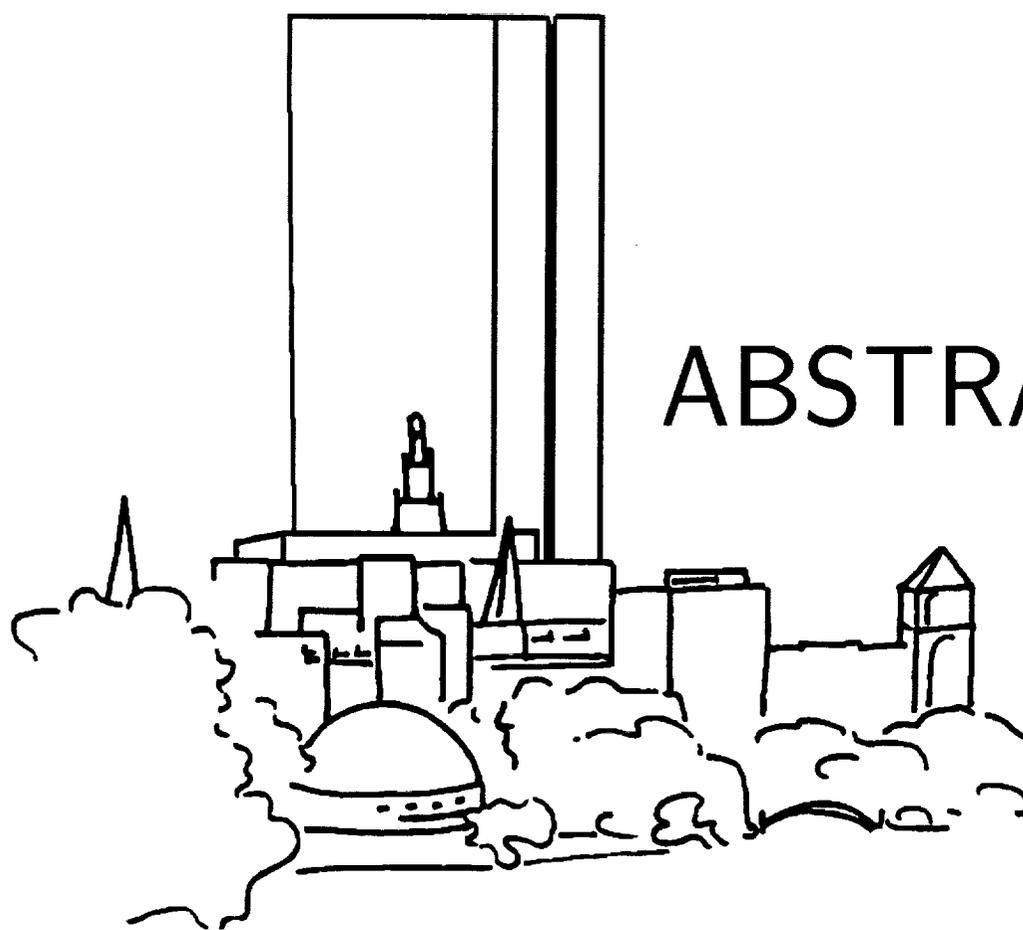Second Annual Conference on

Astronomical Data Analysis Software and Systems

November 2-4, 1992

Boston, Massachusetts
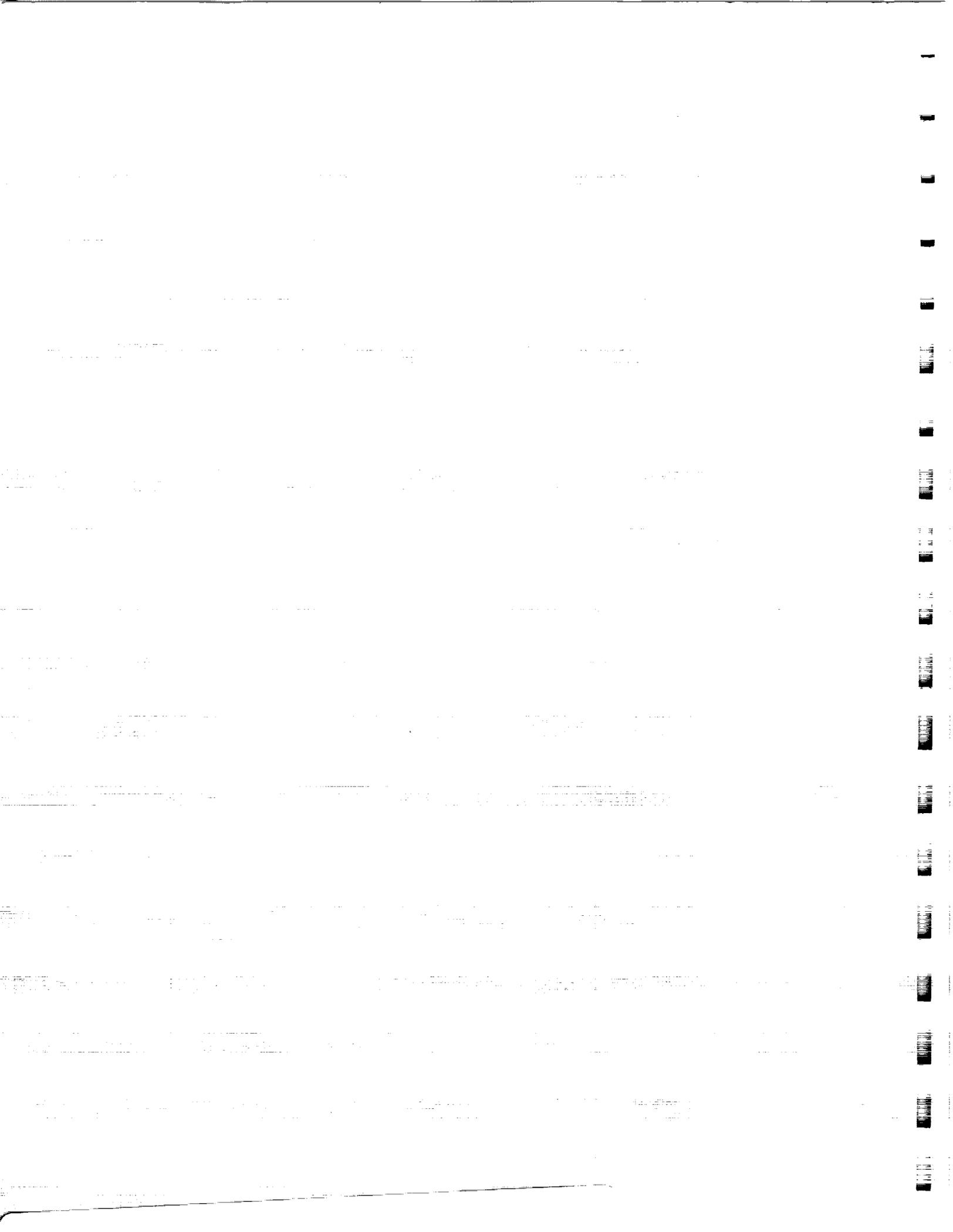
ABSTRACTS

Conference Sponsored by:
    National Aeronautics and Space Administration
    National Optical Astronomy Observatories
    National Science Foundation
    Smithsonian Astrophysical Observatory
    Space Telescope Science Institute

Second Annual Conference on

Astronomical Data Analysis Software and Systems

November 2-4, 1992

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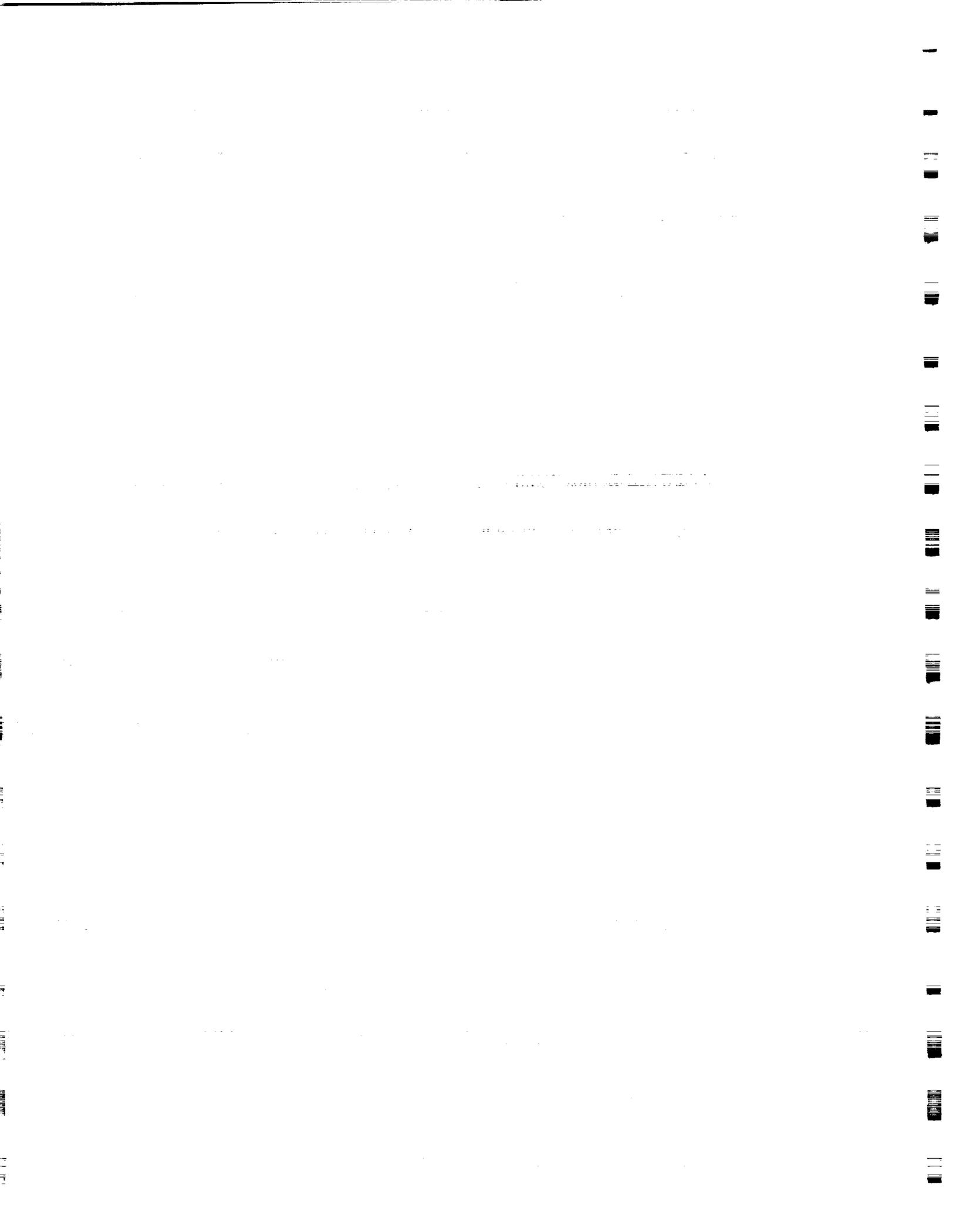
Second Annual Conference on
Astronomical Data Analysis Software and Systems
Monday, November 2, 1992

General Session 1: Next Generation Software Systems and Languages I
Moderator: Bob Hanisch

R.J. Hanisch/F.R. Harnden	8:30- 8:45 am	Opening Remarks
A. Farris	8:45- 9:15 am	C++, Object-Oriented Programming, and Astronomical Data Models
G.A. Croes	9:15- 9:45 am	On AIPS++, A New Astronomical Information Processing System
R.M. Hjellming	9:45-10:00 am	Programmability in AIPS++
	10:00-11:00 am	Poster/Demo Session and Break

General Session 2: Databases, Catalogues and Archives I
Moderator: Roger Brissenden

M.E. Van Steenberg	11:00-11:30 am	NASA's Astrophysics Archives at the National Space Science Data Center
M.A. Albrecht	11:30-12:00 pm	Archiving Data From Ground-based Telescopes
D. Durand	12:00-12:15 pm	A Distributed Clients/Distributed Servers Model for STARCAT
W.E. Williams	12:15-12:30 pm	Tests of a Simple Data Merging Algorithm for the GONG Project
	12:30- 2:00 pm	Lunch

General Session 3: User Interfaces/Visualization I
Moderator: George Jacoby

M.J. Geller	2:00- 2:30 pm	Visualizing the Universe (Part I)
E.E. Falco	2:30- 2:45 pm	Visualizing the Universe (Part II)
J.A. Ewing	2:45- 3:00 pm	An IDL-based Analysis Package for COBE & Other Skycube-Formatted Astronomical Data
	3:00- 4:00 pm	Poster/Demo Session and Break

General Session 4: Real-Time Data Acquisition/Scheduling I
Moderator: Carol Christian

R.I. Kibrick	4:00- 4:30 pm	CCD Data Acquisition Systems at Lick & Keck Observatories
W.F. Lupton	4:30- 4:45 pm	The Keck Task Library (KTL)
B.D. Kelly	4:45- 5:00 pm	The ADAM Environment & Transputers
K.T.C. Jim	5:00- 5:15 pm	The U. Hawaii Institute for Astronomy CCD Camera Control System
P.R. Roelfsema	5:15- 5:30 pm	The ISO SWS On-Line System

BOF Sessions

E. Mandel (SAO)	7:30- 9:30 pm	User Interfaces
M. Fitzpatrick (NOAO)	8:00- 9:00 pm	Site Managers
W. Landsman (GSFC)	8:30- 9:30 pm	IDL

Final Program

Second Annual Conference on
Astronomical Data Analysis Software and Systems
Tuesday, November 3, 1992

General Session 5: User Interfaces/Visualization II
Moderator: Doug Tody

J. Gettys	8:30- 9:00 am	Crystal Ball Gazing
P. Ballester	9:00- 9:15 am	GUIs in the MIDAS Environment
E. Mandel	9:15- 9:30 am	AXAF UIs for Heterogeneous Analysis Environments
T.A. McGlynn	9:30- 9:45 am	Gamma-Core: The Compton Observatory Research Environment
B. O'Neel	9:45-10:00 am	XPI - The Xanadu Parameter Interface
	10:00-11:00 am	Poster/Demo Session and Break

General Session 6: Databases, Catalogues and Archives II
Moderator: Dennis Crabtree

A. Heck	11:00-11:30 am	Electronic Publishing & Intelligent Information Retrieval
M.J. Kurtz	11:30-11:45 am	Intelligent Text Retrieval in the NASA Astrophysics Data System
J.D. Williams	11:45-12:00 pm	StarView: The Object Oriented Design of the ST DADS User Interface
E. Deul	12:00-12:15 pm	Deep Near-Infrared Survey of the Southern Sky (DENIS)
N. Weir	12:15-12:30 pm	SkICAT: A Cataloging & Analysis Tool for Wide Field Imaging Surveys
	12:30- 2:00 pm	Lunch

General Session 7: Real-Time Data Acquisition/Scheduling II
Moderator: Dick Shaw

D.C. Wells	2:00- 2:30 pm	The VLBA Correlator - Real-Time in the Distributed Era
M.D. Johnston	2:30- 3:00 pm	The Application of Artificial Intelligence to Astronomical Scheduling Problems
	3:00- 4:00 pm	Poster/Demo Session and Break

General Session 8: Next Generation Software Systems and Languages II
Moderator: Diana Worrall

D. Tody	4:00- 4:30 pm	IRAF in the Nineties
K. Shortridge	4:30- 4:45 pm	The Evolution of the FIGARO Data Reduction System
H.U. Zimmermann	4:45- 5:00 pm	ROSAT Data Analysis with EXSAS
W. Landsman	5:00- 5:15 pm	The IDL Astronomy User's Library
A.H. Rots	5:15- 5:30 pm	Khoros Software Specification Format & Interoperability
	7:00-11:00 pm	Museum of Science Reception
	11:00-01:00 am	Election Night Soiree

Final Program

Second Annual Conference on
Astronomical Data Analysis Software and Systems
Wednesday, November 4, 1992

General Session 9: Next Generation Software Systems and Languages III
Moderator: Maureen Conroy

J.T. Himer	8:30- 9:00 am	Fortran for the Nineties
J. Bailey	9:00- 9:15 am	An Object-Oriented Data Reduction System in Fortran
M. Peron	9:15- 9:30 am	The ESO-MIDAS Table File System
P.M. Allan	9:30- 9:45 am	Multifrequency Data Analysis Software on STARLINK
A.R. Conrad	9:45-10:00 am	The Keck Keyword Layer
	10:00-11:00 am	Poster/Demo Session and Break

General Session 10: Miscellaneous
Moderator: Rick Harnden

A. Priebe	11:00-11:15 am	Adaptive Filtering of Echelle Spectra of Distant Quasars
F. Valdes	11:15-11:30 am	The Spectral World Coordinate Systems in IRAF/NOAO
D.G. Jennings	11:30-11:45 am	FITS Data Conversion Efforts at the Compton Observatory Science Support Center
L. Benacchio	11:45-12:00 pm	Database Activity in the Italian Astronet: DIRA 2
R.J. Hanisch	12:00-12:15 pm	HST Image Restoration: A Comparison of Pre- and Post-Servicing Mission Results
H.-M. Adorf	12:15-12:30 pm	Restoration of HST Images with Missing Data
R.J. Hanisch/F.R. Harnden	12:30-12:40 pm	Closing Remarks
	12:40- 2:00 pm	Lunch

IRAF/STSDAS/PROS Status Reports

2:00- 2:30 pm	IRAF Panel Discussion
2:30- 3:00 pm	NOAO packages
3:00- 3:30 pm	STSDAS
3:30- 4:00 pm	PROS
4:00- 4:15 pm	Break

BOF Sessions

N. White (GSFC) K. Arnaud (GSFC)	4:15- 5:30 pm	XANADU
R.J. Hanisch (STScI) D. Wells (NRAO) P. Grosbøl (ESO)	4:15- 5:30 pm	FITS WCS

The Conference adjourns at 5:30 pm. All posters removed

Poster Session

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Daily – 8:30am-6:00pm

H.-M. Adorf	Scientific Computing in the 1990ies - An Astronomical Perspective
H.-M. Adorf	A Low-Cost Vector Processor Boosting Compute-Intensive Image Processing Operations
R. Allsman, et al.	How to Handle 6 GBytes a Night and Not Get Swamped
G.C. Anupama and A.K. Kembhavi	CCD Surface Photometry of Galaxies
T. Ayres, et al.	The Cool-Star Spectral Catalog: A Uniform Collection of IUE SWP-LOs
J. Bailey	A Self-Defining Hierarchical Data System
P. Barrett and A. Rots	A Structured Data Transfer Protocol
D. Bazell and I. Bankman	A Neural Network Prototyping Package within IRAF
J.J. Bloch, et al.	The ALEXIS Data Processing Package: An IDL Based System
J.O. Breen and D.M. Meleedy	Seeing the forest for the Trees: Networked Workstations as a Parallel Processing Computer
R.J.V. Brissenden, et al.	VETA X-ray Data Acquisition and Control System
B.C. Bromley	A Multiresolution Wavelet Representation in Two or More Dimensions
I. Busko	Experiments with Recursive Estimation in Astronomical Image Processing
B. Chen, et al.	Extracting Galactic Structure Parameters from Multivariated Density Estimation
• C. Christian, et al.	The EUVE Proposal Database and Scheduling System
M.A. Conroy, et al.	PROS: An IRAF Based System for Analysis of X-ray Data
M. Corcoran, et al.	ROSAT Implementation of a Proposed Multi-Mission X-ray Data Format
L.E. Davis	New IRAF Stellar Photometry Software
L.E. Davis	PHOTCAL: The IRAF Photometric Calibration Package
J. DePonte and F.A. Primini	Detection of X-ray Sources in PROS
J.J. Drake, et al.	The Extreme Ultraviolet Explorer Archive
J.D. Eisenhamer and Z.G. Levay	Enhancements to IRAF/STSDAS Graphics
M. Fitzpatrick	SPPTOOLS: Programming Tools for the IRAF SPP Language
M. Fitzpatrick	The IRAF Radial Velocity Analysis Package
A.A. Henden	Writing Instrument Interfaces with xf/tk/tcl
P.E. Hodge, et al.	Telescope Image Modelling Software in STSDAS
J.-C. Hsu and C.E. Ritchie	How is WFPC Flat Field Made
S.J. Hulbert, et al.	ASpect: A New Spectrum and Line Analysis Package for IRAF
• P.Jacobs, et al.	The HEASARC Graphical User Interface
L.M. John and J. Drake	Quality Control of EUVE Databases
J. Johnson	An Object-Oriented Approach for Supporting Both X and Terminal Interfaces
J.M. Jordan, et al.	A Generic Archive Protocol and an Implementation
D.A. Klinglesmith III, et al.	The Digital Archive of the International Halley Watch
J.E. Krist and H. Hasan	Deconvolution of Hubble Space Telescope Images Using Simulated Point Spread Functions
J.E. Krist	HST PSF Simulation Using Tiny Tim
N.A. Laubenthal, et al.	GRO/EGRET Data Analysis Software: An Integrated System of Custom and Commercial Software Using Standard Interfaces
S. Lesteven	SIMBAD Quality-control
J. Lewis, et al.	Data Indexing Techniques for the EUVE All-Sky Survey
D.M. Lytle	Interactive Spectral Analysis and Computation (ISAAC)
D.M. Lytle	The NSO FTS Database Program and Archive (FTSDBM)

