source distributor with the technical ability to meet the individual requirements of its customers and research institutes. We stock European, Domestic, and Far Eastern bulbs for all industries. The Specialty Bulb Co. Inc.; Tel: 516-589-3393 or 800-331-BULB (2852); Fax: 516-563-3089 (24 hrs.); e-mail: spbulb@aol.com; www: http://members.aol.com/spbulb

The Specialty Bulb Co., Inc.

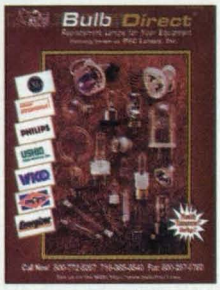
For More Information Circle No. 489

LIQUID NITROGEN CONTROLLERS & PROBES

Teragon offers LN_2 sensors, level transducers, level controllers, and complete auto-fill systems. Features include digital displays, current and voltage outputs, alarms, RS232 and transfer hardware. Designed for the user, these level solutions are economical, reliable and easy to install. Teragon Research, 2518 26th Ave., San Francisco, CA 94116; Tel: 415-664-6814; Fax: 415-664-6745.

Teragon Research

For More Information Circle No. 490



FREE LAMP CATALOG

Bulb Direct, Inc. sells replacement specialty lamps for A/V, photographic, stage, studio, video, micrographic, and graphic arts equipment, plus medical and electronic instruments. We offer brand names with two-day air delivery at no extra cost! New this year...Specialty Energizer Batteries. Bulb Direct Inc., 1 Fishers Rd., Pittsford, NY 14534-9511; Tel: 800-772-5267 or 716-385-3540; Fax: 716-385-4976.

Bulb Direct, Inc.

For More Information Circle No. 491

INTERNALLY GAGED FORCE TRANSDUCERS

Catalogs describe a complete line of force transducers manufactured by Strainsert. Transducers include: flat load cells, tension and compression from 250 to 2 million pounds; clevis pins with 0-10 vdc and 4-20 ma outputs; tension links up to 400,000 pounds; load-sensing bolts and studs; and load indicators. "Special" designs are invited. Strainsert, Union Hill Industrial Park, West Conshohocken, PA 19428; Tel: 610-825-3310; Fax: 610-825-1734.

Strainsert

For More Information Circle No. 492

PREMIER TO THE 21ST CENTURY™

OMEGA Engineering is proud to announce the release of its latest Data Acquisition Handbook, "The Universal Guide to Data Acquisition and Computer Interfaces - Premier to the 21st Century™ Edition." This new handbook contains 600-plus pages of products and valuable technical information. Over 140 pages are dedicated to new and unique products. OMEGA Engineering; Tel: 800-TC-OMEGA or 203-359-1660; e-mail: info@omega.com; http://www.omega.com

OMEGA Engineering

For More Information Circle No. 493

VESPEL® POLYIMIDE PARTS & SHAPES

DuPont Vespel® parts offer reliability and durability for semiconductor manufacturing. These high-performance components can reduce costs through longer life and extended maintenance intervals versus quartz and ceramics. Vespel® parts perform at high temperatures, resist chemical attack, and exhibit superior cleanliness, dimensional stability, and dielectric performance. Applications include clamping rings and other "in chamber" applications, wafer handling and processing, and IC handling and testing. DuPont Engineering Polymers, Barley Mill Plaza, Bldg. 22, PO Box 80022, Wilmington, DE 19880-0022; Tel: 800-972-7252.

DuPont Engineering Polymers

For More Information Circle No. 494

COOL ELECTRONIC CABINETS

Compact Cabinet Coolers are the low-cost, reliable way to cool and purge electronic control panels, eliminating CFCs, fans, and filters. The coolers incorporate a vortex tube to produce cold air from ordinary compressed air. No moving parts assures long life and maintenance-free operation. NEMA 4, 4X, and 12 models available. Literature gives selection data and specifications. EXAIR Corporation, 1250 Century Circle North, Cincinnati, OH 45246; Tel: 800-903-9247; Fax: 513-671-3363; e-mail: techelp@exair.com; http://www.exair.com

EXAIR Corporation

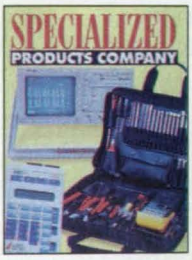
For More Information Circle No. 495

'97 ELECTRONIC HARDWARE

New from Globe Electronic Hardware comes the 1997 revised 240-page catalog, which provides complete engineering dimensions and specs for our precision electronic hardware. Products include standoffs, spacers, captive panel screws, retainers, handles, ferrules, thumb screws, shoulder screws, washers, and other components in American and metric standards. Materials include aluminum, brass, steel, stainless steel, nylon, phenolic, and Teflon. Globe Electronic Hardware; Tel: 800-221-1505 or 718-457-0303; Fax: 718-457-7493; http://www.globe-elec-hdwe.com

Globe Electronic Hardware

For More Information Circle No. 496

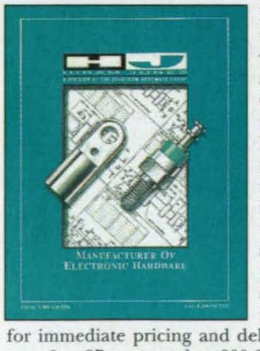


TOOLS, TOOL KITS, CASES & TEST EQUIPMENT

Free 368-page color catalog features over 100 standard tool kits for installation, field service, and repair. Extensive stock case selection with tool kit modification details. Computer test equipment includes oscilloscopes, SIMM testers, EPROM testers, benchtop test equipment, and more. Contains photos, descriptions, specifications, price breaks, index, and order form. Specialized Products Co.; Tel: 800-866-5353; Fax: 800-234-8286.

Specialized Products Co.

For More Information Circle No. 497



Hiram Jones Electronics, Inc./A Division of the Seastrom Hardware Group manufactures a complete line of standard miniature and subminiature terminals including: insulated test jacks, assembled standoffs and press-type terminals. All standard catalog items are available for immediate pricing and delivery. Call today for your free 27-page catalog: 800-634-2356.

