NASA-CR-194400

COSMIC

Monthly Report

AUGUST 1993

(NASA-CR-194400) COSMIC MONTHLY PROGRESS REPORT (COSMIC) 43 p

N94-11688

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G3/61 0185990

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September 15, 1993

Mr. Barney Hannan
Code CU
NASA Headquarters
Washington, DC 20546

Dear Mr. Hannan:

Enclosed please find a copy of the COSMIC Monthly Report for August, 1993.

Sincerely,

John A. Gibson
Director

klk

Enclosure

cc: NASA/CASI ✓
ONRRR
NASA Contracting Office

THE UNIVERSITY OF GEORGIA

COMPUTER SOFTWARE MANAGEMENT

AND

INFORMATION CENTER

MONTHLY PROGRESS REPORT

AUGUST, 1993

UNDER CONTRACT

NASW-4670

PREPARED FOR

TECHNOLOGY UTILIZATION OFFICE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

WASHINGTON, D.C.

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1. GENERAL INFORMATION

A Memorandum of Understanding between STAC and COSMIC concerning potential marketing or promotional activities was signed in August. As a follow-on, the Director attended the Southeastern Region RTTC Affiliates/FLC Meeting in Research Triangle Park, North Carolina. At this meeting, the Director discussed COSMIC activities with both groups.

Mr. E. T. Dickerson, Ms. Linda H. Braun, and Ms. Karen Fleming visited COSMIC on August 12, to discuss the AdaNET projects and explore avenues of cooperation between COSMIC and AdaNET. The meeting has resulted in a draft MOU with four draft amendments that are being considered at this time. It is anticipated that these will be signed in September.

The Assistant Director briefed some DOD Technology Transfer units about RIG technical committee activities. This meeting took place in the Pentagon. While in the D.C. area, the Assistant Director visited Goddard, Headquarters, and Applied Expertise.

The Joint COSMIC-ESTSC catalog was updated in August. The next update is anticipated to be prior to Technology 2003.

In September, COSMIC will exhibit at the Unix Expo in New York City.

2. INVENTORY

The current inventory of programs available from COSMIC is the sum of the Class 1 and 2 programs in TABLE 1, "Issuability Status Summary." The total number of items submitted from each source since COSMIC began is given in the right hand column of TABLE 1. Numbers listed under the "Withdrawn" column reflect those packages for which return or discard authorization has been provided by the appropriate Technology Utilization Office.

TABLE 1. ISSUABILITY STATUS SUMMARY

July 1966 to Date

Center Mnemonic	Class 1	Class 2	Class 3	Class 4	In Process	With-drawn	Total
ARC	75	5	25	3	4	65	177
COS	-	26	2	2	0	87	117
DOD	-	15	41	0	0	46	102
ERL	4	0	0	0	0	16	20
FRC	1	0	8	0	0	6	15
GSC	87	1	72	12	13	285	470
HQN	21	6	7	1	3	86	124
KSC	11	7	19	1	2	81	121
LAR	165	7	139	19	6	160	496
LEW	112	9	173	18	16	129	457
MFS	44	6	103	8	15	1,248	1,424
MSC	136	78	20	25	13	917	1,189
NPO	108	2	71	30	16	368	595
NUC	1	1	7	0	0	66	75
SSC	3	0	1	0	1	0	5
UGA	-	4	3	0	0	12	19
TOTALS	768	167	691	119	89	3,572	5,406

The number of submittals for the current month is above the average of the past few months. The total number of receipts for this month is twenty-one: Fifteen are initial packages, five are updates to a package, and one is an addition to a program. A summary by submittal site is shown in TABLE 2.

TABLE 2. SUMMARY OF TOTAL RECEIPTS 1993

Submittal Site	This Month	Calendar Year to Date
ARC	1	6
COS	0	8
DOD	0	5
ERL (SSC)	1	1
GSC	1	19
HQN	2	7
KSC	1	1
LAR	1	8
LEW	2	18
MFS	3	12
MSC	7	22
NPO	2	16
UGA	0	0
TOTAL	21	123

3. EVALUATION AND PUBLICATION

The program processing activities can be viewed as a three step process, although the steps are not necessarily done in sequence. These steps are program verification, program evaluation, and abstract preparation and publication.

Program verification represents the machine processing phase of evaluation and typically includes the compilation or assembly of supplied code using standard programming language translators followed by loading or linkage editing of the generated object code to insure completeness of the submitted code. This month COSMIC processed twenty-one programs through verification.

Program evaluation involves the review of programs and supporting documentation following the machine processing phase to determine their suitability for public release relative to the standards of completeness and content specified in the COSMIC Submittal Guidelines. Prices for distributed materials are also established during package evaluation. Factors considered in establishing the price charged for program code include the program source instruction counts as a gross measure of development effort, the machine independence or vintage, the quality of the supporting documentation, the known or assumed sales potential for the package, the functionality of the program relative to comparably classified packages, and the demonstrated level of developer programming support.

One hundred twenty-five completed the evaluation activity for the current month. Seventeen were class 1, five were class 2, ninety-six were class 3*, one was class 4, and six were archived.

*Ninety-five were from catalog reduction project.