Daily – 8:30am-6:30pm

K.R. Manning, et al.	Verification of the PROS Timing Analysis Package
M.R. Metzger, et al.	Wilbur: A Low-Cost CCD Camera System for MDM Observatory
D.J. Mink	SKYMAP: Exploring the Universe in Software
S.C. Odewahn, et al.	STARBASE: Database Software for the Automated Plate Scanner
C.G. Page and A.C. Davenhall	Evaluation of RDBMS Packages for use in Astronomy
L. Pásztor	Some Practicable pplications of Quadtree Data Structures/Representation in Astronomy
W.D. Pence and J.K. Blackburn	Development of the FITS Tools Package for Multiple Software Environments
J.W. Percival and R.L. White	Efficient Transfer of Images over Networks
A.P. Reynolds and A.N. Parmar	The EXOSAT Database and Archive
D. Schmidt, et al.	Spatial Region Filtering in IRAF/PROS
● R.L. Seaman	Managing an Archive of Weather Satellite Images
P.L. Shopbell and J. Bland-Hawthorn	Detector Noise Statistics in the Non-linear Regime
P.L. Shopbell and J. Bland-Hawthorn	The IRAF Fabry-Perot Analysis Package: Ring Fitting
K. Shortridge	The Data Acquisition System for the AAO 2-degree Field Project
D.P. Silberberg	Integrating a Local Database into the StarView Distributed User Interface
O.M. Smirnov and N.E. Piskunov	A New Programming Metaphor for Image Processing Procedures
● O.M. Smirnov and N.E. Piskunov	PCIPS 2.0: Powerful Multiprofile Image Processing Implemented on PCs
● O.M. Smirnov and O.Yu. Malkov	Guide Star Catalogue Data Retrieval Software II
E.P. Smith, et al.	UIT Support Observations Archive
L.V. Tóth, et al.	Factor Analysis as a Tool for Spectral Line Component Separation 21cm Emission in the Direction of L1780
J.J. Travisano and J. Pollizzi	Recommendations for a Service Framework to Access Astronomical Archives
B. Turgeon and A. Aston	Tools for the IDL Widget Set within the X-Windows Environment
● F. Valdes	SPECFOCUS: An IRAF Task for Focusing Spectrographs
● F. Városi and W.B. Landsman	DECONV_TOOL: An IDL-based Deconvolution Software Package
● F.Városi and D.Y. Gezari	MOSAIC: IDL Software for Creating Mosaics from Collections of Images
A. Warnock, et al.	STELAR: An Experiment in the Electronic Distribution of Astronomical Literature
R.F. Warren-Smith and P.T. Wallace	The STARLINK Software Collection
R.L. Williamson II	Registering and Resampling Images in STSDAS
N. Wu	First MEM Task IRMEO in IRAF
X. Yan, et al.	Solar Full-disk Magnetic Field Image Receiving System and Observation Software
N.R. Zarate	IRAF and STSDAS Under the New ALPHA Architecture
X. Zhang, et al.	Miyur 232 MHz Survey I - Fields Centered at: $\alpha : 00^h : 41^m, \delta : 41°12'$ and $\alpha : 07^h00^m, \delta : 35°00'$

The Conference adjourns at 5:30pm on Wednesday, November 4, 1992.
All posters removed by 5:00pm.

● Presentation includes demo

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MIDAS
K. Banse and P. Grosbøl
European Southern Observatory

IRAF
J. Barnes and F. Valdes
National Optical Astronomy Observatories

EXSAS
T. Belloni and C. Izzo
Max Planck Institut für Extraterrestrische Physik

Spyglass, Inc.
Spyglass is a developer of easy-to-use visual data analysis software for UNIX workstations and the Macintosh.
Spyglass Transform, which supports many file formats including FITS and HDF, will be demonstrated on a Sun Spacstation.
B. Fortner and M.F. Tyrrell
Spyglass, Inc.

The Peak Technologies Group, Inc.
Peak Technologies is a nationwide, value-added distributor of Hewlett Packard disk, tape & optical storage products. Peak Technologies storage products are designed to provide maximum performance & compatibility with UNIX workstations and personnel computers
M. Hall and J. D'Amico
The Peak Technologies Group .

RSDC/PROS
D. Harris and J. Orszak
Smithsonian Astrophysical Observatory

SPIKE: Application for ASTRO-D Mission Planning
T. Isobe and E. Morgan
Massachusetts Institute of Technology - CSR

SIMBAD
C. Maxon and J. Watson
Smithsonian Astrophysical Observatory

An X-ray Archive on your Desk - The *Einstein* CD-ROMs
A. Prestwich and J. McDowell
Smithsonian Astrophysical Observatory
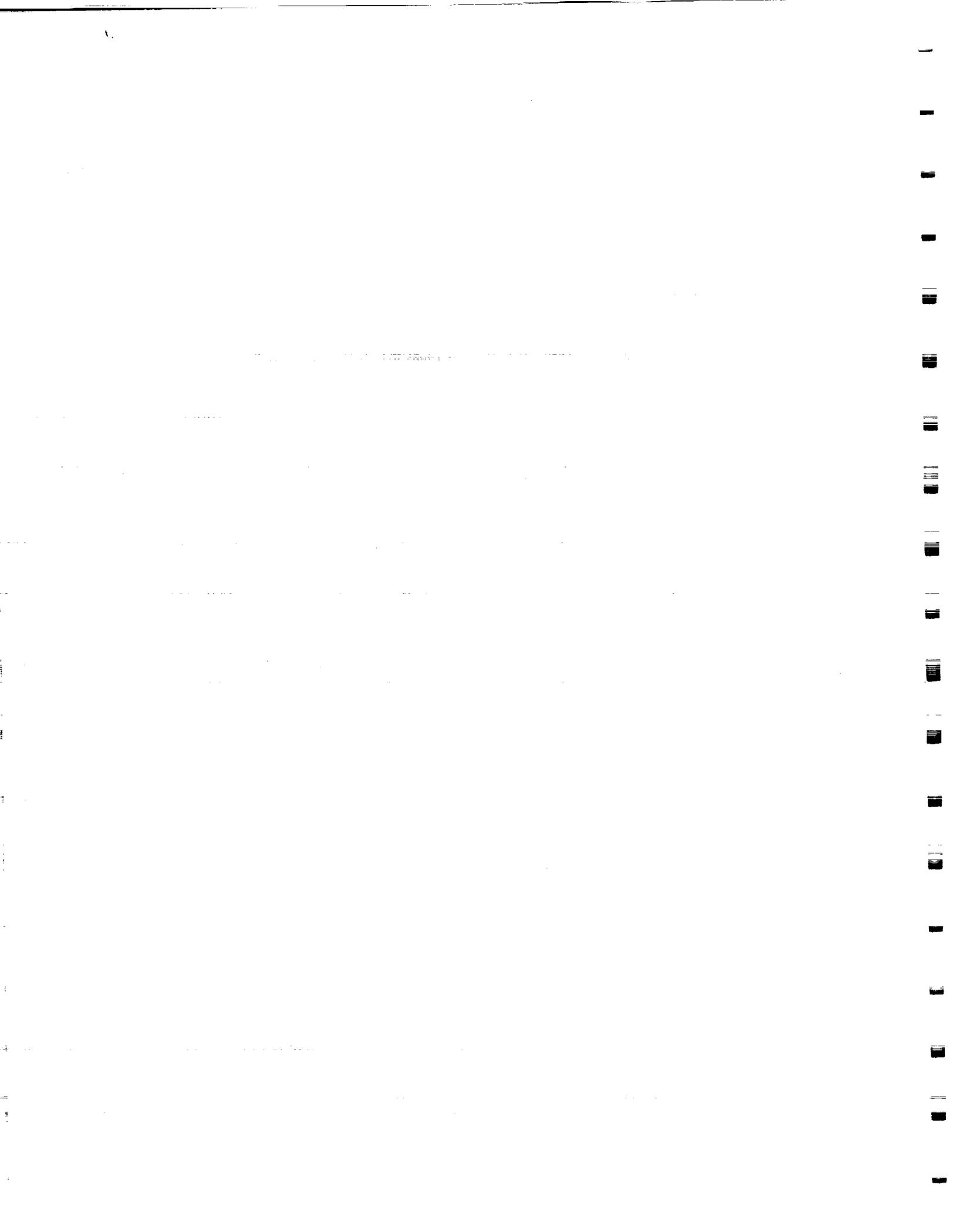
IDL
D.M. Stern
Research Systems, Inc.

ADS
C. Stern-Grant and T. Karakashian
Smithsonian Astrophysical Observatory

The Conference adjourns at 5:30pm on Wednesday, November 4, 1992

ABSTRACTS

(Abstracts appear in alphabetical order)

Restoration of HST images with missing data

H.-M. Adorf

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Karl-Schwarzschild-Str. 2, D-8046 Garching b. München, F.R. Germany
Internet: adorf@eso.org — SPAN: ESO::ADORF

Abstract: Missing data are a fairly common problem when restoring Hubble Space Telescope observations of extended sources. On Wide Field and Planetary Camera images cosmic ray hits and CCD hot spots are the prevalent causes of data losses, whereas on Faint Object Camera images data are missed out due to reseaux marks, blemishes, areas of saturation and the omnipresent frame edges. This contribution discusses a technique for "filling in" missing data by statistical inference using information from the surrounding pixels. The major gain consists in minimizing adverse spill-over effects to the restoration in areas neighbouring those where data are missing. When the mask delineating the support of "missing data" is made dynamic, cosmic ray hits etc. can be detected on the fly during restoration.

Scientific Computing in the 1990ies - An Astronomical Perspective

Hans-Martin Adorf (European Southern Observatory)

The compute performance, storage capability, degree of networking and usability of modern computer hardware have enormously progressed in the past decade. These hardware advances are not paralleled by an equivalent increase in software productivity. Among astronomers the need is gradually perceived to discuss questions such as whether we are prepared to meet the pending challenge of vector and massively parallel computers. Therefore a moderated, time-limited and access-restricted, wide-area network discussion forum is proposed for having a first, broad- minded go at the question whether our current software efforts are heading in the right direction. The main topics, goals, means and form of the proposed discussion process is being laid out.

"One Mbyte of RAM now costs less than two lines of source code." - N. Plant 1992

References
Plant, N.: 1992, "Software in Crisis", Physics World 5, No. 9, 43-47.

A Low-Cost Vector Processor Boosting Compute-Intensive Image Processing Operations

Hans-Martin Adorf (European Southern Obseratory)

Low-cost vector processing (VP) is within reach to everyone seriously engaged in scientific computing. The advent of affordable add-on VP-boards for standard workstations complemented by mathematical/ statistical libraries is beginning to impact compute-intensive tasks such as image processing. A case in point is the restoration of distorted images from the Hubble Space Telescope. A low-cost implementation is presented of the standard Tarasko-Richardson-Lucy restoration algorithm on an Intel i860-based VP-board which is seamlessly interfaced to a commercial, interactive image processing system. First experience is reported (including some benchmarks for standalone FFTs) and some conclusions are drawn.

Archiving data from ground-based telescopes

M. A. Albrecht (ESO)

The scientific throughput of a particular observing facility has been demonstrated to be multiplied with the operation of a data archive and its corresponding retrieval system. A requisite to achieve such an exploitation is a well structured observations catalog, *i.e.* a catalog that includes all information necessary to reduce and analyse the data even many years after its acquisition. At the same time, an information system is required that allow users to browse through the catalog at different levels of detail, adapting the amount of information presented to the actual needs of the user.

Archiving data acquired with ground based telescopes is particularly difficult because of the relative short life-time of instruments and detectors in comparison to the expected life-time of the archive. This feature differentiates ground-based originated archives radically from its space-borne counterparts. The organisation of the observations catalogue becomes highly dependent on the capability of the archive to deal with new instrumental configurations. We introduce in this paper, the concept of a *catalog database* as opposed to the static catalog design currently in use in many archiving facilities, as a method to deal with this problem.

We also present a brief review of activities currently in progress in this area.

Multifrequency Data Analysis Software on STARLINK

P. M. Allan, STARLINK Project, (Rutherford Appleton Laboratory).

Although the STARLINK project was set up to provide image processing facilities to UK astronomers, it has grown over the last 12 years to the extent that it now provides most of the data analysis facilities for UK astronomers.

One aspect of the growth of the STARLINK network is that it now has to cater for astronomers working in a diverse range of wavelengths. Since a given individual may be working with data obtained in a variety of wavelengths, it is most convenient if the data can be stored in a common format and the programs that analyse the data have a similar 'look and feel'. What is known as 'STARLINK software' is obtained from many sources; from STARLINK funded programmers; from astronomers; from foreign projects such as AIPS; from generally available shareware; and from commercial sources when this proves cost effective. This means that the ideal situation of a completely integrated system cannot be realised in practice. Nevertheless, many of the major packages written by STARLINK application programmers and by astronomers do use a common data format, based on the Hierarchical Data System, so that interchange of data between packages designed separately from each other is simply a matter of using the same file names. For example, an astronomer might use KAPPA to read some optical spectra off a FITS tape, then use CCDPACK to debias and flat field the data (it is easy to set up an overnight batch job to do this if there is a lot of data), then use KAPPA to have a quick look at the data and then use Figaro to reduce the spectra.

It is useful to divide data analysis packages into wavelength specific packages, or even instrument specific packages, and general purpose ones. Once the instrumental signature has been removed from some data, any appropriate general purpose package can be used to analyse the data. For example, the ASTERIX package deals with X-ray data reduction, but after dealing with all of the X-ray specific processing, an astronomer may well want to find the brightness of objects in a given frame. Since ASTERIX uses the standard STARLINK data format, the astronomer can use PHO-TOM or DAOPHOT II to measure the brightness of the objects. Although DAOPHOT was written with optical astronomy in mind, it is useful for analysing data from several wavelengths. The ability of DAOPHOT II to handle non-standard point spread functions can be especially useful in many areas of astronomy.

How To Handle 6GBytes a Night and Not Get Swamped

R. Allsman, C. Alcock, T. Axelrod, D. Bennett, K. Cook, H.-S. Park (LLNL), K. Griest, S. Marshall, S. Perlmutter, C. Stubbs, W. Sutherland (Center for Particle Astrophysics, UCB), K. Freeman, B. Peterson, P. Quinn, A. Rodgers (Mt. Stromlo and Siding Spring Observatories, ANU)

The Macho Project has undertaken a 5 year effort to search for dark matter in the halo of the Galaxy by scanning the Magellanic Clouds for micro-lensing events. Each evening's raw image data will be reduced in real-time into the observed stars' photometric measurements. The actual search for micro-lensing events will be a post-processing operation.

The theoretical prediction of the rate of such events necessitates the collection of a large number of repeated exposures. The Project designed camera subsystem delivers 64 Mbytes per exposure with exposures typically occurring every 500 seconds. An ideal evening's observing will provide 6 Gbytes of raw image data and 40 Mbytes of reduced photometric measurements. Recognizing the difficulty of digging out from a snowballing cascade of raw data, the Project requires the real-time reduction of each evening's data. The software team's implementation strategy centered on this non-negotiable mandate.

Accepting the reality that 2 full time people needed to implement the core real-time control and data management system within 6 months, off-the-shelf vendor components were explored to provide quick solutions to the classic needs for file management, data management, and process control. Where vendor solutions were lacking, state-of-the-art models were used for hand tailored subsystems. In particular, petri nets manage process control, memory mapped bulletin boards provide interprocess communication between the multi-tasked processes, and C++ class libraries provide memory mapped, disk resident databases.

The differences between the implementation strategy and the final implementation reality will be presented. The necessity of validating vendor product claims will be explored. Both the successful and hindsight decisions enabling the collection and processing of the nightly data barrage will be reviewed.

CCD Surface Photometry of Galaxies

G.C. Anupama and A.K. Kembhavi (IUCAA)

We present here the results based on analysis of broad band optical images of radio loud and radio quiet galaxies selected from a set of x-ray galaxies. Data reduction techniques, and surface photometry using the IRAF data reduction package are described. The radial surface brightness profile of each galaxy is obtained. The disc, bulge and nucleus of the galaxy are modelled based on the estimated brightness profile. The model of the galaxy is constructed, which is subtracted from the observed image to enhance the small scale features in the galaxy. Colour maps of the galaxy are obtained and compared with those of normal galaxies. The optical properties of the galaxy are compared with its x-ray and radio properties.

The COOL-STAR SPECTRAL CATALOG: A Uniform Collection of IUE SWP-LOs

T. Ayres, D. Lenz, R. Burton (U. Colorado, CASA), & J. Bennett (NASA HQ)

Over the past decade and a half of its operations, the International Ultraviolet Explorer has recorded low-dispersion (5 Å resolution) spectrograms in the 1150–2000 Å interval of more than 800 stars of late spectral type (F–M). The sub–2000 Å region contains a number of emission lines – like O I $\lambda1304$, C II $\lambda1335$, and C IV $\lambda1549$ – that are key diagnostics of physical conditions in the high-excitation chromospheres and subcoronal "transition zones" of such stars. Many of the sources have been observed a number of times, and the available collection of SWP-LO exposures in the IUE Archives exceeds 4,000.

With support from the Astrophysics Data Program, we have assembled the archival material into a catalog of IUE far-UV fluxes of late-type stars. In order to ensure uniform processing of the spectra, we: (1) photometrically corrected the raw vidicon images with a custom version of the 1985 SWP ITF; (2) identified, and eliminated, sharp cosmic-ray "hits" by means of a spatial filter; (3) extracted the spectral traces with the "Optimal" (weighted-slit) strategy; and (4) calibrated them against a well-characterized reference source, the DA white dwarf G191-B2B. Our approach is similar to that adopted by the IUE Project for its "Final Archive", but our implementation is specialized to the case of chromospheric emission-line sources.

We measured the resulting SWP-LO spectra using a semi-autonomous algorithm that establishes a smooth continuum by numerical filtering, and then fits the significant emissions (or absorptions) by means of a constrained Bevington-type multiple-Gaussian procedure. The algorithm assigns errors to the fitted fluxes – or upper limits in the absence of a significant detection – according to a model based on careful measurements of the noise properties of the IUE's intensified SEC cameras.

Here, we describe: the "visualization" strategies we adopted to ensure human-review of the semi-autonomous processing and measuring algorithms; the derivation of the noise model and the assignment of errors; and the structure of the final catalog as delivered to the Astrophysics Data System.