Hiram Jones Electronics, Inc.

For More Information Circle No. 498

ELECTRO-MAGNETIC DESIGN SOFTWARE

The legendary Vector Fields suite of software, including the TOSCA, ELEKTRA and OPERA packages, combines classical finite element techniques with user friendly interactive graphics for high accuracy 2D and 3D simulation and design of all types of electromagnetic equipment.

Vector Fields Inc.

1700 North Farnsworth Avenue
Aurora, IL 60505
Tel: 630-851-1734 Fax: 630-851-2106

For More Information Circle No. 499

COMPUTERS AND ELECTRONICS

Circuit Specialists, Inc., in business for 26 years. Our 150-page catalog has over 9,000 products including industrial & personal computers, computer peripherals, board-level data acquisition & control products, test equipment, motion control products, educational laser & fiber optics, wiring products & much more. Circuit Specialists, Inc., 220 S. Country Club Dr., Bldg. 2, Mesa, AZ 85210; 24-hour catalog request line: 800-811-5201, ext. 5; Fax: 602-464-5824; http://www.cir.com

Circuit Specialists, Inc.

For More Information Circle No. 500

HYBRID STEPPER MOTORS

Four-color brochure details Pacific Scientific's broad selection of high-performance steppers and options. Motors feature NEMA frame sizes, IP65 waterproof construction, and patented Sigmax® technology. Brochure reviews these hybrid steppers with the highest torque and acceleration per frame size in the industry. Custom capabilities, synchronous motors, and planetary gearheads are also featured. Pacific Scientific, Motor Products Division, Rockford, IL; Tel: 815-226-3100; Fax: 815-226-3080.

Pacific Scientific, Motor Products Division

For More Information Circle No. 501

CUSTOM INJECTION MOLDING

Alpine Precision is a custom injection molding facility with in-house mold capabilities, manufacturing prototype, medium, and high production tooling using CNC technology. Acceptable data formats include IGES, DXF, and standard blueprint. Serving the electronics, consumer products, automotive, communications, packaging & medical industries with injection molding machines ranging from 80 to 300 tons; part sizes from one gram to 1-1/4 lbs. Utilizing commodity & engineering resins. Alpine Precision, 5550 N. McGuire Rd., Post Falls, ID 83854; Tel: 208-777-9745; Fax: 208-777-9645; e-mail: alpine@nidlink.com

Alpine Precision

For More Information Circle No. 502

NEW KIND OF MULTIMEDIA VIDEO TEACHES FEA LESSONS

Finite Element Analysis in Action! is a new kind of instructional video for engineers. Available on VHS tape or interactive, multimedia CD-ROM, the video packs a lot of information into a short running time of only 26 minutes. Live lab experiments and FEA analysis are conducted to show how to better use any FEA software. Demonstrates specific modeling and analysis techniques. Tel: 1-800-482-5467; URL: http://www.algor.com/apd.htm; e-mail: apd@algor.com

APD

For More Information Circle No. 503

ALGOR: FINITE ELEMENT SOFTWARE THAT'S CAPABLE & EXCITING

Algor's finite element analysis and virtual engineering software for the 21st century is revolutionizing the way engineers solve problems. Having more advanced solution techniques, a friendlier interface, and lower cost, Algor enables you to do things other software can't do. To see Algor in action, ask for your free information. Algor; Tel: 412-967-2700; Fax: 412-967-2781; e-mail: info@algor.com; http://www.algor.com

Algor

For More Information Circle No. 504

ALGOR PROVIDES "4-WAY" INFO ON THE WORLD WIDE WEB

Algor's Internet place has detailed information on four product lines. Discover Houdini, Algor's automatic CAD solid model to 8-node "brick" mesh converter. Learn about Algor FEA, including case histories. Preview engineering videos, books and multimedia. See all new integrated piping/vessel/plant design software. If you do not have Internet access, call for free info. Algor, Inc.; e-mail: info@algor.com; URL: http://www.algor.com; Tel: 412-967-2700; Fax: 412-967-2781.

Algor, Inc.

For More Information Circle No. 505

1997 PCMCIA PRODUCTS CATALOG

The new PCMCIA-PC CARD standard has been incorporated into many new applications such as: Data-logging, agriculture, digital film, and wireless communications. Envoy Data has just released its new catalog for these new applications plus many other products like: memory, I/O (serial, parallel, SCSI, A/D, etc.) cards; PC card drives for ISA, IDE, SCSI, etc.; along with industrial card and drives, multimedia, industrial, and engineering tools for PCMCIA applications. Envoy Data Corporation, 6 E. Palo Verde, #3, Gilbert, AZ 85296; Tel: 602-892-0954; Fax: 602-892-0029; e-mail: info@envoydata.com; http://www.envoydata.com

Envoy Data Corporation

For More Information Circle No. 506

OPTICAL SYSTEM DELIVERS 7:1 ZOOM RANGE

This NEW 4-page, full-color brochure outlines the uncompromised technology and modular flexibility that makes the OPTEM Zoom 70 ideal for machine vision, inspection, and OEM component applications. Includes: system specifications, function module options, video capabilities, and the many accessories available to enhance and customize a Zoom 70 system to fit your exact specifications. Also available in German. OPTEM International, 78 Schuyler Baldwin Dr., Fairport, NY 14450; Tel: 716-223-2372; Fax: 716-223-3413.