TABLE 3. SUMMARY EVALUATION TOTALS January, 1993 To Date

Submittal Site	Class 1	Class 2	Class 3	Class 4
ARC	6	0	22	1
COS	-	8	1	1
DOD	-	5	38	0
ERL	0	0	0	0
FRC	0	0	6	0
GSC	14	0	55	1
HQN	4	1	1	0
KSC	1	0	0	0
LAR	13	0	103	1
LEW	17	0	75	1
MFS	7	0	20	0
MSC	14	0	5	5
NPO	9	0	47	1
SSC	0	0	0	0
NUC	0	0	6	0
UGA	-	0	2	0
TOTALS	85	14	381	11

Publication activities carried out by COSMIC include the preparation of descriptive abstracts for all new submittal and updated Class 1 and 2 items evaluated each month as well as the preparation of Tech Briefs for the Class 1 packages for publication in the NASA Tech Brief Journal. Ten Tech Briefs were prepared this month.

LAR-15074 - MOM3D - A Method of Moments Code for Electromagnetic Scattering (UNIX Version)

LAR 15075 - EM-ANIMATE - Computer Program for Displaying and Animating the Steady-State Time-Harmonic Electromagnetic Near Field and Surface-Current Solutions

LAR-15130 - MOM3D - A Method of Moments Code for Electromagnetic Scattering (IBM PC Version)

MFS-30004 - M414 - MIL-STD-414 Variable Sampling Procedures Computer Program

MSC-22380 - MEDOF - Minimum Euclidean Distance Optimal Filter

MSC-22429 - CLIPS 6.0 - C Language Integrated Production System, Version 6.0 (Macintosh Version)

MSC-22430 - CLIPS 6.0 - C Language Integrated Production System, Version 6.0 (IBM PC Version)

MSC-22433 - CLIPS 6.0 - C Language Integrated Production System, Version 6.0 (UNIX Version)

MSC-22434 - CLIPS 6.0 - C Language Integrated Production System, Version 6.0 (DEC VAX VMS Version)

NPO-18806 - TFSSRA - Thick Frequency Selective Surface With Rectangular Apertures

MOM3D - A METHOD OF MOMENTS CODE FOR ELECTROMAGNETIC SCATTERING

MOM3D is a FORTRAN method-of-moments electromagnetic analysis algorithm for open or closed 3-D perfectly conducting or resistive surfaces. Radar cross section with plane wave illumination is the prime analysis emphasis; however, provision is also included for local port excitation for computing antenna gain patterns and input impedances. The Electric Field Integral Equation form of Maxwell's equations is solved using local triangle couple basis and testing functions with a resultant system impedance matrix. The analysis emphasis is not only for routine RCS pattern predictions, but also for phenomenological diagnostics: bistatic imaging, currents, and near scattered/total electric fields. The images, currents, and near fields are output in form suitable for animation. MOM3D computes the full backscatter and bistatic radar cross section polarization scattering matrix (amplitude and phase), body currents and near scattered and total fields for plane wave illumination. MOM3D also incorporates a new bistatic k space imaging algorithm for computing down range and down/cross range diagnostic images using only one matrix inversion. MOM3D has been made memory and cpu time efficient by using symmetric matrices, symmetric geometry, and partitioned fixed and variable geometries suitable for design iteration studies. MOM3D may be run interactively or in batch mode on 486 IBM PCs and compatibles, UNIX workstations or larger computers. A 486 PC with 16 megabytes of memory has the potential to solve a 30 square wavelength (containing 3000 unknowns) symmetric configuration. Geometries are described using a triangular mesh input in the form of a list of spatial vertex points and a triangle join connection list.

MOM3D is written in FORTRAN 77. Two machine versions are available from COSMIC: the UNIX version (LAR-15074) is designed to run on SGI series computers running IRIX, and, with modifications that are described in the documentation, has been successfully implemented on a Sun4 series computer running SunOS; the IBM PC version (LAR-15130) has been successfully implemented on an IBM PC compatible running MS-DOS and Lahey FORTRAN v5.1-EM32. The RAM requirements for MOM3D vary with the size of the problem being solved. Sample input and output files are provided for each version. The UNIX and PC versions include an SGI executable and an MS-DOS executable, respectively. The UNIX version also includes electronic documentation in PostScript format, while the PC version includes WordPerfect format electronic documentation.

The standard distribution medium for the UNIX version is a .25 inch streaming magnetic IRIX tape cartridge in UNIX tar format. It is also available on a .25 inch streaming magnetic tape cartridge (SUN QIC-24) in UNIX tar format. The standard distribution medium for the PC version (LAR-15130) is a set of four 5.25 inch 360K MS-DOS format diskettes. The contents of the diskettes are compressed using the PKWARE archiving tools. The utility to unarchive the files, PKUNZIP.EXE, is included. The UNIX version of MOM3D is also available as a part of a bundled package (COS-10048) that includes EM-ANIMATE, an IRIS program capable of displaying and animating MOM3D results. This program was developed in 1992.

MOM3D - A METHOD OF MOMENTS CODE FOR ELECTROMAGNETIC SCATTERING

SUBMITTED BY -

J.F. SHAEFFER

DENMAR, INC.

INQUIRIES CONCERNING THIS PROGRAM SHOULD BE ADDRESSED TO -

COSMIC

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EM-ANIMATE - COMPUTER PROGRAM FOR DISPLAYING AND ANIMATING THE STEADY-STATE TIME-HARMONIC ELECTROMAGNETIC NEAR FIELD AND SURFACE-CURRENT SOLUTIONS

The EM-ANIMATE program is a specialized visualization program that displays and animates the near-field and surface-current solutions obtained from an electromagnetics program, in particular, that from MOM3D (LAR-15074). The EM-ANIMATE program is windows based and contains a user-friendly, graphical interface for setting viewing options, case selection, file manipulation, etc. EM-ANIMATE displays the field and surface-current magnitude as smooth shaded color fields (color contours) ranging from a minimum contour value to a maximum contour value for the fields and surface currents. The program can display either the total electric field or the scattered electric field in either time-harmonic animation mode or in the root mean square (RMS) average mode. The default setting is initially set to the minimum and maximum values within the field and surface current data and can be optionally set by the user. The field and surface-current value are animated by calculating and viewing the solution at user selectable radian time increments between 0 and 2pi.