An Object-Oriented Data Reduction System in Fortran

J. Bailey (AAO)

A data reduction system for the AAO two-degree field project is being developed using an object-oriented approach. Rather than use an object-oriented language (such as C++) the system is written in Fortran and makes extensive use of existing subroutine libraries provided by the UK Starlink project. Objects are created using the extensible N-dimensional Data Format (NDF) which itself is based on the Hierarchical Data System (HDS).

The software consists of a class library, with each class corresponding to a Fortran subroutine with a standard calling sequence. The methods of the classes provide operations on NDF objects at a similar level of functionality to the applications of conventional data reduction systems. However, because they are provided as callable subroutines, they can be used as building blocks for more specialist applications.

The class library is not dependent on a particular software environment though it can be used effectively in ADAM applications. It can also be used from standalone Fortran programs. It is intended to develop a graphical user interface for use with the class library to form the 2dF data reduction system.

A Self-Defining Hierarchical Data System

J. Bailey (AAO)

The Self-Defining Data System (SDS) is a system which allows the creation of self-defining hierarchical data structures in a form which allows the data to be moved between different machine architectures. Because the structures are self-defining they can be used for communication between independent modules in a distributed system.

Unlike disk-based hierarchical data systems such as Starlink's HDS, SDS works entirely in memory and is very fast. Data structures are created and manipulated as internal dynamic structures in memory managed by SDS itself. A structure may then be exported into a caller supplied memory buffer in a defined external format. This structure can be written as a file or sent as a message to another machine. It remains static in structure until it is reimported into SDS.

SDS is written in portable C and has been run on a number of different machine architectures. Structures are portable between machines with SDS looking after conversion of byte order, floating point format and alignment. A Fortran callable version is also available for some machines.

GUIs in the MIDAS Environment

P. Ballester (ESO)

MIDAS (Munich Image Data Analysis System) is the image processing system developed at ESO for astronomical data reduction. MIDAS is used for off-line data reduction at ESO and many astronomical institutes all over Europe. In addition to a set of general commands, enabling to process and analyze images, catalogs, graphics and tables, MIDAS includes specialized packages dedicated to astronomical applications or to specific ESO instruments.

Several graphical interfaces are available in the MIDAS environment: XHelp provides an interactive help facility, XLong and XEchelle enable data reduction of long-slit and echelle spectra. GUI builders facilitate the development of interfaces. All ESO interfaces comply to the ESO User Interfaces Common Conventions which secures an identical Look and Feel for telescope operations, data analysis and archives.

A Structured Data Transfer Protocol

P. Barrett, A. Rots (NASA/GSFC/HEASARC)

The transfer of data between different computers and programs can be a major obstacle during data analysis. We present a new data transfer protocol which is based on a simple structure containing a value, an error and a unit. Each of these members can be arrays or another structure. The ability to nest structures allows for the concept of objects. When using an object-oriented language such as C++, reference can be made to the object name instead of each element explicitly.

Prototype code has been written which implements the basic design with enhancements planned for the future.

N94-27451

A Neural Network Prototyping Package within IRAF

D. Bazell (STScI), I. Bankman (JHU APL)

In this paper we outline our plans for incorporating a Neural Network Prototyping Package into the IRAF environment. The package we are developing will allow the user to choose between different types of networks and to specify the details of the particular architecture chosen.

Neural networks consist of a highly interconnected set of simple processing units. The strengths of the connections between units are determined by weights which are adaptively set as the network "learns". In some cases learning can be a separate phase of the use cycle of the network while in other cases the network learns continuously.

Neural networks have been found to be very useful in pattern recognition and image processing applications. They can form very general "decision boundaries" to differentiate between objects in pattern space and they can perform complicated transformations on inputs. They can also be used for associative recall of patterns based on partial cues and for adaptive filtering.

We discuss the different architectures we plan to use and give examples of what they can do.

Database activity in the Italian Astronet : DIRA 2.

L.Benacchio (OAPd) and M.Nanni (IRA, Bo)

The development and utilization of informational archives and databases started, in the Italian Astronet Project, in the middle of 1983. In that year a small group of astronomers and some more technical people met together in an Astronet working group, with a common, painful experience in managing astronomical catalogues and archives with computers.

Nowadays, some years later, some software packages and the contents of both, a relative general database and several local databases represent the work and the effort of the group. The systems have been conceived and developed keeping in mind the original goal of the Group: to allow the single astronomer to make a free use of original data.

The main package: DIRA was rewritten, after some years of use, to fully take advantage of the several suggestions of the astronomers that used it and gathered experiences in the astronomical catalogues management.

A more technical goal was to install the whole system, born and developed in the vms environment, on unix and unix-like systems.

This new version, DIRA2 has a new user interface, a query language with SQL style commands supporting numerical and character functions also and a set of commands to create new catalogues from existing data. The graphics commands are also more powerful with respect to the previous version.

DIRA (and DIRA2 of course) philosophy and design are very simple and proved to be very appreciated by astronomers, namely, to normalize and homogenize, at minimum, astronomical catalogues, to collect satisfactory astronomical documentation on their contents and, finally, to allow an astronomical approach to the dialogue with the database.

DIRA2 is currently used in most Italian astronomical institutes to retrieve data from a still growing database of about 140 well documented and controlled astronomical catalogues, for the identification of objects, for the preparation of "medium size" survey, in astrometry and in the creation of new catalogues.

The ALEXIS Data Processing Package: An IDL Based System

J.J. Bloch, B.W. Smith, and B.C. Edwards (LANL)

The Array of Low Energy X-ray Imaging Sensors (ALEXIS) experiment consists of a mini-satellite containing six wide angle EUV/ultrasoft X-ray telescopes. Its purpose is to map out the sky in three narrow (~5%) bandpasses around 66, 71, and 93 eV. The 66 and 71 eV bandpasses are centered on intense Fe emission lines which are characteristic of million degree plasmas such as the one thought to produce the soft X-ray background. The 93 eV bandpass is not near any strong emission lines and is more sensitive to continuum sources. The mission will be launched on the Pegasus Air Launched Vehicle in the second half of 1992 into a 400-nautical-mile, high inclination orbit and will be controlled entirely from a small ground station located at Los Alamos. The project is a collaborative effort between Los Alamos National Laboratory, Sandia National Laboratory, and the University of California-Berkeley Space Sciences Laboratory.

The six telescopes are arranged in three pairs. As the satellite spins twice a minute they scan the entire anti-solar hemisphere. Each f/1 telescope consists of a spherical, multilayer-coated mirror with a curved, microchannel plate detector located at the prime focus. The multilayer coatings determine the bandpasses of the telescopes. The field of view of each telescope is 30 degrees with a spatial resolution of 0.5 degree, limited by spherical aberration.

The data processing requirements for ALEXIS are large. Each event in one of the six telescopes is telemetered to the ground with its time of arrival and position on the detector. This information must be folded with the aspect solution for the satellite to reconstruct the direction on the sky from which the photon came. Because of the way the six telescopes scan the sky, the effective exposure calculation is also very computationally intensive. ALEXIS may generate up to 100 megabytes of raw data per day, which are converted into a gigabyte per day of processed data.

While the processing job for ALEXIS is sizable, the programming staff is small. To maximize programming efficiency, and to make the best use of tools available in the public domain, we chose IDL as our software development platform. IDL was used from the start of instrument development through flight. We use IDL as a top-level executive for the processing tasks (replacing Unix shell scripts), as a device independent graphics engine, as a database manager, and as a final data manipulator. IDL routines spawn special purpose C programs to perform detailed telemetry deconvolution and other specialized functions.

In this poster we will discuss the use of IDL and C within the processing and archiving strategy for the ALEXIS data analysis system as implemented on a SPARCstation platform. We will also show results from our End-to-End software simulation capability as processed by our analysis codes.

IDL is a trademark of Research Systems, Inc.

SPARCstation is a trademark of Sun Microsystems.

Unix is a trademark of AT&T.

N94-22454

Seeing the Forest for the Trees: Networked Workstations as a Parallel Processing Computer

J.O. Breen and D.M. Meleedy (CfA)

Unlike traditional "serial" processing computers in which one central processing unit performs one instruction at a time, parallel processing computers contain several processing units, thereby performing several instructions at once. Many of today's fastest supercomputers achieve their speed by employing thousands of processing elements working in parallel. Few institutions can afford these state-of-the-art parallel processors, but many already have the makings of a modest parallel processing system. Workstations on existing high-speed networks can be harnessed as nodes in a parallel processing environment, bringing the benefits of parallel processing to many. While such a system can not rival the industry's latest machines, many common tasks can be accelerated greatly by spreading the processing burden and exploiting idle network resources. We study several aspects of this approach, from algorithms to select nodes to speed gains in specific tasks. With ever-increasing volumes of astronomical data, it becomes all the more necessary to utilize our computing resources fully.

VETA X-Ray Data Acquisition and Control System

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We wish to submit this abstract to the conference
ADASS '92 for a poster preseentation

We describe the X-ray Data Acquisition and Control System (XDACS) used together with the X-ray Detection System (XDS) to characterize the X-ray image during testing of the AXAF P1/H1 mirror pair at the MSFC X-ray Calibration Facility. A variety of X-ray data were acquired, analyzed and archived during the testing including: mirror alignment, encircled energy, effective area, point spread function, system housekeeping and Proportional Counter window uniformity data. The system architecture will be presented with emphasis placed on key features that include a layered UNIX tool approach, dedicated subsystem controllers, real-time X-window displays, flexibility in combining tools, network connectivity and system extensibility. The VETA test data archive will also be described.

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P.1

A Multiresolution Wavelet Representation in Two or More Dimensions

B.C. Bromley (Dartmouth Col.)

In the multiresolution approximation, a signal is examined on a hierarchy of resolution scales by projection onto sets of smoothing functions. Wavelets are used to carry the detail information connecting adjacent sets in the resolution hierarchy. An algorithm has been implemented to perform a multiresolution decomposition in $n \geq 2$ dimensions based on wavelets generated from products of 1-D wavelets and smoothing functions. The functions are chosen so that an n-D wavelet may be associated with a single resolution scale and orientation. This algorithm enables complete reconstruction of a high resolution signal from decomposition coefficients. The signal may be oversampled to accommodate non-orthogonal wavelet systems, or to provide approximate translational invariance in the decomposition arrays.

Experiments with Recursive Estimation in astronomical image processing.

I. Busko   (INPE – Brazil)

Recursive estimation concepts were applied to image enhancement problems since the 70's. However, very few applications in the particular area of astronomical image processing are known (see e.g. Richter, G.M., 1978, *Astron.Nachr*, 299, 283). These concepts were derived, for 2–dimensional images, from the well–known theory of Kalman filtering in one dimension. The historic reasons for application of these techniques to digital images are related to the images' *scanned* nature, in which the temporal output of a scanner device can be processed on–line by techniques borrowed directly from 1–dimensional recursive signal analysis.

However, recursive estimation has particular properties that make it atractive even in modern days, when big computer memories make the full scanned image available to the processor at any given time. One particularly important aspect is the ability of recursive techniques to deal with *non–stationary* phenomena, that is, phenomena which have their statistical properties variable in time (or position in a 2-D image). Many image processing methods make underlying stationarity assumptions either for the stochastic field being imaged, for the imaging system properties, or both. They will underperform, or even fail, when applied to images that deviate significantly from stationarity. Recursive methods, on the contrary, make it feasible to perform *adaptive* processing, that is, to process the image by a processor with properties tuned to the images's *local* statistical properties.

Recursive estimation can be used to build estimates of images degraded by such phenomena as noise and blur. We show examples of recursive adaptive processing of astronomical images, using several local statistical properties to drive the adaptive processor, as average signal intensity, signal–to–noise ratio and autocorrelation function. Software was developed under IRAF, and as such will be made available to interested users.

Extracting galactic structure parameters from multivariated density estimation

B. Chen, M. Crézé   A. Robin, O. Bienaymé
Observatoire de Strasbourg,   Observatoire de Besancon

Multivariate statistical analysis, including includes cluster analysis (unsupervised classification), discriminant analysis (supervised classification) and principle component analysis(dismensionlity reduction method), and nonparameter density estimation have been succesfully used to search for meaningfull associations(Crézé et al., 1991; Robin et al., 1992, Chen, 1992) in the 5-dimensional space of observables between observed points and the sets of simulated points generated from a synthetic approach of galaxy modelling (Robin and Crézé,1986; Bienaymé et al. 1987). These methodologies can be applied as the new tools to obtain information about hidden structure otherwise unrecognizable,and place important constraints on the space distribution of various stellar populations in the Milky Way.

In this paper, we concentrate on illustrating how to use nonparameter density estimation to substitute for the true densities in both of the simulating sample and real sample in the five-dimensional space. In order to fit model predicted densities to reality, we derive a set of equations which include n lines(where n is the total number of observed points) and m (where m: the numbers of predefined groups) unknown parameters. A least-square estimation will allow us to determine the density law of different groups and components in the Galaxy. The output from our software, which can be used in many research fields, will also give out the systematic error between the model and the observation by a Bayes rule.

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The EUVE Proposal Database and Scheduling System

Presented by: C. Christian, E. Olson, P. Jelinsky, and M. Samuel

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We will describe the proposal database and scheduling system for the Extreme Ultraviolet Explorer. The proposal database has been implemented to take input for approved observations selected by the EUVE Peer Review Panel and output target information suitable for the scheduling system to digest. The scheduling system is a hybrid of the SPIKE program and EUVE software which checks spacecraft constraints, produces a proposed schedule and selects spacecraft orientations with optimal configurations for acquiring star trackers, etc. We have used this system to schedule the In Orbit Calibration activities that took place this summer, following the EUVE launch in early June 1992. The strategy we have implemented has implications for the selection of approved targets, which have impacted the Peer Review process. In addition, we will discuss how the proposal database, founded on Sybase, controls the processing of EUVE Guest Observer data.

The Keck Keyword Layer

A. R. Conrad, W. F. Lupton (Keck)

Each Keck instrument presents a consistent software view to the user inter-face programmer. The view consists of a small library of functions, which are identical for all instruments, and a large set of keywords, that vary from instrument to instrument. All knowledge of the underlying task structure is hidden from the application programmer by the keyword layer.

Image capture software uses the same function library to collect data for the image header. Because the image capture software and the instrument control software are built on top of the same keyword layer, a given obser-vation can be "replayed" by extracting keyword-value pairs from the image header and passing them back to the control system.

The keyword layer features non-blocking as well as blocking I/O. A non-blocking keyword write operation (such as setting a filter position) specifies a callback to be invoked when the operation is complete. A non-blocking keyword read operation specifies a callback to be invoked whenever the keyword changes state. The keyword-callback style meshes well with the widget-callback style commonly used in X window programs.

The first keyword library was built for the two Keck optical instruments. More recently, keyword libraries have been developed for the infrared instru-ments and for telescope control. Although the underlying mechanisms used for inter-process communication by each of these systems vary widely (Lick MUSIC, Sun RPC, and direct socket I/O, respectively), a basic user interface has been written that can be used with any of these systems. Since the keyword libraries are bound to user interface programs dynamically at run time, only a single set of user interface executables is needed. For example, the same program, "xshow", can be used to display continuously the tele-scope's position, the time left in an instrument's exposure, or both values simultaneously. Less generic tools that operate on specific keywords, for example an X display that controls optical instrument exposures, have also been written using the keyword layer.

PROS: An IRAF Based System for Analysis of X-ray Data

M.A. Conroy, J. DePonte, J.F. Moran, J.S. Orszak, W.P. Roberts,
D. Schmidt (SAO)

PROS is an IRAF based software package for the reduction and analysis of x-ray data. The use of a standard, portable, integrated environment provides for both multi-frequency and multi-mission analysis. The analysis of x-ray data differs from optical analysis due to the nature of the x-ray data and its acquisition during constantly varying conditions. The scarcity of data, the low signal-to-noise ratio and the large gaps in exposure time make data screening and masking an important part of the analysis.

PROS was developed to support the analysis of data from the ROSAT and Einstein missions but many of the tasks have been used on data from other missions. IRAF/PROS provides a complete end-to-end system for x-ray data analysis:

(i) A set of tools for importing and exporting data via FITS format. In particular, IRAF provides a specialized event-list format, QPOE, that is compatible with its IMAGE (2-D array) format.

(ii) A powerful set of IRAF system capabilities for both temporal and spatial event filtering.

(iii) Full set of imaging and graphics tasks.

(iv) Support for general image manipulations, and coordinate conversions - including World Coordinate System (WCS).

(v) Specialized packages for scientific analysis such as spatial, spectral and timing analysis. These consist of both general and mission specific tasks.

(vi) Complete system support including ftp and magnetic tape releases, electronic and conventional mail hotline support, electronic mail distribution of solutions to frequently asked questions and current known bugs.

We will discuss the design philosophy, architecture and development environment used by PROS to generate a portable, multi-mission software environment. PROS is available on all platforms that support IRAF, including Sun/Unix, VAX/VMS, HP, and Decstations. It is available on request at no charge.

ROSAT Implementation of a Proposed Multi-Mission X-ray Data Format

M. Corcoran, W. Pence, R. White (NASA/GSFC), M. Conroy (SAO)

Until recently little effort has been made to ensure that data from X-ray telescopes are delivered in a format that reflects the common characteristics that most X-ray datasets share. Instrument-specific data-product design hampers the comparison of X-ray measurements made by different detectors and should be avoided whenever possible. The ROSAT project and the High Energy Astrophysics Science Archive Research Center (HEASARC) have defined a set of X-ray data products ("rationalized files") for ROSAT data that can be used for distribution and archiving of data from other X-ray missions. This set of "rationalized files" has been defined to isolate instrument-independent and instrument-specific quantities using standard FITS constructs to ensure portability. We discuss the usage of the "rationalized files" by ROSAT for data distribution and archiving, with particular emphasis on discrimination between instrument-independent and instrument-specific quantities, and discuss application of this format to data from other X-ray missions.

N94-22463

On AIPS++, A New Astronmical Information Processing System

G. A. Croes (NRAO)

Abstract

The AIPS system that has served the needs of the radio astronomical community remarkably well during the last 15 years is showing signs of age and is being replaced by a more modern system, AIPS++. As the name implies, AIPS++ will be developed in an object oriented fashion and will use C++ as its main programming language. The work is being done by a consortium of seven organizations, with coordinated activities worldwide.

After a review of the history of the project to this date from management, astronomical and technical viewpoints, and the current state of the project, the paper concentrates on the tradeoffs implied by the choice of implementation style and the lessons we have learned, good and bad.

N94-22464

L.E. Davis (NOAO/IRAF)

A progress report on the IRAF stellar photometry package DIGIPHOT, with emphasis on algorithm enhancements and photometry catalog processing tools is presented. The IRAF implementation of Stetson's DAOPHOTII algorithms and improvements to the sky fitting algorithms is briefly discussed and results obtained with the new algorithms for NOAO direct imaging data are shown. New interactive photometry tools are presented, including a task for setting the photometry parameters using radial profile plots, and the interactive photometry catalog examining and editing tool PEXAMINE, and plans for future photometry catalog analysis tools are discussed.

PHOTCAL: The IRAF Photometric Calibration Package

L. E. Davis (NOAO/IRAF), P. Gigoux (CTIO)

The IRAF photometric calibration package PHOTCAL is discussed. PHOTCAL is a set of tasks designed to derive the transformation from the instrumental photometric system to the standard photometric system, and apply the transformation to the observations. The PHOTCAL package contains tasks for: 1) creating and/or editing standard star catalogs and observations catalogs, 2) creating, checking and editing the configuration file which specifies the format of the standard star and observations catalogs and the form of the transformation equations, 3) solving the transformation equations interactively or non-interactively using non-linear least squares fitting routines, and 4) applying the transformation to the observations.

PHOTCAL standard star and observations catalogs are simple text files, whose columns are delimited by whitespace, and whose first column contains the star names. This format makes it relatively easy to interface the output of non-IRAF photometry programs as well as the output of the IRAF APPHOT and DAOPHOT photometry packages to PHOTCAL. PHOTCAL maintains a standard star catalog directory for the convenience of the user, but users can easily create their own standard star catalogs and/or define their own standard star catalog directory. Separate observations files produced by APPHOT, DAOPHOT or a user program containing data for stellar fields taken through different filters, can be combined into observations catalogs using one of the PHOTCAL preprocessor tasks.