OPTEM International

For More Information Circle No. 507

SPECIALTY STEEL & FORGE STOCKLIST & REFERENCE MANUAL

Call, Write, Fax or E-Mail for Steelog Metallurgical Dictionary. ISO 9002 Certified Source for Specialty Steels, Open-Die Forgings & Rolled Rings. Specialty Steel & Forge, 26 Law Drive, Fairfield, NJ 07004; Tel: 973-808-8300; Fax: 973-808-4488; e-mail: info@steelforge.com; http://www.steelforge.com

Specialty Steel & Forge

For More Information Circle No. 508

DUAL-CHANNEL FFT SPECTRUM ANALYZER

The SR780 is a two-channel FFT analyzer with a frequency range of 102.4 kHz and a dynamic range of 90 dB. Features include ANSI standard octave analysis, swept sine measurements, transient capture, and computed order tracking (opt.). The SR780 comes with a low distortion source (-80 dBc), 8 MB of memory (up to 32 MB opt.), a 3.5" DOS disk drive, and RS-232 and GPIB computer interfaces. U.S. List Price: $9,950. Stanford Research Systems, Inc.; Tel: 408-744-9040.

Stanford Research Systems, Inc.

For More Information Circle No. 538

LINEAR MOTION PRODUCTS

New 176-page catalog H830 features complete product and technical information for a full range of truly affordable linear motion systems. Products include a new series of heavy-duty slides with integral dust covers, five new rotary tables, X/XY/XYZ stages, electronic components, CAM software, and servos available from stock. A 30-page application section on machines, motors, sizing systems, and more is included. Techno-isel, New Hyde Park, NY 11042-5416; Tel: 516-328-3970; Fax: 800-737-7436; http://www.techno-isel.com

Techno-isel

For More Information Circle No. 539

MAGNETIC SHIELDING MATERIAL REFERENCE GUIDE

Material guide features CO-NETIC AA alloy which shields DC to 100 kHz EMI fields. Brochure includes complete magnetic and physical data for specifications, application notes for shield design and fabrication methods. Eight-page catalog MG-6 is in metric and English units and offers cross-reference to military and commercial specifications. Magnetic Shield Corporation, Perfection Mica Company, 740 N. Thomas Dr., Bensenville, IL 60106; Tel: 630-766-7800; Fax: 630-766-2813.

Magnetic Shield Corporation, Perfection Mica Co.

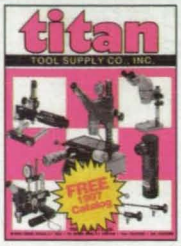
For More Information Circle No. 540

EMI/RFI SHIELDING PRODUCTS

New catalog details hundreds of standard gaskets and grounding strip variations, engineered to meet the most common shielding applications. Standard as well as custom designed shields are manufactured from Beryllium, Copper, and other High-performance materials. Special finishes and a variety of mounting methods are offered. For World Class quality and service call 973-890-7455 or visit our Web Site at: HTTP://WWW.OMEGASHIELDING.COM; e-mail: SALES@OMEGASHIELDING.COM.

Omega Shielding Products Inc.

For More Information Circle No. 541



OPTICS FOR METROLOGY

New 1997 catalog contains 120 pages of information and prices on toolmakers' microscopes, stereo microscopes, alignment microscopes, monocular zoom microscopes, micro-telescopes, pocket microscopes, borescopes, micro video lenses, and fiber optic and miniature illumination systems. Also described are centering microscopes, optical cutting tool geometry analyzers, X-Y tables, and microfinishing equipment. Titan Tool Supply Co., Inc.; Tel: 716-873-9907; Fax: 716-873-9998.

Titan Tool Supply Co.

For More Information Circle No. 542

AIR KNIFE FOR BLOWOFF

The EXAIR-Knife reduces air consumption and noise levels on a wide range of blowoff applications. Using a small amount of compressed air as a power source, the air knife pulls in large volumes of surrounding air to produce a high-flow, high-velocity curtain of air for blowoff. Compressed air flow is amplified 30:1. Six sizes up to 36" in length are available. Applications include: blowing liquid, chips, and contaminant from parts and conveyors; cooling hot parts; and air screening. EXAIR Corporation, 1250 Century Circle North, Cincinnati, OH 45246; Tel: 800-903-9247; Fax: 513-671-3363; e-mail: techelp@exair.com; http://www.exair.com

EXAIR Corporation

For More Information Circle No. 543

PRECISION COMPONENTS CATALOG

PIC Design's comprehensive Catalog 43 is bigger and better than ever – 288 pages including precision Gears, Modular Framing Elements, Linear Motion Systems & Positioning Tables, and expanded lines of Lead Screws & Nuts, Belts & Pulleys, Ball Slides, Shoulder Screws, Bearings, Shafting, Couplings, and more, all in inch and metric sizes. Ordering from the catalog is easy – major credit cards now accepted. PIC Design, PO Box 1004, Middlebury, CT 06762; Tel: 800-243-6125; Fax: 203-758-8271; e-mail: info@pic-design.com

PIC Design

For More Information Circle No. 544

THE SOURCE FOR ELECTRONIC & MECHANICAL HARDWARE

Seastrom takes pride in offering one of the widest selections of standard electronic and assembly hardware available from stock. Seastrom's 66-A Catalog provides a complete source for over 45,000 products. For a free 550-page catalog, call 800-634-2356.

Seastrom Manufacturing Co. Inc.

For More Information Circle No. 545

MONITOR, RECORD & ANALYZE

Astro-Med's 32-channel recorder with built-in monitor, 170 Mbyte internal hard drive and front-panel floppy drive is described in this illustrated 20-page brochure. The unit, called the MT95K2, features extraordinary capabilities including three on-board analysis programs, Windows host control, Windows data analysis, and a wide variety of sophisticated data capture options. Tel: 800-343-4039; Fax: 401-822-2430.

Astro-Med Inc.