The surface currents can also be displayed in either time-harmonic animation mode or in RMS average mode. In RMS mode, the color contours do not vary with time, but show the constant time averaged field and surface-current magnitude solution. The electric field and surface-current directions can be displayed as scaled vector arrows which have a length proportional to the magnitude at each field grid point or surface node point. These vector properties can be viewed separately or concurrently with the field or surface-current magnitudes. Animation speed is improved by turning off the display of the vector arrows. In RMS modes, the direction vectors are still displayed as varying with time since the time averaged direction vectors would be zero length vectors. Other surface properties can

optionally be viewed. These include the surface grid, the resistance value assigned to each element of the grid, and the power dissipation of each element which has an assigned resistance value.

The EM-ANIMATE program will accept up to 10 different surface current cases each consisting of up to 20,000 node points and 10,000 triangle definitions and will animate one of these cases. The capability is used to compare surface-current distribution due to various initial excitation directions or electric field orientations. The program can accept up to 50 planes of field data consisting of a grid of 100 by 100 field points. These planes of data are user selectable and can be viewed individually or concurrently. With these preset limits, the program requires 55 megabytes of core memory to run. These limits can be changed in the header files to accommodate the available core memory of an individual workstation. An estimate of memory required can be made as follows: approximate memory in bytes equals (number of nodes times number of surfaces times 14 variables times bytes per word, typically 4 bytes per floating point) plus (number of field planes times number of nodes per plane times 21 variables times bytes per word). This gives the approximate memory size required to store the field and surface-current data. The total memory size is approximately 400,000 bytes plus the data memory size.

The animation calculations are performed in real time at any user set time step. For Silicon Graphics Workstations that have multiple processors, this program has been optimized to perform these calculations on multiple processors to increase animation rates. The optimized program uses the SGI PFA (Power FORTRAN Accelerator) library. On single processor machines, the parallelization directives are seen as comments to the program and will have no effect on compilation or execution.

EM-ANIMATE is written in FORTRAN 77 for implementation on SGI IRIS workstations running IRIX 3.0 or later. A minimum of 55Mb of RAM is required for execution of this program; however, the code may be modified to accommodate the available memory of an individual workstation. For program execution, twenty-four bit, double-buffered color capability is suggested, but not required. Sample input and output files and a sample executable are provided on the distribution medium. Electronic documentation is provided in PostScript format and in the form of IRIX man pages. The standard distribution medium for EM-ANIMATE is a .25 inch streaming magnetic IRIX tape cartridge in UNIX tar format. EM-ANIMATE is also available as part of a bundled package, COS-10048 that includes MOM3D, an IRIS program that produces electromagnetic near field and surface current solutions. This program was developed in 1993.

SUBMITTED BY -

K.W. HOM

NASA LANGLEY RESEARCH CENTER

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M414 - MIL-STD-414 VARIABLE SAMPLING PROCEDURES COMPUTER PROGRAM

Use of the government Standard MIL-STD-414 can be cumbersome and confusing to a non-statistician. The implementation of MIL-STD-414, "Sampling Procedures and Tables for Inspection by Variables for Percent Defective", requires some mathematical calculations to be performed. It also requires extensive referencing of the Standard tables in order to make a decision to accept or reject a lot. The process of calculation and table reference is tedious, confusing, and can therefore result in errors. This has probably restricted the use of the Standard and led to mistakes in its application. As a result of these observations, M414, MIL-STD-414 Variable Sampling Procedures Computer Program, has been developed to automate the calculation and the accept/reject decision making process.

M414 automates the entire calculation and decision making process by employing computational algorithms which determine lot threshold acceptability values. M414 is a menu driven and user friendly program. Its use can reduce the burden of manual operations, thus promoting variable sampling practice in industry in lieu of GO/NO-GO inspection.

M414 is written in BASIC for IBM PC series and compatible computers running MS-DOS. The program requires 512K of RAM, an 80x87 math co-processor and a CGA monitor for execution. To compile the source, the Microway 87SFL Math Function Software Library (Kingston, MA; 508-746-7341) and MicroSoft QuickBasic v2.0 are required. The standard distribution medium is one 5.25 inch 360K MS-DOS format diskette. Documentation is included in the price of the program. M414 was developed in 1993.

M414 - MIL-STD-414 VARIABLE SAMPLING PROCEDURES COMPUTER PROGRAM

SUBMITTED BY -

Z. HUANG

ROCKWELL INTERNATIONAL CORP.

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MEDOF - MINIMUM EUCLIDEAN DISTANCE OPTIMAL FILTER

The Minimum Euclidean Distance Optimal Filter program, MEDOF, generates filters for use in optical correlators. The algorithm implemented in MEDOF follows theory put forth by Richard D. Juday of NASA/JSC. This program analytically optimizes filters on arbitrary spatial light modulators such as coupled, binary, full complex, and fractional 2pi phase. MEDOF optimizes these modulators on a number of metrics including: correlation peak intensity at the origin for the centered appearance of the reference image in the input plane, signal to noise ratio including the correlation detector noise as well as the colored additive input noise, peak to correlation energy defined as the fraction of the signal energy passed by the filter that shows up in the correlation spot, and the peak to total energy which is a generalization of PCE that adds the passed colored input noise to the input image's passed energy.