The input configuration file required by PHOTCAL is a text file, consisting of a series of instructions written by the user in a mini-language understood by the PHOTCAL parser. These instructions: 1) assign names to the input data columns in the standard star and observations catalogs, 2) assign names and initial values to the parameters to be fit, 3) define and describe how to solve the transformation equations. The mini-language approach permits great flexibility in the format of the input catalogs and the form of the transformation equations.

Detection of X-Ray Sources in PROS

J. DePonte, F.A. Primini (SAO)

The problem of detecting discrete sources in x-ray images has much in common with the problem of automatic source detection at other wavelengths (see, for example, Stetson 1987, P.A.S.P., v.99, pp. 191-222). In all cases, one searches for positive brightness enhancements exceeding a certain threshold, which appear consistent with what one expects for a point source, in the presence of a (possibly) spatially variable background. Multidimensional point spread functions (e.g., dependent on detector position and photon energy) are also common. At the same time, the problem in x-ray astronomy has some unique aspects. For example, for typical x-ray exposures in current or recent observatories, the number of available pixels far exceeds the number of actual x-ray events, so Poisson, rather than Gaussian statistics apply. Further, extended cosmic x-ray sources are common, and one often desires to detect point sources in the vicinity or even within bright, diffuse x-ray emission. Finally, support structures in x-ray detectors often cast sharp shadows in x-ray images making it necessary to detect sources in a region of rapidly varying exposure.

We have developed a source detection package within the IRAF/PROS environment which attempts to deal with some of the problems of x-ray source detection. We have patterned our package after the successful Einstein Observatory x-ray source detection programs. However, we have attempted to improve the flexibility and accessibility of the functions and to provide a graphical front-end for the user. Our philosophy has been to use standard IRAF tasks whenever possible for image manipulation and to separate general functions from mission-specific ones. We will report on the current status of the package and discuss future developments, including simulation tasks, to allow the user to assess detection efficiency and source significance, tasks to determine source intensity, and alternative detection algorithms.

Deep Near-Infrared Survey of the Southern Sky (DENIS)

E. Deul (University of Leiden)

DENIS (Deep Near-Infrared Survey of the Southern Sky) will be the first complete census of astronomical sources in the near-infrared spectral range. The challenges of this novel survey are both scientific and technical. Phenomena radiating in the near-infrared range from brown dwarfs to galaxies in the early stages of cosmological evolution, the scientific exploitation of data relevant over such a wide range requires pooling expertise from several of the leading European astronomical centers. The technical challenges of a project which will provide an order of magnitude more sources than given by the IRAS space mission, and which will involve advanced data-handling and image-processing techniques, likewise require pooling of hardware and software resources, as well as of human expertise.

The DENIS project team is composed of some 40 scientists, computer specialists, and engineers located in 5 European Community countries (France, Germany, Italy, The Netherlands, and Spain), with important contributions from specialists in Austria, Brazil, Chile, and Hungary.

DENIS will survey the entire southern sky in 3 colours, namely in the I band at a wavelength of 0.8 micron, in the 1.25-micron J band, and in the 2.15-micron K′ band. The sensitivity limits will be 18th magnitude in the I band, 16th in the J band, and 14.5th in the K′ band. The angular resolution achieved will be 1 arcsecond in the I band, and 3.0 arcseconds in the J and K′ bands. The European Southern Observatory 1-m telescope on La Silla will be dedicated to survey use during operations expected to last four years, commencing in late 1993.

DENIS aims to provide the astronomical community with complete digitized infrared images of the full southern sky and a catalogue of extracted objects, both of the best quality and in readily accessible form. This will be achieved through dedicated software packages and specialized catalogues, and with assistance from the Leiden and Paris Data Analysis Centers.

The data will be mailed on DAT tapes from La Silla to the two Data Analysis Centers for further processing. Two centers are necessary because of the shear quantity of data and because of the complementary roles the Centers will develop, each exploiting its own particular expertise.

The Leiden Data Analysis Center (LDAC) will extract objects, establish their parameters, and archive them into a source catalogue. The LDAC will collaborate with the Groningen Space Research group that has gained experience in infrared image handling from the IRAS satellite. The Paris Data Analysis Center (PDAC) will be responsible for archiving and preprocessing the raw data to provide a homogeneous set of data suitable for further reduction in both the Leiden and Paris data analysis streams. The PDAC will also extract and archive images for the sources flagged by the LDAC as extended, and create a catalogue of galaxies.

In exploiting the DENIS data we foresee the collaboration with other data analysis centers, such as the Observatoire de Lyon where the relevant DENIS catalogue of galaxies can be incorporated into their extragalactic database. The Point Sources and the Small Extended Sources catalogues could be incorporated in the Late Type Star database at Montpellier, and in the SIMBAD database at CDS. At Groningen the IRAS Point Source catalogue and/or image data can be merged with the DENIS catalogues. At Meudon algorithms and software will be developed with main goal assessing the limits reachable for the homogeneity and intrinsic consistency between the ensemble of the images in the data base (flat-fielding, relative positioning of the fields, bootstrapped flux calibration) but also for the data analysis.

Jeremy J. Drake, Carl Dobson, and Elisha Polomski (Center for EUV Astrophysics, UC Berkeley)

The Extreme Ultraviolet Explorer (EUVE) satellite was launched successfully at 12:400:00 EDT on June 7, 1992 from Cape Canaveral Air Force Station, Florida. The EUVE science payload consists of three scanning telescopes carrying out an all-sky survey in the 70-760A spectral region, and a Deep Survey/Spectrometer telescope performing a deep survey in the 70-250A spectral region. This latter instrumentation will subsequently perform Guests Observer (GO) spectroscopic observations of individual targets.

The EUVE public archive opened for business on July 17, 1992. The purpose of the archive is the storage and distribution of EUVE data and ancillary documentation, information and software which is in the public domain. As the mission proceeds, the all-sky survey, deep survey and spectroscopic data will become publicly available through a variety of interfaces to an archive system centered around an optical juke box. In this paper, we describe the current and future contents, the architecture, and the development plans for the archive.

A distributed clients/distributed servers model for STARCAT

B. Pirenne, (ST-ECF), M. Albrecht (ESO), D. Durand, S. Gaudet (CADC)

STARCAT, the Space Telescope ARchive and CATalogue user interface has been along for a number of years already. During this time it has been enhanced and augmented in a number of different field. This time, we would like to dwell on a new capability allowing geographically distributed user interfaces to connect to geographically distributed data servers. This new concept permits users anywhere on the internet running STARCAT on their local hardware to access e.g., whichever of the 3 existing HST archive site is available, or get information on the CFHT archive through a transparent connection to the CADC in BC or to get the La Silla weather by connecting to the ESO database in Munich during the same session. Similarly PreView (or quick look) images and spectra will also flow directly to the user from wherever it is available. Moving towards an "X"-based STARCAT is another goal being pursued: a graphic/image server and a help/doc server are currently being added to it. They should further enhance the user independence and access transparency.

Enhancements to IRAF/STSDAS Graphics

J. D. Eisenhamer and Z. G. Levay (ST ScI)

The IRAF graphics kernel, *psikern*, is a true encapsulated PostScript® implementation, an improvement over the former SGI-based PostScript output available from IRAF. The *psikern* kernel implements many more capabilities of gio/gki such as cell arrays (grayscale images), color, filled area patterns and true PostScript fonts. Several of the general-purpose graphics tasks in STSDAS such as *igi*, *sgraph*, *skymap*, and *wcslab* have been modified to use these capabilities explicitly. Other graphics tasks not enhanced explicitly can also make use of new capabilities such as PostScript font support. We present an overview of *psikern* and several examples of output created by the enhanced STSDAS tasks.

An IDL-based Analysis Package for COBE and Other Skycube-Formatted Astronomical Data

Ewing, J.A. (ARC), Isaacman, R. B. (GSC) , Gales, J. M. (ARC)

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UIMAGE is a data analysis package written in IDL for the Cosmic Background Explorer (COBE) project. COBE has extraordinarily stringent accuracy requirements: 1% mid-infrared absolute photometry, 0.01% submillimeter absolute spectrometry, and 0.0001% submillimeter relative photometry. Thus, many of the transformations and image enhancements common to analysis of large data sets must be done with special care. UIMAGE is unusual in this sense in that it performs as many of its operations as possible on the data in its native format and projection, which in the case of COBE is the quadrilateralized spherical cube ("skycube"). That is, after reprojecting the data, e.g., onto an Aitoff map, the user who performs an operation such as taking a crosscut or extracting data from a pixel is transparently acting upon the skycube data from which the projection was made, thereby preserving the accuracy of the result.

Current plans call for formatting external data bases such as CO maps into the skycube format with a high-accuracy transformation, thereby allowing Guest Investigators to use UIMAGE for direct comparison of the COBE maps with those at other wavelengths from other instruments. It is completely menu-driven so that its use requires no knowledge of IDL. Its functionality includes I/O from the COBE archives, FITS files, and IDL save sets as well as standard analysis operations such as smoothing, reprojection, zooming, statistics of areas, spectral analysis, etc.

One of UIMAGE's more advanced and attractive features is its terminal independence. Most of the operations (e.g., menu-item selection or pixel selection) that are driven by the mouse on an X-windows terminal are also available using arrow keys and keyboard entry (e.g., pixel coordinates) on VT200 and Tektronix-class terminals. Even limited grey scales of images are available this way. Obviously, image processing is very limited on this type of terminal, but it is nonetheless surprising how much analysis can be done on that medium. Such flexibility has the virtue of expanding the user community to those who must work remotely on non-image terminals, e.g., via modem.

Visualizing the Universe (Part II)

Emilio E. Falco and Michael J. Kurtz (CfA) and Mark Bajuk (NCSA)

It is now possible to create animated views of the universe that are realistic, physically relevant, and breathtaking. To demonstrate the point, we describe our efforts to navigate the CfA redshift survey. For our project, we selected several CCD images of spiral and elliptical galaxies, and placed them at their observed positions in redshift space. We demonstrate how, by choreographing aesthetically pleasing trajectories, we are able to develop our own and the viewer's intuition about the large-scale structures found in the CfA redshift survey. We show for instance that three-dimensional motion enhances significantly our perception of voids and sheets in the distribution of galaxies. Such sophistication happily has become possible with the "coming of age" of observational cosmology, as data have grown to drive the field.

C++, Objected-Oriented Programming, and Astronomical Data Models

A. Farris (STScI)

Contemporary astronomy is characterized by increasingly complex instruments and observational techniques, higher data collection rates, and large data archives, placing severe stress on software analysis systems. The object-oriented paradigm represents a significant new approach to software design and implementation that holds great promise for dealing with this increased complexity. The basic concepts of this approach will be characterized in contrast to more traditional procedure-oriented approaches. The fundamental features of objected-oriented programming will be discussed from a C++ programming language perspective, using examples familiar to astronomers. This discussion will focus on objects, classes and their relevance to the data type system; the principle of information hiding; and the use of inheritance to implement generalization/specialization relationships. Drawing on the object-oriented approach, features of a new database model to support astronomical data analysis will be presented.

SPPTOOLS: Programming Tools for the IRAF SPP Language

M. Fitzpatrick (NOAO/IRAF)

An IRAF package to assist in SPP code development and debugging is described. SPP is the machine-independent programming language used by virtually all IRAF tasks. Tools have been written to aide both novice and advanced SPP programmers with development and debugging by providing tasks to check the code for the number and type of arguments in all calls to IRAF VOS library procedures, list the calling sequences of IRAF tasks, create a database of identifiers for quick access, check for memory which is not freed, and a source code formatter. Debugging is simplified since the programmer is able to get a better understanding of the structure of his/her code, and IRAF library procedure calls (probably the most common source of errors) are automatically checked for correctness.

The IRAF Radial Velocity Analysis Package

M. Fitzpatrick (NOAO/IRAF)

The IRAF Radial Velocity Analysis package is decribed and future plans are presented. A discussion of the current strengths and weaknesses of the package is given along with an analysis of the accuracies that can be expected for a given data set. An overview of the cross-correlation task is presented along with atypical examples of it's use. Future plans for new tasks and algorithms are also described

Visualizing the Universe (Part I)

M.J. Geller and J.P. Huchra (CfA)

These decades are the first in which we can begin to map the universe. Recent surveys reveal patterns in the distribution of galaxies — patterns coherent on scales of 150 million light years or more. These patterns contrast with the smoothness of the radiation background measured by the COBE satellite. Together these observations challenge our understanding of the origin of galaxies and large-scale structure in the universe.

"Visualizing the universe" is crucial for exploring the 3-dimensional maps, for analyzing them, for comparing the data with simulations, for designing instruments to make deeper maps with new large telescopes, and for sharing the excitement of discovery with the public.

Crystal Ball Gazing

Jim Gettys (Digital Equipment Corporation, Cambridge)

Over the last seven years, the CPU on my desk has increased speed by two orders of magnitude, from around 1 MIP to more than 100 MIPS; more important is that it is about as fast as any uniprocessor of any type available for any price, for compute bound problems. Memory on the system is also about 100 times as big, while disk is only about 10 times as big. Local network and I/O performance have increased greatly, though not quite at the same rate as processor speed. More important, I will argue, is that the CPU's address space is 64 bits, rather than 32 bits, allowing us to rethink some time honored presumptions.

The Internet has gone from a few hundred machines to a million, and now have grown to span the entire globe, and wide area networks have now becoming commercial services.

"PC's" are now real computers, bringing what was top of the line computing capability to the masses only a few years behind the leading edge.

So even a year or two from now, we can anticipate commonplace desktop machines running at speeds hundreds of MIPS, with main memories in the hundreds of megabytes to a gigabyte, able to draw millions of vectors/second, and all capable of some reasonable 3D graphics. And only a few years later, this will be the $1500 PC.

So the 1990's certainly brings:

> 64 bit processors becoming standard
> BIP/BFLOP class uniprocessors
> Large scale multiprocessors for special purpose applications
> I/O as the most significant computer engineering problem
> Hierarchical data servers in everyday use
> Routine access to archived data around the world
> And what else?

What do systems such as those we will have this decade imply to those building data analysis systems today? Many of the presumptions of the 1970's and 1980's need to be reexamined in the light of 1990's technology.

HST Image Restoration: A Comparison of Pre- and Post-Servicing Mission Results

R. J. Hanisch, J. Mo (ST ScI)

A variety of image restoration techniques (e.g., Wiener filter, Lucy-Richardson, MEM) have been applied quite successfully to the aberrated HST images. The HST servicing mission (scheduled for late 1993 or early 1994) will install a corrective optics system (COSTAR) for the Faint Object Camera and spectrographs and replace the Wide Field/Planetary Camera with a second generation instrument (WF/PC–II) having its own corrective elements. The image quality is expected to be improved substantially with these new instruments. What then is the role of image restoration for the HST in the long term?

Through a series of numerical experiments using model point-spread functions for both aberrated and unaberrated optics, we find that substantial improvements in image resolution can be obtained for post-servicing mission data using the same or similar algorithms as being employed now to correct aberrated images. Included in our investigations are studies of the photometric integrity of the restoration algorithms and explicit models for HST pointing errors (spacecraft jitter).

Electronic Publishing and Intelligent Information Retrieval

A. Heck (Observatoire Astronomique, Strasbourg, France)

Europeans are now taking steps to homogenize policies and standardize procedures in electronic publishing (EP) in astronomy and space sciences. This arose from an open meeting organized in October 1991 at Strasbourg Observatory (France) and another business meeting held late March 1992 with the major publishers and journal editors in astronomy and space sciences.

The ultimate aim of EP might be considered as the so-called 'intelligent information retrieval' (IIR) or better named 'advanced information retrieval' (AIR), taking advantage of the fact that the material to be published appears at some stage in a machine-readable form.

It is obvious that the combination of desktop and electronic publishing with networking and new structuring of knowledge bases will profoundly reshape not only our ways of publishing, but also our procedures of communicating and retrieving information.

It should be noted that a world-wide survey among astronomers and space scientists carried out before the October 1991 colloquium on the various packages and machines used, indicated that TEX-related packages were already in majoritarian use in our community.

It has also been stressed at each meeting that the European developments should be carried out in collaboration with what is done in the US (STELAR project, for instance). American scientists and journal editors were actually attending both meetings mentioned above.

The paper will offer a review of the status of electronic publishing in astronomy and its possible contribution to advanced information retrieval in this field. It will report on recent meetings such as the 'Astronomy from Large Databases II (ALD-II)' conference dealing with the latest developments in networking, in data, information, and knowledge bases, as well as in the related methodologies.

A.A. Henden (OSU)

Tcl is an embedded control language written in C, running primarily under Unix and with an interpreted C look-and-feel. Tk is an X11 toolkit based on tcl. Xf is an applications builder for tk. The entire package is public domain and available from sprite.berkeley.edu. This paper discusses the use of tk to develop a user interface for OSIRIS, an infrared camera/spectrograph now operational on the OSU Perkins 1.8m telescope. The good and bad features of the development process are described.

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J.T. Himer

Fortran has largely enjoyed prominence for the past few decades as the computer programming language of choice for numerically intensive scientific, engineering, and process control applications. Fortran's well understood static language syntax has allowed resulting parsers and compiler optimizing technologies to often generate among the most efficient and fastest run-time executables, particularly on high-end scalar and vector supercomputers.

Computing architectures and paradigms have changed considerably since the last ANSI/ISO Fortran release in 1978, and while FORTRAN 77 has more than survived, it's aged features provide only partial functionality for today's demanding computing environments. The simple block procedural languages have been necessarily evolving, or giving way, to specialized supercomputing, network resource, and object-oriented paradigms.

To address these new computing demands, ANSI has worked 12-years with three international public reviews to deliver Fortran 90. Fortran 90 superseded and replaced ISO FORTRAN 77 internationally recently as the sole Fortran standard; while domestically in the US, Fortran 90 is expected to be adopted as the ANSI standard this summer, coexisting with ANSI FORTRAN 77 until at least 1996.

The development path and current state of Fortran will be briefly described highlighting the many new Fortran 90 syntactic and semantic additions which support (among others): free form source; array syntax; new control structures; modules and interfaces; pointers; derived data types; dynamic memory; enhanced I/O; operator overloading; data abstraction; user optional arguments; new intrinsics for array, bit manipulation, and system inquiry; and enhanced portability through better generic control of underlying system arithmetic models. Examples from dynamical astronomy, signal and image processing will attempt to illustrate Fortran 90's applicability to today's general scalar, vector, and parallel scientific and engineering requirements, and object oriented programming paradigms.

Time permitting, current work proceeding on the future development of Fortran 2000 and collateral standards will be introduced.

Programmability in AIPS++

R.M. Hjellming (NRAO)

AIPS++ is an Astronomical Information Processing System being designed and implemented by an international consortium of NRAO and six other radio astronomy institutions in Australia, India, the Netherlands, the United Kingdom, Canada, and the USA. AIPS++ is intended to replace the functionality of AIPS, be more easily programmable, and will be implemented in C++ using object-oriented techniques.

Programmability in AIPS++ is planned at three levels. The first level will be that of a command-line interpreter with characteristics similar to IDL and PV-Wave, but with an extensive set of operations appropriate to telescope data handling, image formation, and image processing. The third level will be in C++ with extensive use of class libraries for both basic operations and advanced applications. The third level will allow input and output of data between external FORTRAN programs and AIPS++ telescope and image databases.

In addition to summarizing the above programmability characteristics, this talk will give an overview of the classes currently being designed for telescope data calibration and editing, image formation, and the "toolkit" of mathematical "objects" that will perform most of the processing in AIPS++.