For More Information Circle No. 546

VLSI INTERCONNECTION SPECIALISTS

Ironwood Electronics produces a range of interconnect solutions including hundreds of prototyping adapters, test probe adapters, programming adapters, and other interconnect devices. For fully compliant surface mount interconnect test adapters, we offer a wide selection of high-quality solutions. We also have custom design services for unique solutions in packaging. Ironwood Electronics, PO Box 21151, St. Paul, MN 55121; Tel: 612-452-8100; Fax: 612-452-8400; www.ironwood electronics.com

Ironwood Electronics

For More Information Circle No. 547

MERCURY SLIP RINGS

Bulletin describes rotating electrical connectors that combine mercury with compatible metals for stable, noise-free connections. Conductors are immersed in separate pools of mercury. Shielding protects the mercury and electrodes. The corrosion-resistant connectors have ball bearing construction to minimize seal wear and are suited for sensitive circuits with milliamp signals. Up to 8 channels are available with electrical capacities to 30 A at 240 VAC. Mercotac, Inc., 6195 Corte del Cedro, #100, Carlsbad, CA 92009; Tel: 760-431-7723; Fax: 760-431-0905; www.mercotac.com

Mercotac, Inc.

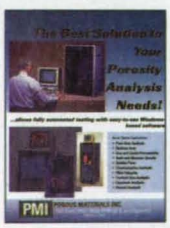
For More Information Circle No. 548

FREE CATALOG OF PUBLICATIONS

Request your free catalog of publications from the publisher of *The Miniguide to ISO 9000*. Quality Resources publications guarantee you the most accurate and timely information available on standards & assessment, benchmarking, re-engineering, process improvement, teams, and more. Free copy of *The Miniguide to ISO 9000* ($4.50 value) to first 500 responses via circle no. Quality Resources, 902 Broadway, New York, NY 10010; Tel: 800-247-8519 or 212-979-8600; Fax: 212-979-8601.

Quality Resources

For More Information Circle No. 549



FROM POROSITY TO PERMEABILITY

PMI Analytical Services provides accurate, reliable, and repeatable results. We evaluate a variety of sample sizes and types from a wide range of industries. Our services include: diffusion permeability, gas and liquid permeability, pore size distribution, surface area, envelope surface area, liquisorb analysis, chemisorption analysis, bubble point, filter integrity, particle size analysis, fractal analysis, bulk and absolute density. Porous Materials, Inc., 83 Brown Rd., Ithaca, NY 14850; Tel: 800-TALK-PMI; www.pmiapp.com

Porous Materials, Inc.

For More Information Circle No. 550

BURST PRESSURE TESTER

Advanced Pressure Products offers a fully automated computer-controlled burst pressure testing system. This system is designed to determine the exact failure pressure at controlled pressurizing rates. Applications include burst pressure of disks or pressure vessels; crushing point of materials; and fatigue cycling. Test accuracy up to .05% of full scale; leak or burst pressure resolution within .01% of full scale; pneumatic pressure up to 5000 PSI; hydraulic pressure up to 60,000 PSI. Advanced Pressure Products, 83 Brown Rd., Ithaca, NY 14850; Tel: 800-APP-VALV; www.pmiapp.com

Advanced Pressure Products

For More Information Circle No. 551

SPACE STATION T-SHIRT

Colorful rendition of orbiting station superimposed dramatically on back of black shirt; image of Earth on front left side. 100% cotton. Adult L or XL.

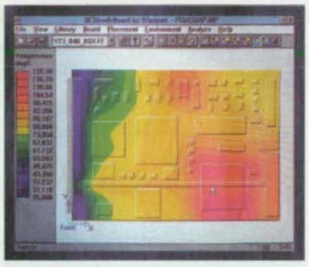
$12.95 Add $5.00 for handling and shipping charges

Mail payment to: NASA Tech Briefs, Dept F
317 Madison Ave, New York, NY 10017
For credit card orders call (212)490-3999

New on Disk

Autodesk, San Rafael, CA, has released an updated version of Autodesk Mechanical Library **parts and materials library software** for designers and drafters. It consists of PartSpec, which allows users to select a part and insert it into an AutoCAD drawing; and MaterialSpec, which provides information on 31,000 materials including 1,000 new materials. A new Web launch feature in PartSpec allows users to jump to information on a particular manufacturer or product line.

For More Information Circle No. 722

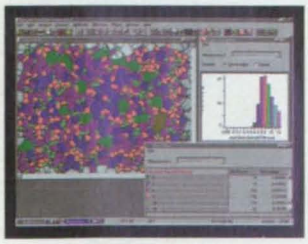


BETAsoft-Board **thermal analysis software** from Dynamic Soft Analysis, Pittsburgh, PA, enables modeling the chip on board. The program interfaces to most ECAD placement files, and is a 3D thermal analysis tool that considers heat conduction, convection, and radiation. It predicts results within 3°C for 30°C temperature rise. It is available for Windows 95, 3.1, and NT.

For More Information Circle No. 721

DASYTEC USA, Amherst, NH, offers versions 3.5 (16-bit) and 4.0 (32-bit) of DASYLab Windows-based **data acquisition software** that includes analog and digital input and output, mathematical calculations, statistical functions, frequency analysis, programmable signal generators, and test and measurement control. Using a standard PC, it can store data to disk at rates of up to 300 kHz.

For More Information Circle No. 720



Materials-Pro Analyzer Version 3.0 **materials analysis software** from Media Cybernetics, Silver Spring, MD, analyzes metals, ceramics, polymers, and other materials. The Windows-based program contains algorithms for boundary reconstruction and allows users to determine grain size, measure shape and orientation, gauge porosity, perform phase analysis, and determine coating thickness and microhardness.

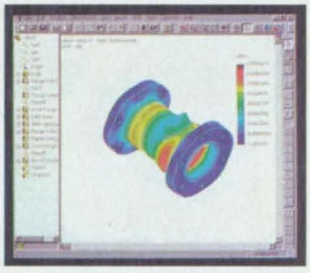
For More Information Circle No. 719

Mitutoyo, Aurora, IL, has released Version 2.0 of MeasurLink® SPC Real-Time **data acquisition and analysis software** that enables connection to and acquisition of data from most measuring devices, including calipers, micrometers, indicators, CMMs, vision systems, and other metrology devices. Features include traceability, real-time statistics, RS232C output, and control chart pattern recognition.