The user of MEDOF supplies the functions that describe the following quantities: 1) the reference signal, 2) the realizable complex encodings of both the input and filter SLM, 3) the noise model, possibly colored, as it adds at the reference image and at the correlation detection plane, and 4) the metric to analyze, here taken to be one of the analytical ones like SNR (signal to noise ratio) or PCE (peak to correlation energy) rather than peak to secondary ratio. MEDOF calculates filters for arbitrary modulators and a wide range of metrics as described above.

MEDOF examines the statistics of the encoded input image's noise (if SNR or PCE is selected) and the filter SLM's (Spatial Light Modulator) available values. These statistics are used as the basis of a range for searching for the magnitude and phase of k, a pragmatically based complex constant for computing the filter

transmittance from the electric field. The filter is produced for the mesh points in those ranges and the value of the metric that results from these points is computed. When the search is concluded, the values of amplitude and phase for the k whose metric was largest, as well as consistency checks, are reported. A finer search can be done in the neighborhood of the optimal k if desired. The filter finally selected is written to disk in terms of drive values, not in terms of the filter's complex transmittance. Optionally, the impulse response of the filter may be created to permit users to examine the response for the features the algorithm deems important to the recognition process under the selected metric, limitations of the filter SLM, etc. MEDOF uses the filter SLM to its greatest potential, therefore filter competence is not compromised for simplicity of computation.

MEDOF is written in C-language for Sun series computers running SunOS. With slight modifications, it has been implemented on DEC VAX series computers using the DEC-C v3.30 compiler, although the documentation does not currently support this platform. MEDOF can also be compiled using Borland International Inc.'s Turbo C++ v1.0, but IBM PC memory restrictions greatly reduce the maximum size of the reference images from which the filters can be calculated. MEDOF requires a two dimensional Fast Fourier Transform (2DFFT). One 2DFFT routine which has been used successfully with MEDOF is a routine found in "Numerical Recipes in C: The Art of Scientific Programming," which is available from Cambridge University Press, New Rochelle, NY 10801. The standard distribution medium for MEDOF is a .25 inch streaming magnetic tape cartridge (Sun QIC-24) in UNIX tar format. MEDOF was developed in 1992-1993.

MEDOF - MINIMUM EUCLIDEAN DISTANCE OPTIMAL FILTER

SUBMITTED BY -

R.S. BARTON

R.D. JUDAY

J.L. ALVAREZ

NASA JOHNSON SPACE FLIGHT CENTER

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CLIPS 6.0 - C LANGUAGE INTEGRATED PRODUCTION SYSTEM, VERSION 6.0

CLIPS, the C Language Integrated Production System, is a complete environment for developing expert systems -- programs which are specifically intended to model human expertise or knowledge. It is designed to allow artificial intelligence research, development, and delivery on conventional computers. CLIPS 6.0 provides a cohesive tool for handling a wide variety of knowledge with support for three different programming paradigms: rule-based, object-oriented, and procedural. Rule-based programming allows knowledge to be represented as heuristics, or "rules-of-thumb" which specify a set of actions to be performed for a given situation. Object-oriented programming allows complex systems to be modeled as modular components (which can be easily reused to model other systems or create new components). The procedural programming capabilities provided by CLIPS 6.0 allow CLIPS to represent knowledge in ways similar to those allowed in languages such as C, Pascal, Ada, and LISP. Using CLIPS 6.0, one can develop expert system software using only rule-based programming, only object-oriented programming, only procedural programming, or combinations of the three.

CLIPS provides extensive features to support the rule-based programming paradigm including seven conflict resolution strategies, dynamic rule priorities, and truth maintenance. CLIPS 6.0 supports more complex nesting of conditional elements in the if portion of a rule ("and", "or", and "not" conditional elements can be placed within a "not" conditional element). In addition, there is no longer a limitation on the number of multifield slots that a deftemplate can contain.

The CLIPS Object-Oriented Language (COOL) provides object-oriented programming capabilities. Features supported by COOL include classes with multiple inheritance, abstraction, encapsulation, polymorphism, dynamic binding, and message passing with message-handlers. CLIPS 6.0 supports tight integration of the rule-based programming features of CLIPS with COOL (that is, a rule can pattern match on objects created using COOL).

CLIPS 6.0 provides the capability to define functions, overloaded functions, and global variables interactively. In addition, CLIPS can be embedded within procedural code, called as a subroutine, and integrated with languages such as C, FORTRAN and Ada. CLIPS can be easily extended by a user through the use of several well-defined protocols. CLIPS provides several delivery options for programs including the ability to generate stand alone executables or to load programs from text or binary files.

CLIPS 6.0 provides support for the modular development and execution of knowledge bases with the defmodule construct. CLIPS modules allow a set of constructs to be grouped together such that explicit control can be maintained over restricting the access of the constructs by other modules. This type of control is similar to global and local scoping used in languages such as C or Ada. By restricting access to deftemplate and defclass constructs, modules can function as blackboards, permitting only certain facts and instances to be seen by other modules. Modules are also used by rules to provide execution control.