Telescope Image Modelling Software in STSDAS

P. E. Hodge, J. D. Eisenhamer, R. A. Shaw, R. L. Williamson II (STScI)

The Telescope Image Modelling (TIM) system written by Chris Burrows and Hashima Hasan creates model point spread functions for optical systems based on ray-trace information. The original TIM runs only on VAX/VMS systems, but we are modifying the software to run under IRAF in the STSDAS package in order to make TIM more widely available. The current status of this project will be discussed. Initially the changes will be restricted to the user interface and replacing VAX-specific code. Soon thereafter the IMSL and NAG subroutines will be replaced by public-domain software, and some of the algorithms may be improved.

How is WFPC Flat Field Made

J.-C. Hsu, C.E. Ritchie (STScI)

N94-22484

An algorithm developed by the WFPC IDT to generate flat fields from Earth streak exposures is now implemented in STSDAS. We explain in detail how this algorithm works and possible deficiencies. We also present two associated tools which can be used to modify the flat field obtained from the standard procedure.

ASpect: A New Spectrum and Line Analysis Package for IRAF

S. J. Hulbert, J. D. Eisenhamer, Z. G. Levay, R. A. Shaw (STScI)

We examined several publicly available spectral analysis software packages looking for one with enough functionality and versatility to meet the analysis needs of astronomers during the next decade—none can satisfactorily support the wide variety of panchromatic science programs that are now becoming possible. Furthermore, we concluded that none of these packages can be simply modified to include critical functions because of their original (limited) designs. During the next two years we will write a new spectral analysis package, *ASpect*, that will incorporate the latest analysis techniques for astronomical spectra in all wavelength domains.

The *ASpect* package has several functional requirements. It must operate on spectra from a wide variety of ground-based and space-based instruments, spanning wavelengths from radio to gamma rays. It must accommodate non-linear dispersion relations. It must provide a variety of functions, individually or in combination, with which to fit spectral features and the continuum. It is vitally important that known bad data be masked, and that uncertainties be propagated throughout the calculations in order for astronomers to evaluate the reliability of results. Finally, this new package must provide a powerful, intuitive graphical user interface to handle the burden of data input/output (I/O), on-line "help", selection of relevant features for analysis, plotting and graphical interaction, and data base management, all in a comprehensible environment.

We anticipate that *ASpect* will take the form of an external package in IRAF (such as the NOAO and STSDAS packages), and will be layered upon the IRAF Virtual Operating System to make it available on as many platforms as possible, while making it resistant to changes in operating systems and compilers. Our choice of IRAF is motivated by its portability, its wide use within the astronomical community, and its rich set of existing user applications.

SPIKE: Application for ASTRO-D Mission Planning

T. Isobe (CSR, MIT), M. Johnston (STScI), E. Morgan, G. Clark (CSR, MIT)

SPIKE is a mission planning software system developed by a team of programmers at the STScI under the direction of Mark Johnston for use with the Hubble Space Telescope (HST). SPIKE has been developed for the purpose of automating observatory scheduling to increase the effective utilization and ultimately, scientific return from orbiting telescopes. High-level scheduling strategies using both rule-based and neural network approaches have been incorporated. Graphical displays of activities, constraints, and schedules are an important feature of the system.

Although SPIKE was originally developed for the HST, it can be used for other astronomy missions including ground-based observatories. One of the missions that has decided to use SPIKE is ASTRO-D, a Japanese X-ray satellite for which the US is providing a part of the scientific payload. Scheduled to fly in February 1993, its four telescopes will focus X-rays over a wide energy range onto CCDs and imaging gas proportional counters. ASTRO-D will be the first X-ray imaging mission operating over the 0.5-12 keV band with high energy resolution. This combination of capabilities will enable a varied and exciting program of astronomical research to be carried out.

ASTRO-D is expected to observe 5 to 20 objects per day and a total of several thousands per year. This requires a the implementation of an efficient planning and scheduling system which SPIKE can provide.

Although the version of SPIKE that will be used for ASTRO-D mission is almost identical to that used for the HST, there are a few differences. For example, ASTRO-D will use two ground stations for data downlinks, instead of the TDRSS system for data transmission. As a consequence ASTRO-D is constrained by limited on-board data storage capacity to schedule high data-rate observations during periods of frequent ground contacts. The ASTRO-D version of SPIKE will consider this constraint and schedule high bit rate observations accordingly.

We will demonstrate the ASTRO-D version of SPIKE to show what SPIKE can provide and how efficiently it creates an observational schedule.

The HEASARC Graphical User Interface

N. White, P. Barrett, P. Jacobs, B. O'Neel   (HEASARC/NASA-GSFC)

An OSF/Motif-based graphical user interface has been developed to
facilitate the use of the database and data analysis software packages
available from the High Energy Astrophysics Science Archive Research
Center (HEASARC). It can also be used as an interface to other,
similar, routines. A small number of tables are constructed to
specify the possible commands and command parameters for a given set
of analysis routines. These tables can be modified by a designer to
affect the appearance of the interface screens. They can also be
dynamically changed in response to parameter adjustments made while
the underlying program is running. Additionally, a communication
protocol has been designed so that the interface can operate locally
or across a network. It is intended that this software be able to run
on a variety of workstations and X terminals.

FITS Data Conversion Efforts at the Compton Observatory Science Support Center

D. G. Jennings, J. M. Jordan, T. A. McGlynn, N. G. Ruggiero, T. A. Serlemitsos
(COSSC/NASA-GSFC)

The Compton Gamma Ray Observatory (CGRO) is an active, earth orbiting satellite consisting of four gamma-ray telescopes. Each telescope is maintained by an independent principal investigator (PI) team, and each PI team has devised separate data formats to handle the needs of their particular instrument.

As mandated by NASA, the Compton Observatory Science Support Center (COSSC) intends to archive and distribute PI data to the public in FITS (Flexible Image Transport System) format. To accomplish this task, we at COSSC have been developing a set of general purpose software tools that facilitate the transformation of non-FITS formatted data into FITS format. These tools, known as ToFU (To Fits Utilities), serve as the kernel of our CGRO data conversion software.

This presentation describes the problems encountered in transcribing large amounts of data into a standard FITS form, and the capabilites of the COSSC-built conversion software designed to preform the transformations.

The U.H. Institute for Astronomy CCD Camera Control System

K.T.C. Jim, H.T. Yamada, G.A. Luppino, R.J. Hlivak (University of Hawaii)

The University of Hawaii Institute for Astronomy CCD Camera Control System consists of a NeXT workstation, a graphical user interface, and a fiber optics communications interface which is connected to a San Diego State University CCD controller. The UH system employs the NeXT-resident Motorola DSP 56001 as a real time hardware controller. The DSP 56001 is interfaced to the Mach-based UNIX of the NeXT workstation by DMA and multithreading. Since the SDSU controller also uses the DSP 56001, the NeXT is used as a development platform for the embedded control software. The fiber optic interface links the two DSP 56001s through their Synchronous Serial Interfaces. The user interface is based on the NeXTStep windowing system. It is easy to use and features real-time display of image data and control over all camera functions. Both Loral and Tektronix 2048x2048 CCDs have been driven at full readout speeds, and the system is intended to be capable of simultaneous readout of four such CCDs. The total hardware package is compact enough to be quite portable and has been used on five different telescopes on Mauna Kea. The complete CCD control system can be assembled for a very low cost. The hardware and software of the control system have proven to be quite reliable, well adapted to the needs of astronomers, and extensible to increasingly complicated control requirements.

Quality Control of EUVE Databases

L.M. John and J. Drake (Center for EUV Astrophysics, UC Berkeley)

The publicly accessible databases for the Extreme Ultraviolet Explorer include: The EUVE Archive mailserver, the CEA ftp site, the EUVE Guest Observer Mailserver, and the Astronomical Data System node. The EUVE Performance Assurance team is responsible for verifying that these public EUVE databases are working properly, and that the public availability of EUVE data contained therein does not infringe any data rights which may have been assigned. In this poster, we describe the Quality Assurance (QA) procedures we have developed from the approach of QA as a service organization, thus reflecting the overall EUVE philosophy of Quality Assurance integrated into normal operating procedures, rather than imposed as an external, post facto, control mechanism.

An Object-Oriented Approach for Supporting Both X and Terminal Interfaces

J. Johnson (STScI)

While the X Window System is clearly becoming the dominant user interface display system, there is still a continuing need to support character cell terminal devices. For a user interface application which must support both, it is desirable to be able to use them to their fullest extent, as opposed to simply providing a character-based display within an X window. An object-oriented application framework is presented here which allows the full capabilities of each system to be used while minimizing and isolating the amount of device-dependent code.

Every user interface application consists of two parts: the various components used to display information and accept user input, and the processing of the interaction between these components. Many user interfaces are built around a core set of components such as menus, text entry fields, and forms. For a given application, the interaction between these components is the same regardless of the display system in use.

Our approach is to implement each component as an object, accessible via a single public interface. All of the code necessary to implement the component for the desired display system is completely encapsulated within the object. The application is then written as a collection of objects interacting in a device-independent manner with one another. If a display system provides additional capabilities, the application can be extended by adding objects (e.g. for image display in X).

This approach provides several benefits. First, the application can be ported to any display system capable of implementing the various components. Of course, the closer the system matches the set of components, the less code will be necessary to implement each object. To implement a text entry field using OSF/Motif is fairly trivial since a TextField widget is already defined, whereas implementing the same object in Curses would require considerably more effort. Second, the objects are application-level components, not low-level as provided by the display system. This allows arbitrarily complex components to be developed using both the display system library (e.g. OSF/Motif) and other application objects. For example, a graphical skymap object could be implemented as a form object containing pushbutton and text entry field objects, as well as calls to the display library to perform the various drawing operations. Third, other user interface applications can be developed using the same set of objects, promoting software reuse.

We are currently implementing StarView, the user interface to the HST science archive (ST DADS) using this approach. StarView will be written in C++, and will use Vermont Views for the terminal interface and OSF/Motif for the X Window interface.

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The Application of Artificial Intelligence to Astronomical Scheduling Problems

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Abstract

Efficient utilization of expensive space- and ground-based observatories is an important goal for the astronomical community: the cost of modern observing facilities is enormous, and the available observing time is much less than the demand from astronomers around the world. The complexity and variety of scheduling constraints and goals has led several groups to investigate how artificial intelligence (AI) techniques might help solve these kinds of problems. The earliest and most successful of these projects was started at Space Telescope Science Institute in 1987 and has led to the development of the *Spike* scheduling system to support the scheduling of Hubble Space Telescope (HST). The aim of Spike at STScI is to allocate observations to timescales of days to a week, observing all scheduling constraints, and maximizing preferences that help ensure that observations are made at optimal times. Spike has been in use operationally for HST since shortly after the observatory was launched in April 1990. Although developed specifically for HST scheduling, Spike was carefully designed to provide a general framework for similar (activity-based) scheduling problems. In particular, the tasks to be scheduled are defined in the system in general terms, and no assumptions about the scheduling timescale are built in. The mechanisms for describing, combining, and propagating temporal and other constraints and preferences are quite general. The success of this approach has been demonstrated by the application of Spike to the scheduling of other satellite observatories: changes to the system are required only in the specific constraints that apply, and not in the framework itself. In particular, the Spike framework is sufficiently flexible to handle both long-term and short-term scheduling, on timescales of years down to minutes or less. This talk will discuss recent progress made in scheduling search techniques, the lessons learned from early HST operations, the application of Spike to other problem domains, and plans for the future evolution of the system.

A Generic Archive Protocol and an Implementation

J. M. Jordan, D. G. Jennings, T. A. McGlynn, N. G. Ruggiero, T. A. Serlemitsos
(COSSC/NASA-GSFC)

Archiving vast amounts of data has become a major part of every scientific space mission today. GRASP, the Generic Archive/Retrieval Services Protocol, addresses the question of how to archive the data collected in an environment where the underlying hardware archives may be rapidly changing.

GRASP is a device independent specification defining a set of functions for storing and retrieving data from an archive, as well as other support functions. GRASP is divided into two levels, the Transfer Interface, and the Action Interface. The Transfer Interface is computer/archive independent code while the Action interface contains code which is dedicated to each archive/computer addressed.

Implementations of the GRASP specification are currently available for DECstations running Ultrix, Sparcstations running SunOS, and microVAX/VAXstation 3100s. The underlying archive is assumed to function as a standard Unix or VMS file system. The code, written in C, is a single suite of files. Preprocessing commands define the machine unique code sections in the device interface. The implementation was written, to the greatest extent possible, using only ANSI standard C functions.

The ADAM Environment and Transputers

B.D.Kelly, J.M.Stewart, B.V.McNally (ROE)

The ADAM environment is both used for data analysis by Starlink and for data acquisition by the UK-involved observatories in Australia, Hawaii and the Canary Islands. ADAM was originally hosted under VAX/VMS but is now at an advanced stage of a Unix port. ADAM comprises a parameter system, hierarchical data system, noticeboard system, error handling system and other components. Originally a multi-task single processor environment, it has been enhanced to a multiprocessor environment using local or wide area networking. The Royal Observatory Edinburgh are producing a Transputer version of the ADAM kernel to allow instruments which make use of Transputers for data acquisition/control to integrate more closely with the ADAM software running at the telescopes. Communication into the Transputer system is based on Ethernet carrying TCP/IP, easing development towards a network of mixed VMS/Unix/Transputer Telescope systems. The Transputer system is being applied to instruments under development for the UKIRT and JCMT telescopes.

CCD Data Acquisition Systems at Lick and Keck Observatories

R. I. Kibrick, R. J. Stover (UCO/Lick), A. R. Conrad (Keck)

This paper will describe and compare two distinct but related CCD data acquisition systems (DAS) currently under development at Lick and Keck Observatories. Although these two systems have a number of major architectural differences, they share a considerable amount of common hardware and software. Both of these new systems build on a large body of proven software that is the foundation of the existing CCD DAS currently in use at Lick Observatory. Both will provide support for reading up to four on-chip amplifiers per CCD and/or reading out mosaics of CCD chips. In addition, they will provide the capability for interactive, real-time adjustment of CCD waveforms for engineering purposes.

Each of these two systems is composed of three major subsystems:

1. an instrument computer and its software
2. a data capture computer and its software
3. a CCD/dewar controller and its software

The instrument computer is a Unix workstation, and the functions it provides include user interfaces, the interactive real-time display of CCD images, and the recording of image and FITS header data to disk and/or tape. The data capture computer is responsible for the packaging and high-speed transfer of the CCD pixel data stream into a bulk RAM, and the subsequent transfer of this data to the instrument computer. The CCD/dewar controller generates the waveforms for clocking the CCD, digitizes the pixel data, and transmits it via high-speed link to the data capture computer. It is also responsible for monitoring and controlling the dewar temperature and cryogen levels.

A significant portion of both systems is based on hardware and software developed by Robert Leach of the Astronomy Department of San Diego State University. In both systems, the CCD/dewar controller will employ Leach-designed timing, analog, and utility boards. The timing and utility boards make use of Motorola DSP 56001 digital signal processors for high-speed waveform generation and data capture. In addition, the Lick system will employ the Leach-designed DSP-based DMA controller in its data capture computer.

Given the number of different types of processors and high-speed data links employed in both systems, a major emphasis of this paper will be on the various forms of inter-processor communications utilized for data transfer and distributed process synchronization.

The Digital Archive of the International Halley Watch

D.A. Klinglesmith III, M.B. Niedner (NASA-GSFC), E. Grayzeck (U. of MD, PDS-SBN), M. Aronsson, R.L. Newburn (NASA-JPL), A. Warnock III (Hughes STX)

The International Halley Watch was established to coordinate, collect, archive, and distribute the scientific data from Comet P/Halley that would be obtained from both the ground and space. This paper describes one of the end products of that effort, namely the IHW Digital Archive.

The IHW Digital Archive consists of 26 CD-ROMs containing over 32 giga bytes of data from the 9 IHW disciplines as well as data from the 5 spacecraft missions flown to comet P/Halley and P/Giacobini-Zinner. The total archive contains over 50,000 observations by 1,500 observers from at least 40 countires. The first 24 CDs, which are currently available, contain data from the 9 IHW disciplines. The two remaining CDs will have the spacecraft data and should be available within the next year. A test CD-ROM of these data has been created and is currently under review.

The distribution of the data within the first 24 CDs is such that 5 of the discs, "the mixed discs", contain information from all 9 IHW disciplines. Eighteen of the discs, "the compressed LSPN discs", contain the digitized imagery from the Large-Scale Phenomena Network. One disc, "the trial run disc", contains data collected from comets P/Crommelin and P/Giacobini-Zinner. Most all of the data is stored in FITS format and has PDS labels associated with it. In general the data directories and file structures are time ordered.

Besides the actual data, the IHW Digital Archive contains an extensive amount of metadata: indices, ephemerides, directory structures, documentation and software. The original data was obtained by a large, diverse group of professional and amateur astronomers who in turn provided the data to the 9 IHW discipline teams. These discipline teams organized the data into standard formats and forwarded them to the Lead Center at JPL The Lead Center went through an extensive verification process and generated the first set of metadata. The verification process and the generation of more metadata was continued at NASA Goddard Space Flight Center and the CD-ROM premaster tapes were created there. The CD-ROMs where manufactured by Digital Audio Disc Corporation under contract to NASA-Goddard. The digital archive will be distributed to those contributors of comet data who request it, as well numerous astronomical institutions world wide. Additional assistance and distribution will be available through the Small Bodies Node of the Planetary Data System.

The generation of this digital archive was clearly an international effort. It could not have been done without the cooperation of many people and institutions too numerous to mention here. Refer to the **ACKNWLDG.TXT** file in the root directory and **PREFACE.TXT** file in the \DOCUMENT\APPENDIX\ directory on disk 23 of the digital archive for a complete list of credits. The history and structure of the IHW is detailed in the The Comet Halley Archive Summary Volume (Z. Sekanina, editor, NASA/JPL 400-450 8/91).

Deconvolution of Hubble Space Telescope Images using Simulated Point Spread Functions

J. E. Krist and H. Hasan (STScI)

Presented is a study of the use of simulated point spread functions (PSFs) to deconvolve Hubble Space Telescope images. We concentrate on images from the Wide Field and Planetary Camera (WFPC) and examine the affect of position dependence of the PSF and the telescope focus position on deconvolutions. Comparisons will be made to what will be expected from WFPC II, which will include corrective optics. Since PSFs can be simulated for any specific observation, with the added advantage of being noise free and the ability to subsample them, they may be more suitable for deconvolution than observed ones in some cases. And since finding a suitable observed PSF may be difficult, simulated ones may be easier to use.

HST PSF Simulation using Tiny Tim

J. E. Krist (STScI)

Tiny Tim is a program which simulates Hubble Space Telescope imaging camera PSFs. It is portable (written and distributed in C) and is reasonably fast. It can model the WFPC, WFPC II, FOC, and COSTAR corrected FOC cameras. In addition to aberrations such as defocus and spherical, it also includes WFPC obscuration shifting, mirror zonal error maps, and jitter. The program has been used at a number of sites for deconvolving HST images. Tiny Tim is available via anonymous ftp on stsci.edu in the directory software/tinytim.

Intelligent Text Retrieval in the NASA Astrophysics Data System

M.J. Kurtz, T. Karakashian, C.P. Stern, G. Eichhorn, S.S. Murray, J.M. Watson (CfA), P.G. Ossorio, J.L. Stoner (Ellery Systems)

In collaboration with the NASA Scientific and Technical Information System the NASA Astrophysics Data System (ADS) is establishing a service to provide access to the literature abstracts relevant to astronomy in the NASA Scientific and Technical Aerospace Reports and the International Aerospace Abstracts (together also known as NASA RECON).

The service will include several sophisticated retrieval methods, which may be combined. Included will be methods to perform relevancy ranking from natural language queries, synonym and misspelling recognition, author name translation (e.g. for multiple transliteration possibilities) and other features.

The capabilities of the current release will be shown, and the plans for the near future will be discussed.