For More Information Circle No. 718

MATHANSR **math solution software** from Solveware, Jupiter, FL, is a Microsoft Excel®-based spreadsheet program that displays math solutions with graphics and tables. Separate solutions are provided for most math problems. Through Excel, answers can be obtained for any dimension on the graphically displayed figures.

For More Information Circle No. 717



Structural Research & Analysis Corp., Los Angeles, CA, has announced the COSMOS/Express™ series of **design analysis software** providing COSMOS/FFE® static analysis for popular solid modeling programs. The software series solves typical statics problems, and enables users of popular desktop CAD programs to add analysis to their design process.

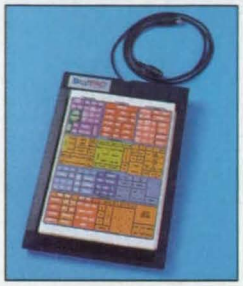
For More Information Circle No. 715

FactorySuite™ integrated **industrial automation software** from Wonderware Corp., Irvine, CA, is available in two versions integrating seven software products for developing manufacturing automation systems. FactorySuite provides process visualization modules, PC-based machine and process control, and a real-time plant database system; and FactorySuite Plus™ offers the same features with application modules for resources management and work-in-progress tracking, as well as flexible batch management. Both operate on Windows NT 4.0.

For More Information Circle No. 716

New on the Market

Product of the Month

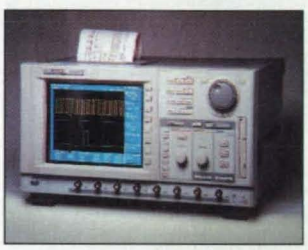


Polytel Computer Products Corp., Sunnyvale, CA, has introduced DraftPAD, a programmable **touchpad** for computer keyboards that customizes computer-aided design (CAD) applications. Available in 176-key and 300-key models, the touchpad incorporates multiple macros per key to eliminate repetitive keystrokes, and is supplied with pre-programmed macro files for popular design software, LISP routines, and other tools. The unit works with the computer's operating system rather than the application program, and can be moved from one computer to another. It can be used as a supplement to pointing input devices such as a digitizer and mouse.

For More Information Circle No. 700

American Variseal Corp., Broomfield, OH, offers spring-energized Variseal™ **seals** in new materials. Turcon® Variseals, made of PTFE compounds, are chemically inert; Zurcon™ Variseals feature low permeability and conform to their mating surface; and Ultra-high Molecular Weight Polyethylene (UHMWPE) abrasion-resistant plastic Variseals are self-lubricating and non-stick to protect against paint, adhesive, salt, sand, and slurries.

For More Information Circle No. 701



The DL2700 **digital storage oscilloscope** from Yokogawa Corp. of America, Newnan, GA, can be configured with 2, 4, 6, or 8 channels with 512kw, 2MW, or 8MW of memory per channel. It features an 8.4" TFT color display, and standard SCSI interface. Formulas for waveform computation can be defined using various mathematical functions. Computations are executed by an Intel 1960 RISC processor. Users can trigger on and view mixed analog and logic signal combinations.

For More Information Circle No. 713

Panasonic Medical & Industrial Video, Secaucus, NJ, has announced the GP-MF802 and GP-MF602 industrial black-and-white **machine vision cameras** for high-speed imaging. The 802 progressive scan camera features a 1/3" CCD and dual outputs that capture still images of moving objects in 1/60th of a second; the 602 features a 1/2" CCD that produces 570 lines of resolution. Both incorporate an electronic trigger with direct shutter control.

For More Information Circle No. 707

The HFG-45 handheld **digital force gauge** from Transducer Techniques, Temecula, CA, is available in units of lbs., ozs., kg, N, or kN for loads up to 45 pounds with accuracy of .5% in either tension or compression. It can be used for continuous or peak capture measurements and operates with four AA batteries. Optional equipment includes a test hook, extension rod, compression plate, and AC power supply.

For More Information Circle No. 711

The HP LogicDart **logic probe** from Hewlett-Packard, Palo Alto, CA, incorporates a 100 Msa/s timing analyzer, logic monitor, DC voltmeter, and continuity tester to help troubleshoot fine-pitch digital circuitry. It can display all three input channels simultaneously with up to 10 ns resolution, and can store up to ten 2,048-sample waveforms. The unit can be battery- or bench-operated and provides both visual and audible condition feedback.

For More Information Circle No. 706

New on the Market

Geotest, Irvine, CA, has introduced the MEC-2000 **development platform** for portable field applications requiring a ruggedized enclosure. It can be configured for data logging and acquisition, process control, and remote test applications. The unit features an internal 14-slot, PC-compatible, passive backplane and optional IBM-PC-compatible controller. It also features four top-mounted, shock absorbing isolators and a detachable remote control unit.

For More Information Circle No. 703

Proportion-Air, Indianapolis, IN, offers the QB1 closed-loop **pneumatic servo valve,** which incorporates a failsafe to atmosphere option. Units accept a 4-20mA or 0-10 VDC command signal and regulate from vacuum to 500 psi outlet. Upon loss of power to the servo valve, the unit automatically fails to atmospheric pressure.

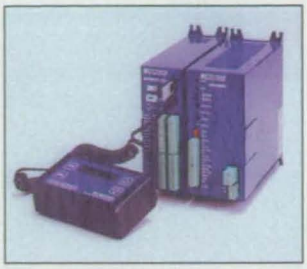
For More Information Circle No. 708

The DT3010 PCI bus-mastering multi-function **data acquisition board** from Data Translation, Marlboro, MA, provides a maximum sample rate of 1.25 megasamples/second with 12-bit resolution, and allows the use of multiple plug-in data acquisition boards in a single PCI slot. It includes 32 single-ended or 16 differential analog inputs, 16 digital I/O channels, two dynamic digital outputs, two high-speed analog outputs, and four counter/timer channels.