The CRSV (Cross-Reference, Style, and Verification) utility included with previous version of CLIPS is no longer supported. The capabilities provided by this tool are now available directly within CLIPS 6.0 to aid in the development, debugging, and verification of large rule bases.

COSMIC offers four distribution versions of CLIPS 6.0: UNIX (MSC-22433), VMS (MSC-22434), MACINTOSH (MSC-22429), and IBM PC (MSC-22430). Executable files, source code, utilities, documentation, and examples are included on the program media. All distribution versions include identical source code for the command line version of CLIPS 6.0. This source code should compile on any platform with an ANSI C compiler. Each distribution version of CLIPS 6.0, except that for the Macintosh platform, includes an executable for the command line version. For the UNIX version of CLIPS 6.0, the command line interface has been successfully implemented on a Sun4 running SunOS, a DECstation running DEC RISC ULTRIX, an SGI Indigo Elan running IRIX, a DEC Alpha AXP running OSF/1, and an IBM RS/6000 running AIX. Command line interface executables are included for Sun4 computers running SunOS 4.1.1 or later and for the DEC RISC ULTRIX platform. The makefiles may have to be modified slightly to be used on other UNIX platforms.

The UNIX, Macintosh, and IBM PC versions of CLIPS 6.0 each have a platform specific interface. Source code, a makefile, and an executable for the Windows 3.1 interface version of CLIPS 6.0 are provided only on the IBM PC distribution diskettes. Source code, a makefile, and an executable for the Macintosh interface version of CLIPS 6.0 are provided only on the Macintosh distribution diskettes. Likewise, for the UNIX version of CLIPS 6.0, only source code and a makefile for an X-Windows interface are provided. The X-Windows interface requires MIT's X Window System, Version 11, Release 4 (X11R4), the Athena Widget Set, and the Xmu library. The source code for the Athena Widget Set is provided on the distribution medium. The X-Windows interface has been successfully implemented on a Sun4 running SunOS 4.1.2 with the MIT distribution of X11R4 (not OpenWindows), an SGI Indigo Elan running IRIX 4.0.5, and a DEC Alpha AXP running OSF/1 1.2.

The VAX version of CLIPS 6.0 comes only with the generic command line interface. ASCII makefiles for the command line version of CLIPS are provided on all the distribution media for UNIX, VMS, and DOS.

Four executables are provided with the IBM PC version: a windowed interface executable for Windows 3.1 built using Borland C++ v3.1, an editor for use with the windowed interface, a command line version of CLIPS for Windows 3.1, and a 386 command line executable for DOS built using Zortech C++ v3.1. All four executables are capable of utilizing extended memory and require an 80386 CPU or better. Users needing an 8086/8088 or 80286 executable must recompile the CLIPS source code themselves. Users who wish to recompile the DOS executable using Borland C++ or MicroSoft C must use a DOS extender program to produce an executable capable of using extended memory.

The version of CLIPS 6.0 for IBM PC compatibles requires DOS v3.3 or later and/or Windows 3.1 or later. It is distributed on a set of three 1.4Mb 3.5 inch diskettes. A hard disk is required. The Macintosh version is distributed in compressed form on two 3.5 inch 1.4Mb Macintosh format diskettes, and requires System 6.0.5, or higher, and 1Mb RAM. The version for DEC VAX/VMS is available in VAX BACKUP format on a 1600 BPI 9-track magnetic tape (standard distribution medium) or a TK50 tape cartridge. The UNIX version is distributed in UNIX tar format on a .25 inch streaming magnetic tape cartridge (Sun QIC-24). For the UNIX version, alternate distribution media and formats are available upon request.

The CLIPS 6.0 documentation includes a User's Guide and a three volume Reference Manual consisting of Basic and Advanced Programming Guides and an Interfaces Guide. An electronic version of the documentation is provided on the distribution medium for each version: in MicroSoft Word format for the Macintosh and PC ver-

sions of CLIPS, and in both PostScript format and MicroSoft Word for Macintosh format for the UNIX and DEC VAX versions of CLIPS. CLIPS was developed in 1986 and Version 6.0 was released in 1993.

SUBMITTED BY -

NASA JOHNSON SPACE FLIGHT CENTER

INQUIRIES CONCERNING THIS PROGRAM SHOULD BE ADDRESSED TO -

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TFSSRA - THICK FREQUENCY SELECTIVE SURFACE WITH RECTANGULAR APERTURES

Thick Frequency Selective Surface with Rectangular Apertures (TFSSRA) was developed to calculate the scattering parameters for a thick frequency selective surface with rectangular apertures on a skew grid at oblique angle of incidence. The method of moments is used to transform the integral equation into a matrix equation suitable for evaluation on a digital computer. TFSSRA predicts the reflection and transmission characteristics of a thick frequency selective surface for both TE and TM orthogonal linearly polarized plane waves.

A model of a half-space infinite array is used in the analysis. A complete set of basis functions with unknown coefficients is developed for the waveguide region (waveguide modes) and for the free space region (Floquet modes) in order to represent the electromagnetic fields. To ensure the convergence of the solutions, the number of waveguide modes is adjustable. The method of moments is used to compute the unknown mode coefficients. Then, the scattering matrix of the half-space infinite array is calculated. Next, the reference plane of the scattering matrix is moved half a plate thickness in the negative z-direction, and a frequency selective surface of finite thickness is synthesized by positioning two plates of half-thickness back-to-back. The total scattering matrix is obtained by cascading the scattering matrices of the two half-space infinite arrays.