The IDL Astronomy User's Library

W.B. Landsman (Hughes/STX)

IDL (Interactive Data Language) is a commercial[1] programming, plotting, and image display language, which is widely used in astronomy. The IDL Astronomy User's Library is a central repository of over 400 astronomy-related IDL procedures accessible via anonymous FTP. I will overview the use of IDL within the astronomical community, and discuss recent enhancements to the IDL astronomy library. These enhancements include a fairly complete I/O package for FITS images and tables, an image deconvolution package and an image mosaic package, and access to IDL OpenWindows/Motif widgets interface. The IDL Astronomy Library is funded by NASA through the Astrophysics Software and Research Aids Program.

[1] - Research Systems Inc., Boulder, CO

GRO/EGRET Data Analysis Software: An Integrated System of Custom and Commercial Software Using Standard Interfaces

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The Energetic Gamma Ray Telescope Experiment (EGRET) on the Compton Gamma Ray Observatory has been in orbit for more than a year and is being used to map the full sky for gamma rays in a wide energy range from 30 to 20,000 MeV. Already these measurements have resulted in a wide range of exciting new information on quasars, pulsars, galactic sources, and diffuse gamma ray emission.

The central part of the analysis is done with skymaps that typically cover an 80 x 80 degree section of the sky for an exposure time of several days. Specific software developed for this program generates the counts, exposure and intensity maps. The analysis is done on a network of UNIX based workstations and takes full advantage of a custom-built user interface called X-dialog. The maps that are generated are stored in the FITS format for a collection of energies. These, along with similar diffuse emission background maps generated from a model calculation, serve as input to a maximum likelihood program that produces maps of likelihood with optional contours that are used to evaluate regions for sources. Likelihood also evaluates the background corrected intensity at each location for each energy interval from which spectra can be generated.

Being in a standard FITS format permits all of the maps to be easily accessed by the full complement of tools available in several commercial astronomical analysis systems. In the EGRET case, IDL is used to produce graphics plots in two and three dimensions, and to quickly implement any special evaluation that might be desired.

Other custom-built software, such as the spectral and pulsar analyses, take advantage of the XView toolkit for display and Postscript output for the color hardcopy.

This poster paper outlines the data flow and provides examples of the user interfaces and output products. It stresses the advantages that are derived from the integration of the specific instrument-unique software and powerful commercial tools for graphics and statistical evaluation. This approach has several proven advantages including flexibility, a minimum of development effort, ease of use, and portability.

SIMBAD Quality-control

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The astronomical database SIMBAD developed at the Centre de données astronomiques de Strasbourg presently contains 760 000 objects (stellar and non stellar). It has the unique characteristic of being structured specifically for astronomical objects. All types of heterogenous data (bibliographic references, measurements and sets of identification) are connected with each object. The attributes that define quality of the database include :
- Reliability : cross-identification should not rely upon just exact values object coordinates. It also means that information attached to one simple object should be consistent. We have to control the existing data in order to start with a reliable base and to cross-identify new data assuring the quality as data grows.
- Exhaustivity : delays between publication of new informations and their inclusion in the database should be as short as possible. We have to maintain the integrity of the database as data accumulates.
Taking the amount of data into consideration and the rate of new data production, it is necessary to use automatic methods.

One of the possibilities is to use multivariate data analysis. The Factor-space is a n-dimensional relevancy space. Which is described by the n-axes representing a set of n subject matter headings, the words and phrases can be used to scale the axes and the documents are then a vector average of the terms within them.

Our application is based on the NASA-STI bibliographical database. The selected data concern astronomy, astrophysic and spacl radiation (102,963 references from 1975 to 1991 included 8070 keywords).
The F-space is built from this bibliographical data. By comparing the F-space position obtained from the NASA-STI keywords with the F-space position obtained from the SIMBAD references, we will be able to show whether it is possible to retrieve information with a restricted set of words only. If the comparison is valid, this will be a way to enter bibliographic information in the SIMBAD quality control process.
Futhermore, it is possible to connect the physical measurements of stars from SIMBAD to literature concerning these stars from the NASA-STI abstracts. The physical properties of stars (e.g. UBV colors) are not randomly distributed. Stars are distributed among different clusters in a physical parameter space. We will show that there are some relations between this classification and the literature concerning these objects clusters in a factor space. We will investigate the nature of the relationship between the SIMBAD measurements and the bibliography. These would be new relationships that are not pre-established by an atronomer. In addition, the bibliography could be neutral information that can be used in combination with the measured parameters.

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Data Indexing Techniques for the EUVE All-Sky Survey

J. Lewis, V. Saba, and C. Dobson (Center for EUV Astrophysics, UC Berkeley)

This poster describes techniques developed for manipulating large full-sky datasets for the Extreme Ultraviolet Explorer project. We have adapted the quatrilateralized cubic sphere indexing algorithm to allow us to efficiently store and process several types of large data sets, such as full-sky maps of photon counts, exposure time, and count rates. A variation of this scheme is used to index sparser data such as individual photon events and viewing times for selected areas of the sky, which are eventually used to create EUVE source catalogs.

The Keck Task Library (KTL)

W. F. Lupton, A. R. Conrad (Keck)

KTL is a set of routines which eases the job of writing applications which must interact with a variety of underlying sub-systems (known as *services*). A typical such application is an X Window user interface coordinating telescope and instruments. In order to connect to a service, application code specifies a service name—typically an instrument name—and a *style*, which defines the way in which the application will interact with the service. Two styles are currently supported: *keyword*, where the application reads and writes named keywords and the resulting inter-task message traffic is hidden; and *message*, where the application deals directly with messages. The keyword style is intended mainly for user interfaces, and the message style is intended mainly for lower-level applications.

KTL applications are event driven: a typical application first connects to all its desired services, then expresses interest in specified events. The application then enters an event dispatch loop in which it waits for events and calls the appropriate service's event-handling routine. Each event is associated with a callback routine which is invoked when the event occurs. Callback routines may (and typically do) interact with other sub-systems and KTL provides the means of doing so without blocking the application (vital for X Window user interfaces). This approach is a marriage of ideas culled from the X window, ADAM, Keck instrument and Keck telescope control systems.

A novel feature of KTL is that it knows nothing about any services or styles. Instead it defines a generic set of routines which must be implemented by all services and styles (essentially open(), ioctl(), read(), write(), event() and close()) and activates shareable libraries at run-time. Services have been implemented (in both keyword and message styles) for HIRES (the Keck high resolution echelle spectrograph built by Lick Observatory), LWS (the Keck long wavelength spectrometer built by UC San Diego) and the Keck telescope. Each of these implementations uses different underlying message systems: the Lick MUSIC system, RPCs, and direct sockets (respectively). Services for the remaining three front-line Keck instruments will be implemented over the next few months.

Interactive Spectral Analysis And Computation (ISAAC)

D. M. Lytle, (NOAO)

Isaac is a task in the NSO external package for IRAF. A descendant of a FORTRAN program written to analyze data from a Fourier transform spectrometer, the current implementation has been generalized sufficiently to make it useful for general spectral analysis and other one dimensional data analysis tasks. The user interface for Isaac is implemented as an interpreted mini-language containing a powerful, programmable vector calculator. Built-in commands provide much of the functionality needed to produce accurate line lists from input spectra. These built-in functions include automated spectral line finding, least squares fitting of Voigt profiles to spectral lines including equality constraints, various filters including an optimal filter construction tool, continuum fitting, and various I/O functions.

The NSO FTS database program and archive (FTSDBM)

D. M. Lytle, (NOAO)

Data from the NSO Fourier transform spectrometer is being rearchived from half inch tape onto write-once compact disk. In the process, information about each spectrum and a low resolution copy of each spectrum is being saved into an on-line database. FTS-DBM is a simple database management program in the NSO external package for IRAF. A command language allows the FTSDBM user to add entries to the database, delete entries, select subsets from the database based on keyword values including ranges of values, create new database files based on these subsets, make keyword lists, examine low resolution spectra graphically, and make disk number/file number lists. Once the archive is complete, FTSDBM will allow the database to be efficiently searched for data of interest to the user and the compact disk format will allow random access to that data.

AXAF USER INTERFACES FOR HETEROGENEOUS ANALYSIS ENVIRONMENTS

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The AXAF Science Center (ASC) will develop software to support all facets of data center activities and user research for the AXAF X-ray Observatory, scheduled for launch in 1999. We would like to provide astronomers with the ability to utilize heterogeneous data analysis packages, that is, to allow astronomers to pick the best packages for doing their scientific analysis. For example, ASC software will be based on IRAF, but we will incorporate non-IRAF programs into the data system where appropriate. Additionally, we will seek to allow AXAF users to mix ASC software with their own local software. The need to support heterogeneous analysis environments is not special to the AXAF project, and therefore finding mechanisms for coordinating heterogeneous programs is an important problem for astronomical software today.

Our approach to solving this problem has been to develop two interfaces that allow the scientific user to run heterogeneous programs together. The first is an IRAF-compatible parameter interface that provides non-IRAF programs with IRAF's parameter handling capabilities. Included in the interface an application programming interface to manipulate parameters from within programs, and also a set of host programs to manipulate parameters at the command line or from within scripts. The parameter interface has been implemented to support parameter storage formats other than IRAF parameter files, allowing one, for example, to access parameters that are stored in data bases.

We have also developed an X Windows graphical user interface called "agcl", layered on top of the IRAF-compatible parameter interface, that provides a standard graphical mechanism for interacting with IRAF and non-IRAF programs. Users can edit parameters and run programs for both non-IRAF programs and IRAF tasks. The agcl interface allows one to communicate with any command line environment in a transparent manner and without any changes to the original environment. For example, we routinely layer the GUI on top of IRAF, ksh, SMongo, and IDL.

The agcl, based on the facilities of a system called Answer Garden, also has sophisticated support for examining documentation and help files, asking questions of experts, and developing a knowledge base of frequently required information. Thus, the GUI becomes a total environment for running programs, accessing information, examining documents, and finding human assistance.

Because the agcl can communicate with any command-line environment, most projects can make use of it easily. We are continually discovering new applications for these interfaces. It is our intention to evolve the GUI and its underlying parameter interface in response to these needs - from users as well as developers - throughout the astronomy community.

This presentation describes the capabilities and technology of the above user interface mechanisms and tools. It also discusses the design philosophies guiding our work, as well as our hopes for the future.

Verification of the PROS Timing Analysis Package

N94-22506

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ROSAT observations of known pulsars are used to verify the functions of timing programs. The Crab Pulsar and PSR 0540-69, with 33 and 50 millisecond periods are used to examine the fast fourier transform and the epoch-folding task used to search for periodic signals. These fast pulsars provide a more vigorous test of the system than those with periods of a few seconds.

GammaCore: The Compton Observatory Research Environment

T.A. McGlynn, D.G. Jennings, J.M. Jordan, N. Ruggiero, T.A. Serlemitsos (COSSC/CSC).

The Compton Observatory Science Support Center (COSSC) is developing a coherent analysis environment for the analysis of Compton and other gamma-ray astronomy data. This environment, *GammaCore*, allows the astronomer to access the data analysis systems developed at the Principal Investigator (PI) sites for the four Compton Observatory instruments. In addition users have access to standard astronomical tools such as IRAF, IDL and XANADU.

The user interface of *GammaCore* is the AGCL (AnswerGarden Command Language), developed at the AXAF Science Center. The parameter interface supported by the AGCL allows *GammaCore* to access all PI software systems in a uniform fashion. These systems are quite different, having been developed independently on heterogeneous systems without much concern for general portability. The data kibitzer concept, where a window running in a specific PI environment is controlled by the AGCL has been used extensively. Users can choose to view what is going on in the native environment, to use the window to control PI software directly, or to ignore the PI systems entirely and to work only through the homogeneous AGCL interface.

Software developed at the COSSC is also integrated within *GammaCore*. Extensive facilities for conversions of PI data formats to and from FITS have been developed. Access to the Compton data archive and catalogs will also be completely integrated with the *GammaCore*. Users can retrieve any publicly available Compton data.

This paper examines the issues that have arisen in attempting to meld these widely diverse systems. The advantages and limitations of the parameter interface and the kibitzer are discussed along with issues of data portability, documentation, and the feasibility of multi-instrument analysis.

Limited capabilities are now available within *GammaCore* with significant enhancements planned over the coming year. An implementation including all PI systems will be available within that time. Instructions on how to access *GammaCore* and how to get more information are given.

Wilbur: A Low-Cost CCD Camera System for MDM Observatory

M. R. Metzger (MIT), G. A. Luppino (IfA), J. L. Tonry (MIT)

The recent availability of several "off-the-shelf" components, particularly CCD control electronics from SDSU, has made it possible to put together a flexible CCD camera system at relatively low cost and effort. We describe Wilbur, a complete CCD camera system constructed for the Michigan-Dartmouth-MIT Observatory. The hardware consists of a Loral 2048^2 CCD controlled by the SDSU electronics, an existing dewar design modified for use at MDM, a Sun Sparcstation 2 with a commercial high-speed parallel controller, and a simple custom interface bewteen the controller and the SDSU electronics. The camera is controlled from the Sparcstation by software that provides low-level I/O in real time, collection of additional information from the telescope, and a simple command interface for use by an observer. Readout of the 2048^2 array is complete in under 2 minutes at 5 e^- read noise, and readout time can be decreased at the cost of increased noise. The system can be easily expanded to handle multiple CCDs/multiple readouts, and can control other dewars/CCDs using the same host software.

SKYMAP: Exploring the Universe in Software

D.J. Mink (SAO)

SKYMAP is a computer program which produces maps of arbitrary portions of the sky in a variety of projections and coordinate systems. Over the past 10 years it has been used to produce finder charts for occultations by planets, display scan and image data from the Spacelab 2 Infrared Telescope, and make maps of fields for astronomical observations at X-ray, optical, infrared, and radio wavelengths. It can display multiple source catalogs, including the HST Guide Star Catalog, as well as solar system objects with astrometric accuracy using the JPL DE-130 ephemeris or tabulated positions. SKYMAP can be tuned to a specific task using an ASCII parameter file which controls how information is displayed on any Tektronix-compatible graphics display. The program contains a variety of interactive graphic and image processing features and has been ported to a variety of computer systems. A recent project visually demonstrates source density variation in various commonly-used all-sky catalogs.

STARBASE: Database Software for the Automated Plate Scanner

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The Automated Plate Scanner (APS) of the University of Minnesota, a unique high speed "flying spot" laser scanner, is currently being used to scan and digitize the 936 O and E plate pairs of the first epoch Palomar Sky Survey. The resultant database will be used to produce a catalog of approximately a billion stars and several million galaxies. We describe the ongoing development of a dedicated APS database management system which will be made available to the astronomical community via INTERNET.

A specialized DBMS called STARBASE has been written to provide fast access to the hundreds of millions of images collected by the APS. This system provides an initial reduction mode for parameterizing APS images and classifying image types using a novel set of neural network image classifiers. A second analysis mode, which will be that commonly used by the general user, provides for searches of the database which may be constrained by any combination of physical and positional parameters. Through the use of pointer hash trees, the system has been optimized for extremely fast positional searches using either right ascension and declination on the sky or linear X and Y positions on the POSS field. In addition to fast data retrieval, the system provides a graphical interface for displaying scatter plots or histograms of the collected data. In addition, a specialized image display system is being developed to allow the user to view densitometric data for all objects classified as extended by the neural network system. Finally, STARBASE has a flexible programmable interface which allows other programs to access information in the database. This allows users to write applications suited to their particular needs to process APS data.

XPI - The Xanadu Parameter Interface.

N. White, P. Barrett, B. O'Neel, P. Jacobs, (HEASARC/NASA-GSFC)

XPI is a table driven parameter interface which greatly simplifies both command driven programs such as BROWSE and XIMAGE as well as stand alone single-task programs. It moves all of the syntax and semantic parsing of commands and parameters out of the users code into common code and externally defined tables. This allows the programmer to concentrate on writing the code unique to the application rather than reinventing the user interface and for external graphical interfaces to interface with no changes to the command driven program. XPI also includes a compatibility library which allows programs written using the IRAF host interface (Mandel and Roll) to use XPI in place of the IRAF host interface.

Evaluation of RDBMS packages for use in astronomy

C.G.Page, A.C.Davenhall (University of Leicester, UK)

Tabular datasets arise in many areas of astronomical data analysis, from raw data (such as photon event lists) to final results (such as source catalogs). The Starlink Catalog Access and Reporting package, SCAR, was originally developed to handle IRAS data and it has been the principal relational DBMS in the Starlink software collection for several years. But SCAR has many limitations and is VMS-specific, while Starlink is in transition from VMS to Unix. Rather than attempt a major re-write of SCAR for Unix, it seemed more sensible to see whether any existing database packages were suitable for general astronomical use. We first drew up a list of desirable properties for such a system and then used these criteria to evaluate a number of packages, both free ones and those commercially available. It is already clear that most commercial DBMS packages are not very well suited to our requirements, for example most cannot carry out efficiently even fairly basic operations such as joining two catalogs on an approximate match of celestial positons.

This paper reports the results of our evaluation exercise and notes the problems in using a standard DBMS package to process scientific data.

In parallel with this we have started to develop a simple database engine that can handle tabular data in a range of common formats including simple direct-access files (such as SCAR and Exosat DBMS tables) and FITS tables (both ASCII and binary). Details of this are also reported.

Some Practicable Applications of Quadtree Data Structures/Representation in Astronomy

P-1

L. Pásztor (MTA TAKI, Eötvös Univ. Budapest)

Development of quadtree as hierarchical data structuring technique for representing spatial data (like points, regions, surfaces, lines, curves, volumes etc.) has been motivated to a large extent by storage requirements of images, maps and other multidimensional (spatially structured) data. For many spatial algorithms time-efficiency of quadtrees in terms of execution may be as important as their space-efficiency concerning storage conditions.

Briefly, the quadtree is a class of hierarchical data structures which is based on the recursive partition of a square region into quadrants and subquadrants until a predefined limit.

Beyond the wide applicability of quadtrees in image processing, spatial information analysis and building digital databases (processes becoming ordinary for the astronomical community) there may be numerous further applications in astronomy. Some of these practicable applications based on quadtree representation of astronomical data are presented and suggested for further considerations.

Examples are shown for use of point as well as region quadtrees. Statistics of different leaf and nonleaf nodes (homogeneous and heterogeneous sub-quadrants respectively) at different levels may provide useful information on spatial structure of astronomical data in question. By altering the principle guiding the decomposition process, different type of spatial data may be focused on. Finally, a sampling method based on quadtree representation of an image is proposed which may prove to be efficient in the elaboration of sampling strategy in a region where observations were carried out previously either with different resolution or/and in different bands.

Development of the FITS Tools Package for Multiple Software Environments

W.D. Pence, J.K. Blackburn (HEASARC/NASA)

The HEASARC is developing a package of general purpose software for analyzing
data files in FITS format. This paper describes the design philosophy which
makes the software both machine-independent (it runs on VAXs, Suns, and DEC-
stations) and software environment-independent. Currently the software can be
compiled and linked to produce IRAF tasks, or alternatively, the same source
code can be used to generate stand-alone tasks using one of two implementations
of a user-parameter interface library. The machine independence of the soft-
ware is achieved by (1) writing the source code in ANSI standard Fortran or C,
(2) using the machine-independent FITSIO subroutine interface for all data file
I/O, and (3) using a standard user-parameter subroutine interface for all user
I/O. The latter interface is based on the Fortran IRAF Parameter File inter-
face developed at STScI. The IRAF tasks are built by linking to the IRAF
implementation of this parameter interface library. Two other implementations
of this parameter interface library, which have no IRAF dependencies, are now
available which can be used to generate standalone executable tasks. These
stand-alone tasks can simply be executed from the machine operating system
prompt either by supplying all the task parameters on the command line, or by
entering the task name after which the user will be prompted for any required
parameters. A first release of this FTOOLS package is now publicly available.
The currently available tasks will be described, along with instructions on how
to obtain a copy of the software.

Efficient Transfer of Images over Networks

J. W. Percival (U. Wisc) and R. L. White (STScI)

Effective remote observing requires sending large images over long distances. The usual approach to the transfer problem is to require high bandwidth transmission links, which are expensive to install and operate. An alternative approach is to use existing low-bandwidth connections, such as phone lines or the Internet, in a highly efficient manner by compressing the images. The combined use of existing low-cost infrastructure and standard networking software means that remote observing can be made practical even for small observatories with limited network resources.