For More Information Circle No. 702

Distributed I/O modules from Giddings & Lewis Automation Control, Fond du Lac, WI, are block units containing a power supply and necessary I/O network interfaces. System configurations of up to 77 blocks can be implemented. Four models are available: a 16-point, 24 V DC input; 16-point, 24 V DC output; a 4-point, 14-bit resolution analog input; and a 4-point, 15-bit resolution, 4-20mA output.

For More Information Circle No. 704



Warner Electric/Dana Corp., South Beloit, IL, offers the MCS 2000 digital **tension control system** for winding/rewinding, intermediate zone, and unwinding applications including electric and pneumatic brakes and clutches, and AC/DC and servo motors. It operates in open loop mode and responds to sensors for closed loop control such as load cells and ultrasonics. Operating parameters are set with a handheld programmer.

For More Information Circle No. 712

Greco Systems, El Cajon, CA, has introduced a removable **drive canister** that provides protection and security of data. The optional disk drive can be used with IBM PC-compatible computers and withstands rugged environments including shock, vibration, temperature fluctuations, humidity, and dust. It features a front handle and guiderails for removal and insertion, 100ph connector, and a rear-mounted power conductor.

For More Information Circle No. 705

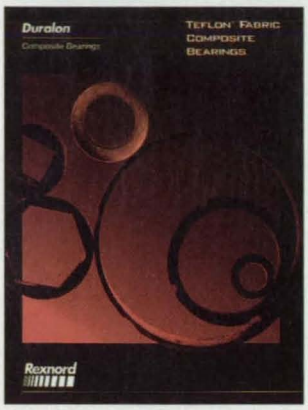
Thomas Industries, Sheboygan, WI, has introduced the 2650 Series of twin-piston **air compressors and vacuum pumps** with flow rates from 2.80 to 5.60 CFM and maximum intermittent pressure to 50 PSIG. They also feature maximum continuous pressure to 40 PSIG and maximum vacuum to 27.0 in. Hg. All models incorporate permanently lubricated bearings, oil-less piston and cylinders, die-cast aluminum components, and a piston seal.

For More Information Circle No. 710

Polyethylene **threaded caps** from stockCap, St. Louis, MO, have a knurled design to aid in application and removal. The caps seal out dirt, dust, and moisture, and provide a seal for low-pressure requirements. They are available in nine sizes, and are designed with ASAE thread sizes of 3/8"-24 to 1-1/16"-12.

For More Information Circle No. 709

New Literature



Rex Bearing Division, Rexnord Corp., Downers Grove, IL, offers a six-page brochure describing self-lubricating Duralon® **composite bearings** with a woven Teflon® fabric liner. They are available in thread forms and spherical shapes, and in round, square, and hexagonal diameters.

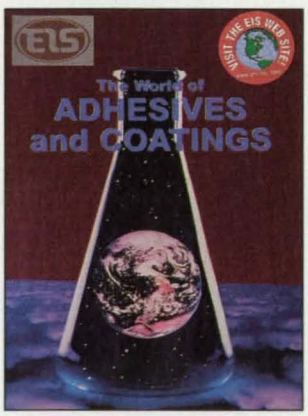
For More Information Circle No. 725

A Resource Guide to **instrument class valves** is available from Valcor Scientific, div. of Valcor Engineering, Springfield, NJ. Included are Neonate Series inert instrument class valves in a variety of plastics and elastomeric seal materials.

For More Information Circle No. 726

Hager Hinge, St. Louis, MO, offers literature describing Roton™ **continuous geared hinges** that evenly distribute door weight and maintain door alignment in high-traffic areas. The hinges feature an internal rolling contact gear profile, cover channel, and plastic solid bearing blocks.

For More Information Circle No. 728

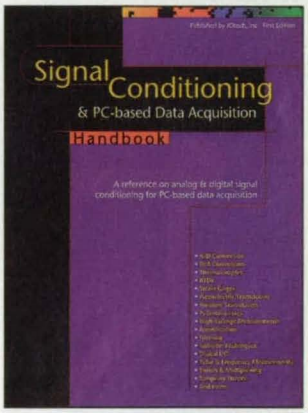


Electrical Insulation Suppliers (ESI), Hillside, IL, has released a 104-page guide to **adhesives and coatings** offered by manufacturers in electronics and electrical industries. Featured are adhesives, coatings, potting compounds, dispensing equipment, sealants, and encapsulants.

For More Information Circle No. 727

MARC Analysis Research Corp., Palo Alto, CA, has released a CD-ROM containing information and demos of its **simulation software.** A copy of MARC/Designer linear analysis software is included, and MARC/AutoForge bulk metal forming simulation software, MARC/Link CAD system linking software, and MARC finite element analysis software are highlighted.

For More Information Circle No. 729



IOtech, Cleveland, OH, has released a 128-page guide to **signal conditioning and data acquisition** that includes analog to digital conversion, multiplexing, temperature measurement, strain and acceleration, and amplification. Noise reduction and isolation, and digital and pulse-train conditioning also are discussed.

For More Information Circle No. 731

A 56-page catalog of **LCD displays and modules** is offered by Lumex Opto/Components, Palatine, IL. Featured are dot matrix, graphics, and full-color TFT graphics modules, as well as multi-digit liquid crystal displays with electronic, mechanical, and application specifications.

For More Information Circle No. 730

Innovative Integration, Westlake Village, CA, offers an 82-page catalog of **DSP and data acquisition** products. Featured are ISA, PCI, and standalone Bus-based products; plug-on modules for DSP baseboards, data loggers, and software.