TFSSRA is written in FORTRAN 77 with single precision. It has been successfully implemented on a Sun4 series computer running SunOS, an IBM PC compatible running MS-DOS, and a CRAY series computer running UNICOS, and should run on other systems with slight modifications. Double precision is recommended for running on

a PC if many modes are used or if high accuracy is required. This package requires the LINPACK math library, which is included. TFSSRA requires 1Mb of RAM for execution. The standard distribution medium for this program is one 5.25 inch 360K MS-DOS format diskette. It is also available on a .25 inch streaming magnetic tape cartridge (Sun QIC-24) in UNIX tar format. This program was developed in 1992 and is a copyrighted work with all copyright vested in NASA.

SUBMITTED BY -

J.C. CHEN

CAL TECH/JET PROPULSION LAB.

INQUIRIES CONCERNING THIS PROGRAM SHOULD BE ADDRESSED TO -

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4. MARKETING

The marketing activities performed by COSMIC involve: promotion of COSMIC and computer programs available from COSMIC in the technical press and trade journals; attendance at trade shows and professional society meetings to promote the services and software available from COSMIC; utilization of various media for the general promotion of COSMIC; utilization of benefits analysis reports to highlight COSMIC's technology transfer function; and preparation of abstract collections and program summaries.

No trade shows were scheduled for August. The COSMIC diskette catalog was updated in August along with the Joint COSMIC/ESTSC catalog. The mid-year issue of the Software Technology Transfer was sent out in August.

A Memorandum of Understanding between STAC and COSMIC was signed in August. This MOU outlines some ways COSMIC and STAC can market their services jointly to the Southeast Region.

The Assistant Director visited Goddard and Headquarters while in Washington to discuss some RIG activities with DOD personnel at the Pentagon.

The Director attended the Southeast Region RTTC/FLC Affiliates Meeting in Research Triangle Park, North Carolina, and presented a briefing on COSMIC activities to both groups.

The calendar of events follows.

Sept. 21-23, 1993 **UNIX-Expo**, New York, NY

Meeting Contact: Christina Coudas

COSMIC: Exhibit (Brian Clements)

Oct. 5-7, 1993 **Networld**, Dallas, TX

Meeting Contact: Walter Heiland

COSMIC: Exhibit with NASA

Oct. 19-21, 1993 **Computing in Aerospace 9**, San Diego, CA

Meeting Contact: Melinda Howell

COSMIC: Table-Top Exhibit and Panel on Software Reuse.

(John Gibson)

Oct. 22, 1993 **NASTRAN Advisory Group**, San Diego, CA

Contact: Shirley Sanders

COSMIC: Host (John Gibson)

Nov. 16-18, 1993 **RIG Meeting** - Athens, GA

COSMIC: Host

Dec. 7-9, 1993 **Technology 2003**, Anaheim, CA

Meeting Contact: Wendy Janiel

(800) 944-NASA

COSMIC: Exhibit (Staff)

Jan. 10-13, 1994 **AIAA Sciences Conference**, Reno, NV

Contact: Melinda Howell (202) 646-7467

COSMIC: Exhibit (John Gibson)

April 25-29, 1994 **NASTRAN Users' Colloquium**, San Diego, CA

Meeting Contact: Shirley Sanders

COSMIC: Host

June 27-29, 1994 **T^2S Annual Meeting**, Huntsville, AL

Meeting Contact: Dick Snow

COSMIC: Attend

5. CUSTOMER SERVICE

Customer Service provided by COSMIC, in addition to the distribution of program code and documentation, includes responding to requests for information. These requests may be in the form of telephone calls, letters, Tech Briefs cards, mini-brochure cards, trade show return cards, or magazine inquiry cards. Generally the requested information concerns the services provided by COSMIC, or information on specific programs or groups of programs which may be available from COSMIC. This month, a total of 4430 information requests were processed. This was divided into 4324 domestic requests and 106 international requests. Of the domestic requests, 1433 were responses to Tech Briefs and 852 were responses to press releases, paid ads, and card decks. In addition to the above, E-Mail new program announcements were sent to 2188 E-Mail subscribers, and there were 286 sessions on the COSLINE information system.

One other area of customer service is the response to requests for information relevant to problems associated with a particular program product installation. These requests are usually handled jointly with the Technical Service staff. After the customer problems have been resolved, a Problem Report Sheet is processed and added to the program package file for future reference. No problem reports were processed this month.

During the current month, a total of 181 customers representing 162 organizations received materials (program, documentation, or catalogs) from COSMIC. Customers

represent individuals, whereas, organizations represent corporations or institutions. These customers are located in 31 different states or territories. Both NASA and non-NASA disseminations are reflected in these statistics.

6. BENEFITS IDENTIFICATION

COSMIC follows an active campaign of interviewing previous customers in order to ascertain the utility of distributed programs and identify specific benefits accruing to users of these programs. Additionally, contact with customers is used to evaluate the services provided by COSMIC. When notable benefits are identified, they are documented in reports written by COSMIC staff which are then approved for public release by the customers. One benefit report was released for publication this month.

COSMIC SOFTWARE BENEFITS REPORT

The following report describes one application of software developed as part of a project funded by the National Aeronautics and Space Administration. The Computer Software Management and Information Center (COSMIC) operates as an extension of NASA's Technology Utilization Program to supply NASA computer programs to other agencies and the private sector. For additional information on this or other NASA software packages, call or write COSMIC.