We have implemented such a scheme based on the H-transform compression method developed by White (1992) for astronomical images, which are often resistant to compression because they are noisy. The H-transform can be used for either lossy or lossless compression, and compression factors of at least 10 can be achieved with no noticeable losses in the astrometric or photometric properties of the compressed images. The H-transform allows us to organize the information in an image so that the "useful" information can be sent first, followed by the noise, which makes up the bulk of the transmission. The receiver can invert a partially received set of H-coefficients, creating an image that improves with time. The H-transform is particularly well-suited to this style of incremental reconstruction, because the spatially localized nature of the basis functions of the H-transform prevents the appearance of artifacts such as ringing around point sources and edges.

Our implementation uses the WIYN Telescope Control System's TCP-based communications protocol. We sent an 800x800 16-bit astronomical image over a 2400 baud connection, which would normally take about 71 minutes; after only 60 *seconds*, the partially received H-transform produced an image that did not differ appreciably from the original. This poster will present a quantification of the efficiencies, as well as examples of images reconstructed from partial data.

The ESO-MIDAS Table File System

M. Peron, P. Grosbøl (ESO)

The new and substantially upgraded version of the Table File System in MIDAS is presented as a scientific database system. Midas applications for performing database operations on tables are discussed, for instance, the exchange of the data to and from the TFS, the selection of objects, the *uncertainty* joins across tables and the graphical representation of data.
This upgraded version of the TFS is a full implementation of the binary table extension of the FITS format; in addition, its also supports arrays of strings. Different storage strategies for optimal access of very large data sets are implemented and are addressed in detail.

As a simple relational database, the TFS may be used for the management of personal data files. This opens the way to intelligent pipeline processing of large amount of data.

One of the key features of the Table File system ⟶ provide also an extensive set of tools for the analysis of the final results of a reduction r   olumn operations using standard and special mathematical functions as well as sta*   ons can be carried out, commands for linear regression and model fitting usir   re methods and user-defined functions are available. Finally, statisti   multivariate methods can also operate on tables. Some of these

An X-ray Archive on your Desk — The *Einstein* CD-ROM's

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Data from the *Einstein Observatory* imaging proportional counter (IPC) and high resolution imager (HRI) have been released on several CD-ROM sets. The sets released so far include pointed IPC and HRI observations in both simple image and detailed photon event list format, as well as the IPC slew survey. With the data on these CD-ROM's, the user can perform spatial analysis (e.g. surface brightness distributions), spectral analysis (with the IPC event lists), and timing analysis (with the IPC and HRI event lists). The next CD-ROM set will contain IPC unscreened data, allowing the user to perform custom screening to recover, for instance, data during times of lost aspect data or high particle background rates.

Adaptive Filtering of Echelle Spectra of distant Quasars

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The study of the $Ly\ \alpha$ – forest of distant ($z > 3$) Quasars is an important tool in obtaining a more detailed picture of the distribution of matter along the line of sight and thus of the general distribution of matter in the Universe and is therefore of important cosmological significance. Obviously this is one of the tasks, where spectral resolution plays an important role.

The spectra we used, were obtained with the EFOSC at the ESO 3.6m telescope. Applying for the data reduction the standard Echelle procedure, as it is implemented for instance in the MIDAS-package, one uses stationary filters (e.g. median) for noise and cosmic particle event reduction in the 2-dimensional Echelle image. These filters are useful if the spatial spectrum of the noise reaches essentially higher frequencies then the highest resolution features in the image. Otherwise the resolution in the data will be degraded and the spectral lines smoothed. However, in the Echelle spectra the highest resolution is already in the range of one or a few pixels and therefore stationary filtering means always a loss of resolution.

We developed an Echelle reduction procedure on the basis of a space variable filter described by Richter [1] (see also [2]) which recognizes the local resolution in the presence of noise and adapts to it. It will be shown that this technique leads to an improvement in resolution by a factor of 2 with respect to standard procedures.

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The EXOSAT Database and Archive

A. P. Reynolds and A. N. Parmar (ESA/ESTEC)

The EXOSAT database provides on-line access to the results and data products (spectra, images and lightcurves) from the EXOSAT mission as well as access to data and logs from a number of other missions (such as EINSTEIN, COS-B, ROSAT and IRAS). In addition, a number of familiar optical, infrared, and X-ray catalogues, including the HST guide star catalogue are available. The complete database is located at the EXOSAT observatory at ESTEC in the Netherlands and is accessible remotely via a captive account.

The database management system has been specifically developed to efficiently access the database and to allow the user to perform statistical studies on large samples of astronomical objects as well as to retrieve scientific and bibliographic information on single sources. The system was designed to be mission independent and includes timing, image processing and spectral analysis packages as well as software to allow the easy transfer of analysis results and products to the user's own institute.

The archive at ESTEC comprises a subset of the EXOSAT observations, stored on magnetic tape. Observations of particular interest have beeen copied in compressed format to an optical jukebox, allowing users to retrieve and analyse selected raw data entirely from their terminals. Such analysis may be necessary if the user's needs are not accomodated by the products contained in the database (in terms of time resolution, spectral range and the finesse of the background subtraction, for instance). Long-term archiving of the full final observation data is taking place at ESRIN in Italy as part of the ESIS program, again using optical media, and ESRIN have now assumed responsibility for distributing the data to the community. Tests have shown that raw observational data (typically several tens of megabytes for a single target) can be transferred via the existing networks in reasonable time.

The ISO SWS on-line system

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The software which is currently being developed for the Short Wavelength Spetrometer (SWS) of the Infrared Space Observatory (ISO) will be described. The spectrometer has a wide range of capabilities in the 2 - 45 μm infrared band. SWS contains two independent gratings, one for the long and one for the short wavelength section of the band. With the gratings a spectral resolution of $\sim$1000 to $\sim$2500 can be obtained. The instrument also contains two Fabry-Pérault's yielding a resolution between $\sim$1000 and $\sim$20000.

Software is currently being developed for the aquisition, calibration and analysis of SWS data. The software is firstly required to run in a pipeline mode without human interaction, to process data as they are received from the telescope. However, both for testing and calibration of the instrument as well as for evaluation of the planned operating procedures the software should also be suitable for interactive use. Thirdly the same software will be used for long term characterisation of the instrument.

The software must work properly within the environment designed by the European Space Agency (ESA) for the spacecraft operations. As a result strict constraints are put on I/O devices, throughput etc.

Khoros Software Specification Format and Interoperability

A. H. Rots (USRA/NASA-GSFC)

Khoros defines formats for User Interface Specification (UIS) and Program Specification (PS) files. From such files, its code generator, Ghostwriter, creates source files and documentation. The great advantage of the system is that the code fragments that make up part of the PS file are purely generic. All Khoros-related code is created by the code generator; this includes all user interface code. As a matter of fact, both specification files are very generic in nature. Thus, one could imagine using it as the basis for other software systems. A case will be made that writing a code generator that would create IRAF-compatible code from the Khoros UIS and PS files is fairly trivial.

Another aspect of the Khoros system conventions concerns the way execution commands are generated by the user interface and the actual syntax of those commands. The protocols are such that interoperability at the level of executable modules is readily possible.

SPATIAL REGION FILTERING IN IRAF/PROS

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In order to analyze X-ray data, it is nearly always necessary to extract source and background events from a data set. Typically, this is done by defining geometric spatial regions of the data set to describe the source and background. For example, one might wish to extract source events from a circular or elliptical region centered at a particular pixel, and background events from a circular or elliptical annulus whose inner radius matches the source region. At the same time, it might be necessary to exclude one or more nearby sources from the source or background region in question. Thus, it might be necessary to define a pie-shaped region or even an entirely irregularly-shaped region to exclude.

A spatial filtering scheme called REGIONS has been implemented in IRAF/PROS to support these and other types of spatial region extraction. It allows users to create a spatial mask by specifying one or more ASCII geometric shape descriptors (box, circle, ellipse, pie, point, annulus and polygon) as regions to be included or excluded in the mask. In addition, two or more shapes can be combined using Boolean algebra to create an infinite variety of sophisticated regions.

Each geometric shape has a specific set of parameters that describe that shape. For example, a circle is described by a center and a radius, while a box is described by a center, length, width, and rotation angle. These quantities can be specified in units of pixels or, in cases where the target image contains world coordinate system information, they can be described in units such as RA and Dec.

Users can create region mask files by feeding an ASCII region descriptor to the IRAF/PROS *plcreate* task. Temporary masks can also be created from ASCII region descriptors by individual applications that call the routines in the region creation library. This library implements a yacc-based region parser that compiles the ASCII descriptors into "software CPU" instructions which are then executed to create the mask. The mask created from these region descriptors is a standard IRAF PLIO mask. It can be combined with other PLIO masks (e.g., exposure masks) to provide complete spatial filtering capabilities.

This presentation describes the capabilities of the above region filtering scheme. It also discusses the design philosophy guiding our work, as well as our plans for the future.

Managing an Archive of Weather Satellite Images

R. L. Seaman (NOAO)

The author's experiences are described of building and maintaining an archive of hourly weather satellite pictures at NOAO. This archive has proven very popular with visiting and staff astronomers — especially on windy days and cloudy nights. Given access to a source of such pictures, a suite of simple shell and IRAF CL scripts can provide a great deal of robust functionality with little effort.

These pictures and associated data products such as surface analysis (radar) maps and National Weather Service forecasts are updated hourly at anonymous ftp sites on the Internet, although your local Atmospheric Sciences Department may prove to be a more reliable source. The raw image formats are unfamiliar to most astronomers, but reading them into IRAF is straightforward. Techniques for performing this format conversion at the host computer level are described which may prove useful for other chores.

Pointers are given to sources of data and of software, including a package of example tools. These tools include shell and Perl scripts for downloading pictures, maps, and forecasts, as well as IRAF scripts and host level programs for translating the images into IRAF and GIF formats and for slicing & dicing the resulting images. The author gives hints for displaying the images and for making hardcopies.

Detector Noise Statistics in the Non-linear Regime

P. L. Shopbell, J. Bland-Hawthorn (Rice U.)

We have examined the statistical behavior of an idealized linear detector in the presence of threshold and saturation levels. We assume that the noise is governed by the statistical fluctuations in the number of photons emitted by the source during an exposure. Since physical detectors cannot have infinite dynamic range, our model illustrates that all devices have non-linear regimes, particularly at high count rates. The primary effect is a decrease in the statistical variance about the mean signal due to a portion of the expected noise distribution being removed via clipping. Higher order statistical moments are also examined, in particular, skewness and kurtosis. In principle, the expected distortion in the detector noise characteristics can be calibrated using flatfield observations with count rates matched to the observations. For this purpose, we describe some basic statistical methods that utilize Fourier analysis techniques.

The IRAF Fabry-Perot Analysis Package: Ring Fitting

P. L. Shopbell, J. Bland-Hawthorn (Rice U.), G. Cecil (U.N.C.)

As introduced at ADASS I, a Fabry-Perot analysis package for IRAF is currently under development as a joint effort of ourselves and Frank Valdes of the IRAF group. Although additional portions of the package have also been implemented, we report here primarily on the development of a robust ring fitting task, useful for fitting the calibration rings obtained in Fabry-Perot observations. The general equation of an ellipse is fit to the shape of the rings, providing information on ring center, ellipticity, and position angle. Such parameters provide valuable information on the wavelength response of the etalon and the geometric stability of the system. Appropriate statistical weighting is applied to the pixels to account for increasing numbers with radius, the Lorentzian cross-section, and uneven illumination. The major problems of incomplete, non-uniform, and multiple rings have been addressed with the final task capable of fitting rings regardless of center, cross-section, or completion. The task requires only minimal user intervention, allowing large numbers of rings to be fit in an extremely automated manner.

The Evolution of the FIGARO Data Reduction System

K. Shortridge (AAO)

The Figaro data reduction system originated at Caltech around 1983. It was based on concepts being developed in the U.K. by the Starlink organisation, particularly the use of hierarchical self-defining data structures and the abstraction of most user-interaction into a set of 'parameter system' routines. Since 1984 it has continued to be developed at AAO, in collaboration with Starlink and Caltech. It has been adopted as Starlink's main spectroscopic data reduction package, although it is by no means limited to spectra; it has operations for images and data cubes and even a few (very specialised) for four-dimensional data hypercubes. It has continued to be used at Caltech and will be used at the Keck. It is also in use at a variety of other organisations around the world.

Figaro was originally a system for VMS Vaxes. Recently it has been ported (at Caltech) to run on SUNs, and work is underway at the University of New South Wales on a DecStation version. It is hoped to coordinate all this work into a unified release, but coordination of the development of a system by organisations covering three continents poses a number of interesting administrative problems.

The hierarchical data structures used by Figaro allow it to handle a variety of types of data, and to add new items to data structures. Error and data quality information has been added to the basic file format used, error information being particularly useful for Infra-red data. Cooperating sets of programs can add specific sub-structures to data files to carry information that they understand (polarimetry data containing multiple data arrays, for example), without this affecting the way other programs handle the files. Complex instrument-specific ancillary information can be added to data files written at a telescope and can be used by programs that understand the instrumental details in order to produce properly calibrated data files. Once this preliminary data processing has been done the resulting files contain 'ordinary' spectra or images that can be processed by programs that are not instrument-specific. The structures holding the instrumental information can then be discarded from the files.

Much effort has gone into trying to make it easy to write Figaro programs; data access subroutines are now available to handle access to all the conventional items found in Figaro files (main data arrays, error information, quality information etc), and programs that only need to access such items can be very simple indeed. A large number of Figaro users do indeed write their own Figaro applications using these routines.

The fact that Figaro programs are written as callable subroutines getting information from the user through a small set of parameter routines means that they can be invoked in numerous ways; they are normally linked and run as individual programs (called by a small main routine that is generated automatically), but are also available linked to run under the ADAM data acquisition system and there is an interface that lets them be called as part of a user-written Fortran program.

The long-term future of Figaro probably depends to a large extent on how successfully it manages the transition from being a VMS-only system to being a multi-platform system.

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The Data Acquisition System for the AAO 2-degree Field Project

K. Shortridge, T.J. Farrell, J. Bailey (AAO)

The Anglo-Australian Observatory (AAO) is building a system that will provide a two-degree field of view at prime focus. A robot positioner will be used to locate up to 400 optical fibres at pre-determined positions in this field. While observations are being made using one set of 400 fibres, the robot will be positioning a second set of fibres in a background field that can be moved in to replace the first when the telescope is moved to a new position. The fibres feed two spectrographs each with a 1024 square CCD detector. The software system being produced to control this involves Vaxes for overall control and data recording, UNIX workstations for fibre configuration calculations and on-line data reduction, and VME systems running VxWorks for real-time control of critical parts such as the positioner robot. The system has to be able to interact with the observatory's present data acquisition systems, which use the ADAM system. As yet, the real-time parts of ADAM have not been ported to Unix, and so we are having to produce a smaller-scale system that is similar but inherently distributed (which ADAM is not). We are using this system as a testbed for ideas that we hope may eventually influence an ADAM II system.

The system we are producing is based on a message system that is designed to be able to handle inter-process and inter-processor messages of any length, efficiently, and without ever requiring a task to block (ie be unresponsive to 'cancel' messages, enquiry messages), other than when deliberately waiting for external input — all of which will be through such messages. The essential requirement here is that a message 'send' operation should never be able to block. The messages will be hierarchical, self-defining, machine-independent data structures. This allows us to provide very simple monitoring of messages for diagnostic purposes, and allows general purpose interface programs to be written without needing to share precise byte by byte message format definitions.

Programs in this system have interfaces defined simply in terms of named actions and their parameters. Real-time control programs are required to be able to handle a number of such actions concurrently; data reduction programs will normally only need to handle one action at a time ('process an image', 'display a spectrum', etc).

Integrating a Local Database into the StarView Distributed User Interface

D.P. Silberberg (STScI)

We are developing a distributed user interface to the Space Telescope Data Archive and Distribution Service (DADS) known as StarView. The DADS architecture consists of the data archive as well as a relational database catalog describing the archive. StarView is a client/server system in which the user interface is the front-end client to the DADS catalog and archive servers. Users query the DADS catalog from the StarView interface. Query commands are transmitted via a network and evaluated by the database. The results are returned via the network and are displayed on StarView forms. Based on the results, users decide which data sets to retrieve from the DADS archive. Archive requests are packaged by StarView and sent to DADS, which returns the requested data sets to the users.

The advantages of distributed client/server user interfaces over traditional one-machine systems are well known. Since users run software on machines separate from the database, the overall client response time is much faster. Also, since the server is free to process only database requests, the database response time is much faster. Disadvantages inherent in this architecture are slow overall database access time due to the network delays, lack of a "get previous row" command, and that refinements of a previously issued query must be submitted to the database server, even though the domain of values have already been returned by the previous query. This architecture also does not allow users to cross correlate DADS catalog data with other catalogs. Clearly, a distributed user interface would be more powerful if it overcame these disadvantages.

We are integrating a local database into StarView to overcome these disadvantages. When a query is made through a StarView form, which is often composed of fields from multiple tables, it is translated to an SQL query and issued to the DADS catalog. At the same time, a local database table is created to contain the resulting rows of the query. The returned rows are displayed on the form as well as inserted into the local database table. Identical results are produced by reissuing the query to either the DADS catalog or to the local table.

Relational databases do not provide a "get previous row" function because of the inherent complexity of retrieving previous rows of multiple-table joins. However, since this function is easily implemented on a single table, StarView uses the local table to retrieve the previous row. Also, StarView issues subsequent query refinements to the local table instead of the DADS catalog, eliminating the network transmission overhead. Finally, other catalogs can be imported into the local database for cross correlation with local tables. Overall, we believe that this is a more powerful architecture for distributed, database user interfaces.

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A New Programming Metaphor For
Image Processing Procedures

O.M.Smirnov *(Inst. of Astr. of the Russian Ac. Sci.)*
N.E.Piskunov *(Obs. and Astrophys. Lab., U. of Helsinki)*

Most image processing systems, besides an Application Program Interface (API) which lets users write their own image processing programs, also feature a higher level of programmability. Traditionally, this is a command or macro language, which can be used to build large procedures (scripts) out of simple programs or commands. This approach, a legacy of the teletypewriter, has serious drawbacks. A command language is clumsy when (and if!) it attempts to utilize the capabilities of a multitasking or multiprocessor environment, it is but adequate for real-time data acquisition and processing, it has a fairly steep learning curve, and the user interface is very inefficient, especially when compared to a graphical user interface (GUI) that systems running under X11 or Windows should otherwise be able to provide. All these difficulties stem from one basic problem: a command language is not a natural metaphor for an image processing procedure.

The paper describes in detail a more natural metaphor—an *image processing factory*. A factory is a set of programs (applications) that execute separate operations on images, connected by *pipes* that carry data (images and parameters) between them. The programs function concurrently, processing images as they arrive along pipes, and querying the user for whatever other input they need. From the user's point of view, programming (constructing) factories is a lot like playing with LEGO blocks—much more intuitive than writing scripts.

The paper focuses on some of the difficulties of implementing factory support, most notably the design of an appropriate API. It also shows that factories retain all the functionality of a command language (including loops and conditional branches), while suffering from none of the drawbacks outlined above. Other benefits of factory programming include self-tuning factories and the process of encapsulation, which lets a factory take the shape of a standard application both from the system and the user's point of view, and thus be used as a component of other factories.

A bare-bones prototype of factory programming has been implemented under the PcIPS image processing system, and a complete version (on a multitasking platform) is under development.