For More Information Circle No. 732

NASA Tech Briefs, ISSN 0145-319X, USPS 750-070, copyright© 1997 by Associated Business Publications Co., Ltd. Copyright is not claimed for the individual "tech briefs" contained in this publication. The U.S. Government has a paid-up license to exercise all rights under the copyright claimed herein for government purposes. NASA Tech Briefs is published monthly by Associated Business Publications Co., Ltd., 317 Madison Ave., New York, NY 10017-5391. Editorial, sales, production and circulation offices at 317 Madison Ave., New York, NY 10017-5391. Subscription for non-qualified subscribers in the U.S., Panama Canal Zone, and Puerto Rico, $75.00 for 1 year; $135.00 for 2 years; $200.00 for 3 years. Single copies $10.00. Foreign subscriptions one-year U.S. Funds $195.00. Remit by check, draft, postal, express orders or VISA, MasterCard, or American Express. Other remittances at sender's risk. Address all communications for subscriptions or circulation to NASA Tech Briefs, 317 Madison Ave., New York, NY 10017-5391. Second Class postage paid at New York, NY and additional mailing offices.

POSTMASTER: please send changes to NASA Tech Briefs, P. O. Box 10523, Riverton, NJ 08076-0523.

Advertisers Index

Company	Web Site	Circle Number	Page
Abaris Training Resources, Inc.	www.training.abaris.com	478	103
Adaptive Research	www.adaptive-research.com	610,753	3,92
Adina R & D, Inc.	www.adina.com	628,756	37,94
Advanced Pressure Products	www.pmiapp.com	551	106
Affinity		454	11a
Alacron	www.alacron.com	556,755	64,93
Algor, Inc.	www. algor.com	603,759,504-505	7,96,105
Alpine Precision		502	105
American Portable Research, Inc.	www.DEMANDTM.com	423	109
Ampac Products Inc.		419	107
Analytical Graphics	www.stk.com	530,751	55,91
Ansoft	www.ansoft.com	668,754	41,93
APD	www.algor.com/apd.htm	503	105
Applied Science Laboratories		584	111
Astro-Med Inc.		546	106
Autodesk AutoCAD LT	www.autodesk.com		13
Avalon Electronics, Inc.	www.aval.demon.co.uk/avalon	466	102
Bentley Systems, Incorporated	www.bentley.com/modelserver/	554,766	9,99
Breault Research Organization Inc.	www.breault.com	475	13a
Bulb Direct, Inc.		491	104
Busak + Shamban		565,752	19,92
CADSI	www.cadsi.com	405	32
Cardinal Aluminum Co.		413	63
Carr Lane Manufacturing Co.	www.carrlane.com	581	111
Circuit Specialists, Inc.	www.cir.com	500	105
Communications Specialties, Inc.	www.commspecial.com.	431	101
Compaq Computer Corporation	www.compaq.com	557	68-69
Corel Corporation	www.corel.com	561	35
CUI Stack		422	108
Cybernetics			51
Datum Inc.	www.datum.com.	414	67
Digi-Key Corporation	www.digikey.com	636,765	5,99
DuPont		758	30-31,95
DuPont Engineering Polymers		485,494	103,104
Eastman Kodak Company, Motion Analysis Systems Division.	www.masdkodak.com	511	89
Enterprise Software Products, Inc.	www.femap.com	514,769	71,101
Envoy Data Corporation	www.envoydata.com	506	105
Ergotron	www.ergotron.com	408	40
EXAIR Corporation	www.exair.com	469,495,543	102,104,106
Exciton Inc.		473	13a
Farrand Controls		583	111
Fiber Guide Industries	www.fiberguide.com	451,472	2a, 13a
FJW Optical Systems, Inc.		452	9a
FloMet, Inc.	www.flomet.industry.net	402	14
Folsom Research	www.folsom.com	652	15
Gage Applied Sciences (U.S.) Inc.	www.gage-applied.com	532	49
Geotest, Inc.	www.geotestinc.com	479	103
Gems Sensors		580	111
Globe Electronic Hardware	www.globe-elec-hdwe.com	496	104
Gould Instrument Systems	www.gouldis.com	606	2
Government Micro Resources, Inc.	www.gmri.com	690	21
Hewlett-Packard		484	103
Hewlett-Packard Company	www.hp.com/go/hpbennetonfl		22-23
Hiram Jones Electronics, Inc.		498	104
Hitachi Denshi America, Ltd.		410	58
Imagination Systems Inc.	www.imagination.com	476	103
Integrated Engineering Software		644,750	43,91
Integrated Systems, Inc.	www.isi.com	513	57
International Light	www.intl-light.com	474	13a
Invention Machine Corporation	www.invention-machine.com	639,768	47,100
Ironwood Electronics	www.ironwoodelectronics.com	547	106
Iscan, Inc.	www.iscaninc.com	433	28
Kaman Instrumentation	www.kamansensors.com/kaman	428	76
Keithley Instruments, Inc.	www.keithley.com	461	102
Keyence Corporation of America	www.keyence.com	663,761	11,97
Lasiris Inc.	www.lasiris.com	471	13a
Litton Poly-Scientific	www.litton-ps.com	512,757	87,94
Magnetic Shield Corporation, Perfection Mica Co.		540	105
MARC Analysis Research Corp.	www.MARC.com	659,763	39,98
Master Bond Inc.		425	110
MathSoft, Inc.	www.mathsoft.com/mathcad	608	25
The MathWorks, Inc.	www.mathworks.com/ntb	675,767	17,100
Matrix Systems Corporation.	www.matrixsystems.com.	415	73
Mercotac, Inc.	www.mercotac.com	548	106
Metal Powder Industries Federation	www.mpif.org/mpifz	537	85
Micron Electronics	www.micronpc.com	518	33
Minco Products, Inc.		420	107
N Vision	www.nvis.com	529	83
Nanonics Corporation	www.nanonics.com/catalog/	421	108
National Instruments Corporation.	www.natinst.com	464,467	102
National Instruments Corporation.	www.natinst.com/mags/labview41.htm	601,406	COV II,36
National Technology Transfer Center	http://ntas.techtracs.org	764,658	98,COV III
NemaSoft		477	103
Numerical Algorithms Group, Inc.	www.nag.com	417	75
Omega Engineering	www.omega.com	516,517,493	1,104
Omega Shielding Products Inc.	www.omegashielding.com	541	106
OPTEM International		507	105
Optima Precision Inc.	www.optima-prec.com	450	1a
Oregon Micro Systems Inc.		462	102
Pacific Scientific		468,501	102,105
Parametric Technology Corporation	www.workstation.digital.com	575	53
Penn Engineering & Mfg. Corp.	www.pemnet.com	481	103
PIC Design		544	106
Porous Materials, Inc.	www.pmiapp.com	487,550	103,106
Presray Corporation	www.presray.com	432	88
Quality Resources		549	106
Research Systems, Inc.	www.rsinc.com	515	COV IV
RGB Spectrum	www.rgb.com	401	10
Rifocs Corporation	www.rifocs.com	416	74
Rolyn Optics Co.		582	111
Seastrom Manufacturing Co. Inc.		545	106
Servometer	www.servometer.com	424	109
SL Corporation	www.sl.com	411	59
Solid Concepts Inc.	www.solidconcepts.com.	403	27
SolidWorks Corporation	www.solidworks.com/304	524	4
Soltec Cororation	www.solteccorp.com	404	29
Sorbothane Inc.	www.sorbothane.com	418	90
Specialized Products Co.		497	104
The Specialty Bulb Co., Inc.	www: http://members.aol.com/spbulb	489	104
Specialty Steel & Forge	www.steelforge.com	508	105
Stahl Specialty Company		465	102
Stanford Research Systems, Inc.		538	105
Strainsert		492	104
Sumitomo Metals Industries		427	28
Systran Corp.	www.systran.com	480	103
TAL Technologies, Inc.	www.taltech.com	482	103
Tec Products and Lab Services		455	11a
Techno-isel	www.techno-isel.com	539	105
Technology 2007			77-79
Teclab	www.teclab-bench.com	488	104
Teknor Industrial Computers, Inc.	www.teknor.com	760	96
Teragon Research		490	104
Thompson Casting Co., Inc.		426	110
3M Specialty Optical Fibers		440,470	COV 11a, 13a
Titan Tool Supply Co.		542	106
Transducer Techniques Inc.	www.ttloadcells.com	463	102
Uniphase	www.uniphase.com	441	3a
United Electronic Industries	www.ueidaq.com	486	103
Vector Fields Inc.	www.vectorfields.com	762,499	97,104
Velmex, Inc.	www.velmex.com	453	9a
VLSI Standards		483	103
Western Graphtec, Inc.		412	61
Wilsec, Inc.		429	76
Working Model, Inc., Div. of Knowledge Revolution	www.workingmodel.com	527	45