Program Title:	CLIPS
Program Number:	MSC-21916
NASA Center:	Johnson Space Center
Organization Name:	MathSoft, Inc.

MathSoft, Inc. is the leading developer of technical calculation software for desktop computers. Founded in 1985, MathSoft released its primary product, Mathcad, a year later. Mathcad provides a "live," easy-to-use software alternative to scratch pads, whiteboards, calculators and spreadsheets.

MathSoft co-founder and chairman Allen Razdow, who is also vice president of research and development, is always looking for ways to make his company's products easier to use. In doing so, he discovered NASA'S C Language Integrated Production System (CLIPS), a shell for developing expert systems. CLIPS is designed to allow for the research, development, and delivery of artificial intelligence on conventional computers. A collection of conditions and the actions to be taken if these conditions are met are constructed into a rule network by the CLIPS "rules engine". As facts are asserted either prior to or during a session, these facts are matched to this rule network. The versatility and portability of CLIPS has made it a valuable research tool for a variety of applications.

After reviewing CLIPS, Mr. Razdow gave Ed Burke, Principal Engineer at MathSoft, the task of determining whether CLIPS could be integrated into Mathcad. The result of Mr. Burke's efforts is a major advance in calculation software called SmartMath and is included in the latest version of the program, Mathcad 4.0. Written using CLIPS, SmartMath provides an intelligent interface between the user's problem and Mathcad's numeric and symbolic capabilities. By using a program developed by NASA, MathSoft saved the time and money involved in writing a program from scratch. SmartMath reviews the user's input and executes a strategy for solving the problem by writing a new set of Mathcad equations in a pop-up window, and delivering the results to the Mathcad document. Thus, the user is freed from having to construct his own Mathcad solutions, and the product becomes more powerful and easier to use.

Two basic SmartMath features -- Symbolic/Numeric Optimization and Fully Integrated, Live Symbolics -- are currently implemented. The first feature uses Mathcad's symbolic processor to simplify expressions before they are computed by Mathcad. As a result, Mathcad can directly solve problems that used to require several steps, resulting in faster, more accurate solutions. In Fully Integrated, Live Symbolics, a new "symbolic equal-sign" triggers SmartMath to evaluate expressions symbolically, using all previous definitions in the document. Thus, just like Mathcad's numerical calculations, SmartMath will recompute a symbolic result whenever any of the equations it depends on are changed.

By using existing software, companies can develop and enhance their products more efficiently and with less cost than if they wrote the program themselves. Also, NASA is able to sell its programs at a greater discount than private software

companies. CLIPS is available from COSMIC, NASA's Software Technology Transfer Center. COSMIC is located at the University of Georgia, in Athens, Ga.

7. MAINTENANCE AND SUPPORT

AUGUST PROGRESS REPORT FOR NASTRAN MAINTENANCE

RPK's primary goal for August was to deliver the 1993 DEC ULTRIX version of NASTRAN with updated supplemental documentation, and to define the requirements for delivering the 1993 generic version of NASTRAN. These goals were accomplished. RPK successfully eliminated the need to use any special beta-test FORTRAN compiler on the ULTRIX version using a DEC standard-released FORTRAN compiler. The following is an itemization of the work accomplished during the month of August:

1. The DEC ULTRIX version of NASTRAN was delivered to COSMIC for distribution. This included both the deliverable software system and the associated documentation.
2. Supplemental documentation for the 1993 DEC ULTRIX NASTRAN Release was completely rewritten. The supplemental documentation for all versions is now in the same format with the same table of contents.
3. All demonstration problems were run and validated for the 1993 DEC ULTRIX NASTRAN release.
4. A meeting was held with COSMIC to define the requirements for the generic version of NASTRAN and to determine future work items to be included in the 1994 versions of NASTRAN. The results from this meeting were documented in a memo dated August 20 sent to COSMIC from RPK. A brief summary of the results of this meeting is given below:

a. Create a supplemental documentation for the generic version that is similar in format to the supplemental documentation for the ULTRIX version. This documentation will describe the methods and procedures for installing the generic version of NASTRAN on any given UNIX platform. Included will be documentation on a "C" shell user interface for NASTRAN.

b. Install NASTRAN on the DEC ALPHA platform on both Open VMS and OSF systems. This will be a new deliverable product to be announced at the 1994 NASTRAN Colloquium.

c. Emphasis is to be placed on determining new algorithms for the symmetric matrix decomposition.

d. Correct all outstanding SPRs.

e. Other future work items were defined for consideration by the NASTRAN Advisory Group (NAG).

5. Support was given to NASTRAN users as follows:

a. Helped Ken Zagzebski of Wyle Laboratories with a very large problem that was using up all available disk space on his DEC VAX. The problem was successfully executed. Two SPRs resulted from this that are being documented to be corrected for the 1994 release.

b. Helped Greg Davis of JPL with his generic version of NASTRAN on the SUN. The problem involved opening FORTRAN unit 12 for the PLT1 file.

c. Received and documented an SPR from Bill Case of GSFC that described problems with the calculation of MPC forces.

d. Provided information to eight (8) potential lessees.

e. Aided seven (7) lessees with problems that did not result in an SPR.

6. Work began on merging all corrections for the different 1993 versions of NASTRAN. In addition, cleanup of the code began and included the following:
   a. Eliminating open core common blocks needed for machines requiring overlay structures (no longer supported).
   b. Eliminate commented code that is no longer valid.
   c. Modify code with statements to be commented and un-commented for various platforms.