Body-building equipment
Developed 1995.

NASA

- ▷ MANUFACTURING
- ✕ MEDICAL
- ▷ MATERIALS
- ▷ SENSORS

NASA engineers have partnered with thousands of companies to develop new products. Like an exercise machine patterned after a zero gravity simulator. It's now in health clubs nationwide.

To learn how you can tap into our 100 billion dollars of R&D, visit our Web site. Or call the National Technology Transfer Center to find out how our technology can help your bottom line.

http://ntas.techtracs.org 1-800-678-6882

Create Revolutionary Results. Fast.

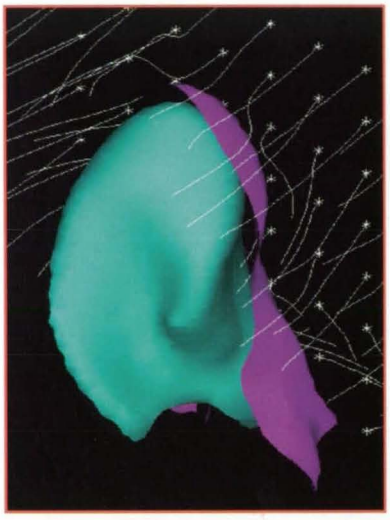


Image processed in IDL software and courtesy of NASA and ST ScI.

Visualize your data with IDL®, the *Interactive Data Language*, and see results in a whole new way.

Easily create amazing graphics with IDL software's accelerated 3D system. Want to spin or fly-through a surface? No problem. Shade and illuminate with multiple light sources?

IT'S A SNAP IN IDL.

IDL software's array-oriented architecture is designed for high-performance processing of large, complex data. That's why it's the standard in the world's preeminent medical, military, engineering & science organizations. IDL is so efficient that a few lines of IDL can do the job of hundreds of lines of C or Fortran. And, its object-oriented system lets you develop sophisticated applications from reusable code modules.

IDL SOFTWARE

Analyze data faster. Create simulations easier. Write better applications.

Read in, analyze and output your data with the click of a mouse with IDL Insight™.

Connect to your relational database with the IDL DataMiner™.

Automatically share your programs – with full graphical interfaces – among Windows, Unix and Macintosh systems. Check out our flexible license options – we'll help you protect your intellectual property and economically distribute your applications.

Create maps in any of 16 projections.

Crunch numbers with IDL's integrated mathematics, statistics and industry-standard Numerical Recipes™ algorithms.

new release

IDL 5.0

For More Information Circle No. 515

Stop waiting for your results. Call us for a free Demo CD or visit our website and download it today. www.rsinc.com

Research Systems 303-786-9900 info@rsinc.com Software ≡ Vision™

International Distributor Offices

Austria, Germany, Liechtenstein, Luxembourg, Switzerland, The Netherlands CREASO, GmbH tel: 49 8105 25055 • **Brazil** SulSoft tel: 55 51 337 38 91 • **China, Hong Kong** 3-Link Systems Pte Ltd. tel: 86106 261 0161 **France, Belgium** Fast Parallel Solutions France tel: 33 1 41 73 20 00 • **Italy** Alliant Computer Systems SRL tel: 39 39 6091766 • **Japan** Adam Net Ltd tel: 81 35802 2251 • **Korea** InterSys tel: 82 42 869 4746 **Spain** Estudio Atlas tel: 34 45 298 080 • **Taiwan** Concentrate Corporation tel: 886 2 883 7752 • **United Kingdom** Floating Point Systems UK Ltd. tel: 44 118 977 6333