The following tasks are defined for the month of September:

1. Deliver the 1993 generic version of NASTRAN including rewriting the user supplemental documentation. This includes installing and validating the generic version on two UNIX platforms to be defined by COSMIC (not including the DEC ULTRIX).
2. Complete the cleanup of the code for the 1994 releases.
3. Begin working on SPRs as documented in the memo from RPK to COSMIC dated August 20.
4. Install all code changes as provided by the Naval Surface Warfare Center.
5. Respond to users who call with problems.

RPK will begin working this month on work items to be completed for the 1994 releases. RPK plans to deliver the 1993 generic version during the month of September. Requirements of this generic version are now defined and with the new user supplemental documentation should become a clear definite product of COSMIC for general use. If there are any questions, please call.

TABLE 4 TOTAL DISSEMINATIONS

ITEM	Current Month VOLUME	Current Month VALUE	Dec. 1, 1991 To Date VOLUME	Dec. 1, 1991 To Date VALUE
A. ITEMS INVOICED				
1. Programs	48	25,400.00	1253	868,000.50
2. Documentation	101	5,537.00	2406	163,296.00
3. Leases (Initial)	16	14,600.00	432	420,549.00
4. Leases (Renewals)	1	2,500.00	155	590,100.01
5. Leases (Misc.)	0	0	0	0
6. Catalogs	48	1,345.00	1084	32,695.00
7. Miscellaneous	16	2,127.41	442	55,862.86
TOTAL INVOICE		$51,509.41		$2,130,503.37
B. NASA (No Charge)				
1. Programs	31	34,750.00	635	652,284.00
2. Documentation	37	1,985.00	759	40,416.00
3. Leases (Initial)	6	21,800.00	162	295,700.00
4. Leases (Renewals)	3	12,000.00	70	282,000.00
5. Leases (Misc.)	0	0	0	0
6. Catalogs	0	0	1036	26,255.00
7. Miscellaneous	0	0	19	2,470.00
TOTAL NASA		$70,535.00		$1,299,125.00
C. OTHER (No Charge)				
1. Programs	4	3,850.00	107	121,375.00
2. Documentation	0	0	48	2,527.00
3. Leases	3	15,000.00	10	37,000.00
4. Catalogs	0	0	4	140.00
5. Miscellaneous	0	0	1	100.00
TOTAL OTHER		$18,850.00		$161,142.00
GRAND TOTAL DISSEMINATION		$140,894.41		$3,590,770.37

TABLE 5 NASTRAN DISSEMINATIONS

ITEM	Current Month VOLUME	Current Month VALUE	Dec. 1, 1991 To Date VOLUME	Dec. 1, 1991 To Date VALUE
A. ITEMS INVOICED				
1. Licenses Initial	0	0	7	21,300.00
2. Licenses Renewals	0	-1,500.00	116	364,475.01
3. Licenses (Misc.)	0	0	0	0
4. Documentation	4	160.00	117	6,280.00
5. Miscellaneous	1	735.91	6	4,272.24
TOTAL NASTRAN INVOICED		$(604.09)		$396,327.25
B. NASA (No Charge)				
1. Licenses Initial	1	5,500.00	9	42,500.00
2. Licenses Renewals	3	12,000.00	48	190,000.00
3. Licenses (Misc.)	0	0	0	0
4. Documentation	0	0	39	2,540.00
5. Miscellaneous	0	0	0	0
TOTAL NASA NASTRAN		$17,500.00		$235,040.00
GRAND TOTAL NASTRAN		$16,895.91		$631,367.25

TABLE 6 DOD DISSEMINATIONS

ITEM	Current Month VOLUME	Current Month VALUE	Dec. 1, 1991 To Date VOLUME	Dec. 1, 1991 To Date VALUE
A. ITEMS INVOICED				
1. Programs	0	0	7	9,300.00
2. Documentation	2	54.00	17	733.00
3. Leases	0	0	10	2,000.00
TOTAL DOD		$54.00		$12,033.00

TABLE 7 FOREIGN DISSEMINATIONS

ITEM	Current Month VOLUME	Current Month VALUE	Dec. 1, 1991 To Date VOLUME	Dec. 1, 1991 To Date VALUE
A. ITEMS INVOICED				
1. Programs	7	6,300.00	248	349,150.00
2. Documentation	15	1,656.00	399	52,967.00
3. Leases (Initial)	1	2,150.00	40	127,100.00
4. Leases (Renewals)	0	0	24	148,400.00
5. Leases (Misc.)	0	0	0	0
6. Catalogs	3	145.00	117	6,710.00
7. Miscellaneous	3	421.00	71	14,640.40
TOTAL FOREIGN		$10,672.00		$698,967.40

FINANCIAL STATUS

NASW 4670

AUGUST 1993

	CURRENT MONTH	CONTRACT TO DATE
Expense:		
Personnel	49,136.15	923,843.50
Staff Benefits	13,663.44	259,258.32
Travel	1,933.77	53,436.98
Equipment Purchases	0	27,613.95
Computer Time	277.10	8,610.13
Operating Expense	35,852.12	540,304.32
Program Maintenance	0	738,818.01
Overhead	22,165.64	441,000.78
Total Expense	123,028.22	2,992,885.99
Income:		
Sales Income	71,961.50	1,901,578.50
NASA Payments	71,711.75	1,252,905.75
Total Income	143,673.25	3,154,484.25
FINANCIAL STATUS:		
Income - Expense	20,645.03	161,598.26