C.3

pcIPS 2.0: Powerful Multiprofile Image Processing Implemented On PCs

O.M.Smirnov *(Inst. of Astr. of the Russian Ac. Sci.)*
N.E.Piskunov *(Obs. and Astrophys. Lab., U. of Helsinki)*

Over the years, the processing power of personal computers has steadily increased. Now, 386- and 486-based PCs are fast enough for many image processing applications, and inexpensive enough even for amateur astronomers. pcIPS is an image processing system based on these platforms that was designed to satisfy a broad range of data analysis needs, while requiring minimum hardware and providing maximum expandability. It will run (albeit at a slow pace) even on a 80286 with 640K memory, but will take full advantage of bigger memory and faster CPUs. Because the actual image processing is performed by external modules, the system can be easily upgraded by the user for all sorts of scientific data analysis.

pcIPS supports large format 1D and 2D images in any numeric type from 8-bit integer to 64-bit floating point. The images can be displayed, overlaid, printed and any part of the data examined via an intuitive graphical user interface that employs buttons, pop-up menus, and a mouse. pcIPS automatically converts images between different types and sizes to satisfy the requirements of various applications.

pcIPS features an API that lets users develop custom applications in C or FORTRAN. While doing so, a programmer can concentrate on the actual data processing, because pcIPS assumes responsibility for accessing images and interacting with the user. This also ensures that all applications, even custom ones, have a consistent and user-friendly interface. The API is compatible with *factory programming*, a metaphor for constructing image processing procedures that will be implemented in future versions of the system (see Smirnov, Piskunov this conference).

Several application packages were created under pcIPS . The basic package includes elementary arithmetics and statistics, geometric transformations and import/export in various formats (FITS, binary, ASCII, GIF). The CCD processing package and the spectral analysis package were succesfully used to reduce spectra from the Nordic Telescope at La Palma. A photometry package is also available, and other packages are being developed.

A multitasking version of pcIPS that utilizes the factory programming concept is currently under development. This version will remain compatible (on the source code level) with existing application packages and custom applications.

Guide Star Catalogue Data Retrieval Software II

O.M.Smirnov, O.Yu.Malkov *(Inst. of Astr. of the Russian Ac. Sci.)*

The Guide Star Catalogue (GSC), being the largest astronomical catalogue to date, is widely used by the astronomical community for all sorts of applications, such as statistical studies of certain sky regions, searches for counterparts to observational phenomena, and generation of finder charts. It's format (2 CD-ROMs) requires minimum hardware and is ideally suited for all sorts of conditions, especially observations.

Unfortunately, the actual GSC data is not easily accessible. It takes the form of FITS tables, and the coordinates of the objects are given in one coordinate system (equinox 2000). The included reading software is rudimentary at best. Thus, even generation of a simple finder chart is not a trivial undertaking. To solve this problem, at least for PC users, we have created GUIDARES. GUIDARES is a user-friendly program that lets you look directly at the data in the GSC, either as a graphical sky map or as a text table.

GUIDARES can read a sampling of GSC data from a given sky region, store this sampling in a text file, and display a graphical map of the sampled region in projected celestial coordinates (perfect for finder charts). GUIDARES supports rectangular and circular regions defined by coordinates in the equatorial, ecliptic (any equinox) or galactic systems.

Eric P. Smith, Paul Hintzen, and Kwang-Ping Cheng (LASP/GSFC)

We are in the process of archiving the $\sim$1.2Tbytes of imaging data we have acquired in support of UIT observations. The UIT is one of three telescopes comprising the ASTRO spacecraft and is a 38-cm f/9 Ritchey-Chretien telescope with wavelength coverage 1200A to 3000A and a 40 arcminute diameter field-of-view at 4" FWHM resolution. During the ASTRO shuttle mission there were 65 different pointings (some with multiple targets) of the UIT and hence 65 fields. Our support data of these fields were obtained with the KPNO and CTIO 0.9m telescopes and several of the 2048 x2048 CCDs. Our images are typically about 20 acrminutes on a side and contain the entire UV target except for nearby galaxies, for which we have created mosaiced images. We are archiving all good quality images in the broadband and narrow band filters for every target. Though all of the UIT targets were well studies astronomical objects, these frames are many of the first large field format images of them and, when combined with the soon to be released UV frames, provide a unique dataset.

These data have already been used to address a wide variety of astronomical questions. Vacuum ultraviolet (VUV) observations were used to study star formation in a sample of nearby galaxies, since integrated VUV - optical colors provide the most sensitive available measure of the formation rate of massive stars. The blue stages later in stellar evolution are also being studied. These data allow more accurate determination of the helium and metallicities of hothorzontal branch stars. (See the August 10 issue of the *Astrophysical Journal Letters.*) We are preparing to release these data to the public in CD-ROM format through the National Space Science Data Center.

IRAF in the Nineties

D. Tody (NOAO)

The IRAF data reduction and analysis system has been around since 1981. Today it is a mature system with hundreds of applications, and is supported on all the major platforms. Many institutions, projects, and individuals around the US and around the world have developed software for IRAF. Some of these packages are comparable in size to the IRAF core system itself.

IRAF is both a data analysis system, and a programming environment. As a data analysis system it can be easily installed by a user at a remote site and immediately used to view and process data. As a programming environment IRAF contains a wealth of high and low level facilities for developing new applications for interactive and automated processing of astronomical or other data.

As important as the applications programs and user interfaces are to the scientist using IRAF, the heart of the IRAF system is the programming environment. The programming environment determines to a large extent the types of applications which can be built within IRAF, what they will look like, and how they will interact with one another and with the user. While applications can be easily added to or removed from a software system, the programming environment must remain fairly stable, with carefully planned evolution and growth, over the lifetime of a system. The IRAF programming environment is the framework on which the rest of the IRAF system is built.

This paper will discuss the IRAF programming environment as it exists in 1992, and the work currently underway to enhance the environment. The structure of the programming environment as a class hierarchy is discussed, with emphasis on the work being done on the image data structures, graphics and image display interfaces, and user interfaces. The new technologies which we feel IRAF must deal with successfully over the coming years are discussed. Finally, a preview of what IRAF might look like to the user by the end of the decade is presented.

Factor Analysis as a Tool for Spectral Line Component Separation
21cm emission in the direction of L1780

L.V. Tóth (Helsinki University Observatory and Eötvös University Budapest), K. Mattila, L. Haikala (Helsinki University Observatory), and L.G. Balázs (Konkoly Observatory Budapest)

The spectra of the 21cm HI radiation from the direction of L1780, a small high-galactic latitude dark/molecular cloud, have been analysed by multivariate methods.

Factor analysis has been performed on HI (21cm) spectra in order to separate the different components responsible for the spectral features. The rotated, orthogonal factors explain the spectra as a sum of radiation from the background (an extended HI emission layer), and from the L1780 dark cloud.

The coefficients of the cloud-indicator factors have been used to locate the HI "halo" of the molecular cloud.

Our statistically derived "background" and "cloud" spectral profiles, as well as the spatial distribution of the HI halo emission distribution have been compared to the results of a previous study (Mattila and Sandell, 1979) which used conventional methods analysing nearly the same data set.

Reference:
Mattila, K. and Sandell, G., 1979, A&A, 78, 264.

Recommendations for a Service Framework to Access Astronomical Archives

J. J. Travisano (CSC), J. Pollizzi (STScI)

There are a large number of astronomical archives and catalogs on-line for network access, with many different user interfaces and features. Some systems are moving towards distributed access, supplying users with client software for their home sites which connects to servers at the archive site.

This paper will describe many of the issues involved in defining a standard framework of services that archive/catalog suppliers can use to achieve a basic level of interoperability. Such a framework would simplify the development of client and server programs to access the wide variety of astronomical archive systems. The primary services that are supplied by current systems include: catalog browsing, dataset retrieval, name resolution, and data analysis.

The following issues (and probably more) need to be considered in establishing a standard set of client/server interfaces and protocols:

- Archive Access – dataset retrieval, delivery, file formats, data browsing, analysis, etc.

- Catalog Access – database management systems, query languages, data formats, synchronous/asynchronous mode of operation, etc.

- Interoperability – transaction/message protocols, distributed processing mechanisms (DCE, ONC/SunRPC, etc), networking protocols, etc.

- Security – user registration, authorization/authentication mechanisms, etc.

- Service Directory – service registration, lookup, port/task mapping, parameters, etc.

- Software – public vs proprietary, client/server software, standard interfaces to client/server functions, software distribution, operating system portability, data portability, etc.

Several archive/catalog groups, notably the Astrophysics Data System (ADS), are already working in many of these areas. In the process of developing StarView, which is the user interface to the Space Telescope Data Archive and Distribution Service (ST-DADS), we too have been analyzing these issues and the work of others. We propose a framework of standard interfaces for accessing services on any archive system which would benefit archive user and supplier alike.

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Tools for the IDL Widget Set within the X-Windows Environment

B. Turgeon, A. Aston (ISTS/Space Astrophysics Laboratory & York University)

New tools using the *IDL* widget set will be presented. In particular, an utility allowing the easy creation and update of slide presentations, XSlideManager, will be explained in details and examples of its application will be shown. In addition to XSlideManager, other mini-utilities will be discussed. These various pieces of software follow the philosophy of the *X-Windows* distribution system and are made available to anyone within the Internet network. Acquisition procedures through *anonymous ftp* will be clearly explained.

The Spectral World Coordinate Systems in IRAF/NOAO

F. Valdes (NOAO/IRAF)

The world coordinate system (WCS) for dispersion calibrated spectra used in the IRAF/NOAO spectroscopy packages is described. In particular the image header keywords which define the coordinates in an "image" pixel array. These keywords appear both as part of the IRAF image structure and map directly to FITS format. The types of spectra include multidimensional images with spectral dispersion as one axis, one dimensional images, and a special "multispec" format consisting of multiple, semi-independent, one dimensional spectra in two or three dimensional images. The types of coordinate systems include multidimensional linear coordinates with individual keywords and one dimensional linear and nonlinear coordinates for the "multispec" images stored in IRAF WCS attributes. The nonlinear world coordinate systems include polynomial, spline, sampled table, and look-up table function representations.

SPECFOCUS: An IRAF Task for Focusing Spectrographs

F. Valdes (NOAO/IRAF)

An IRAF task for measuring the point-spread function (PSF) along the dispersion and wavelength shifts across the dispersion in two dimensional arc spectra is described. In typical use a set of spectra are obtain with various spectrograph focusing and alignment adjustments and the PSF information and shift information is derived and presented in tabular and graphical forms. Within each image the spectra may be divided into a number of samples along the dispersion and across the dispersion to investigate variations at different points in the detector at fixed focus settings. With many spectra and many samples interpreting the measurements is challenging. The task provides an interactive graphical interface to display the measurements in a number of interesting ways. The underlying algorithm for measuring the PSF and shifts is the auto/cross-correlation of spectral arc samples.

NASA's Astrophysics Archives at the National Space Science Data Center

M. E. Van Steenberg (NASA-GSFC)

NASA maintains an archive facility for Astronomical Science data collected from NASA's missions at the National Space Science Data Center (NSSDC) at Goddard Space Flight Center. This archive was created to insure the science data collected by NASA would be preserved and useable in the future by the science community. Through 25 years of operation there are many lessons learned, from data collection procedures, archive preservation methods, and distribution to the community. This talk will present some of these more important lessons, for example: KISS (Keep It Simple, Stupid) in system development. The talk will also address some of the myths of archiving, such as "scientists always know everything about everything", or "it can not possibly be that hard, after all simple data tech's do it". There are indeed good reasons that a proper archive capability is needed by the astronomical community, the important question is how to use the existing expertise as well as the new innovative ideas to do the best job archiving this valuable science data.

DECONV_TOOL: an IDL based Deconvolution Software Package

F. Városi, W. B. Landsman   (Hughes STX Corp.)

There are a variety of algorithms for deconvolution of blurred images, each having its own critirea or statistic to be optimized in order to estimate the original image data. Using the Interactive Data Language (IDL), we have implemented the Maximum Likelihood, Maximum Entropy, Maximum Residual Likelihood, and σ-CLEAN algorithms in a unified environment called DeConv_Tool. Most of the algorithms have as their goal the optimization of statistics such as standard deviation and mean of residuals, Shannon entropy, log-likelihood, chi-square of the residual auto-correlation. These statistics are computed by DeConv_Tool for the purpose of determining the performance and convergence of any particular method and comparisons between methods. DeConv_Tool allows interactive monitoring of the statistics and the deconvolved image during computation. The final results, and optionally, the intermediate results, are stored in a structure convenient for comparison between methods and review of the deconvolution computation. The routines comprising DeConv_Tool are available via anonymous FTP through the IDL Astronomy User's Library.

MOSAIC: Software for Creating Mosaics from Collections of Images

F. Városi, D. Y. Gezari (NASA/GSFC)

We have developed a powerful, versatile image processing and analysis software package called MOSAIC, designed specifically for the manipulation of digital astronomical image data obtained with (but not limited to) two-dimensional array detectors. The software package is implemented using the Interactive Data Language (IDL), and incorporates new methods for processing, calibration, analysis, and visualization of astronomical image data, stressing effective methods for the creation of mosaic images from collections of individual exposures, while at the same time preserving the photometric integrity of the original data. Since IDL is available on many computers, the MOSAIC software runs on most UNIX and VAX workstations with the X-Windows or SunView graphics interface.

p-1 ## STELAR: An Experiment in the Electronic Distribution of Astronomical Literature

A. Warnock (Hughes STX), M. E. Van Steenburg (NASA/GSFC), L. E. Brotzman, J. Gass, D. Kovalsky (Hughes STX)

STELAR (STudy of Electronic Literature for Astronomical Research) is a Goddard-based project designed to test methods of delivering technical literature in machine readable form. To that end, we have scanned a five year span of the ApJ, ApJ Supp, AJ and PASP, and have obtained abstracts for eight leading academic journals from NASA/STI CASI, which also makes these abstracts available through the NASA RECON system. We have also obtained machine readable versions of some journal volumes from the publishers, although in many instances, the final typeset versions are no longer available.

The fundamental data object for the STELAR database is the *article*, a collection of items associated with a scientific paper - abstract, scanned pages (in a variety of formats), figures, OCR extractions, forward and backward references, errata and versions of the paper in various formats (*e.g.*, TeX, SGML, PostScript, DVI). Articles are uniquely referenced in the database by journal name, volume number and page number.

The selection and delivery of articles is accomplished through the WAIS (Wide Area Information Server) client/server model, requiring only an Internet connection. Modest modifications to the server code have made it capable of delivering the multiple data types required by STELAR.

WAIS is a platform independent and fully open multi-disciplinary delivery system, originally developed by Thinking Machines Corp. and made available free of charge. It is based on the ISO Z39.50 standard communications protocol. WAIS servers run under both UNIX and VMS. WAIS clients run on a wide variety of machines, from UNIX-based X-windows systems to MS-DOS and Macintosh microcomputers. The WAIS system includes full-text indexing and searching of documents, network interface and easy access to a variety of document viewers.

ASCII versions of the CASI abstracts have been formatted for display and the full text of the abstracts has been indexed. The entire WAIS database of abstracts is now available for use by the astronomical community. Enhancements of the search and retrieval system are under investigation to include specialized searches (by reference, author or keyword, as opposed to full text searches), improved handling of word stems, improvements in relevancy criteria and other retrieval techniques, such as factor spaces.

The STELAR project has been assisted by the full cooperation of the AAS, the ASP, the publishers of the academic journals, librarians from GSFC, NRAO and STScI, the Library of Congress and the University of North Carolina at Chapel Hill.

The STARLINK Software Collection

R.F. Warren-Smith, P.T. Wallace (RAL, UK)

The UK's STARLINK project based at the Rutherford Appleton Laboratory develops and distributes software applicable to a wide range of problems in Astronomy; it covers most wavebands, caters for a variety of instrumentation, and ranges from programming tools and libraries through to large packages of applications. This poster summarizes the facilities available and gives details of how they may be obtained. Recent developments and other features of particular interest are highlighted.

SkICAT : A Cataloging and Analaysis Tool for Wide Field Imaging Surveys

N. Weir (Caltech), U.M. Fayyad (JPL), S.G. Djorgovski (Caltech), J. Roden (JPL)

We describe an integrated system, SkICAT (Sky Image Cataloging and Analysis Tool), for the automated reduction and analysis of the Palomar Observatory-ST ScI Digitized Sky Survey. The Survey will consist of the complete digitization of the photographic Second Palomar Observatory Sky Survey (POSS-II) in three bands, comprising nearly three Terabytes of pixel data. SkICAT applies a combination of existing packages, including FOCAS for basic image detection and measurement and SAS for database management, as well as custom software, to the task of managing this wealth of data. One of the most novel aspects of the system is its method of object classication. Using state-of-the-art machine learning classification techniques (GID3* and O-BTree), we have developed a powerful method for automatically distinguishing point sources from non-point sources and artifacts, achieving comparably accurate discrimination a full magnitude fainter than in previous Schmidt plate surveys. The learning algorithms produce decision trees for classification by examining instances of objects classified by eye on both plate and higher quality CCD data. The same techniques will be applied to perform higher-level object classification (e.g., of galaxy morphology) in the near future. Another key feature of the system is the facility to integrate the catalogs from multiple plates (and portions thereof) to construct a single catalog of uniform calibration and quality down to the faintest limits of the survey. SkICAT also provides a variety of data analysis and exploration tools for the scientific utilization of the resulting catalogs. We include initial results of applying this system to measure the counts and distribution of galaxies in two bands down to $B_J \approx 21$ mag over an ~ 70 square degree multi-plate field from POSS-II. SkICAT is constructed in a modular and general fashion and should be readily adaptable to other large-scale imaging surveys.

The VLBA Correlator — Real-Time in the Distributed Era

D.C. Wells (Nat. Radio Astronomy Obs.)

The Correlator is the signal processing engine of the Very Long Baseline Array [VLBA]. Radio signals are recorded on special wideband (128 Mb/s) digital recorders at the 10 telescopes, with sampling times controlled by hydrogen maser clocks. The magnetic tapes are shipped to the Array Operations Center in Socorro, New Mexico, where they are played back simultaneously into the Correlator. Real-time software and firmware controls the playback drives to achieve synchronization, compute models of the wavefront delay, control the numerous modules of the Correlator, and record FITS files of the fringe visibilities at the back-end of the Correlator.

In addition to the more than 3000 custom VLSI chips which handle the massive data flow of the signal processing, the Correlator contains a total of more than 100 programmable computers, 8-, 16- and 32-bit CPUs. Code is downloaded into front-end CPUs dependent on operating mode. Low-level code is assembly language, high-level code is C running under a RT OS. We use VxWorks on Motorola MVME147 CPUs. Code development is on a complex of SPARC workstations connected to the RT CPUs by Ethernet.

The overall management of the correlation process is dependent on a database management system. We use Ingres running on a Sparcstation-2. We transfer logging information from the database of the VLBA Monitor and Control System to our database using Ingres/NET. Job scripts are computed and are transferred to the real-time computers using NFS, and correlation job execution logs and status flow back by the route. Operator status and control displays use windows on workstations, interfaced to the real-time processes by network protocols. The extensive network protocol support provided by VxWorks is invaluable.

The VLBA Correlator's dependence on network protocols is an example of the radical transformation of the real-time world over the past five years. Real-time is becoming more like conventional computing. Paradoxically, "conventional" computing is also adopting practices from the real-time world: semaphores, shared memory, light-weight threads, concurrency. This appears to be a convergence of thinking.

StarView: The Object Oriented Design of the ST DADS User Interface

J. D. Williams, J. A. Pollizzi (STScI)

StarView is the user interface being developed for the Hubble Space Telescope Data Archive and Distribution Service (ST DADS). ST DADS is the data archive for HST observations and a relational database catalog describing the archived data. Users will use StarView to query the catalog and select appropriate datasets for study. StarView sends requests for archived datasets to ST DADS which processes the requests and returns the datasets to the user.

StarView is designed to be a powerful and extensible user interface. Unique features include an internal relational database to navigate query results, a form definition language that will work with both CRT and X interfaces, a data definition language that will allow StarView to work with any relational database, and the ability to generate adhoc queries without requiring the user to understand the structure of the ST DADS catalog. Ultimately, StarView will allow the user to refine queries in the local database for improved performance and merge in data from external sources for correlation with other query results. The user will be able to create a query from single or multiple forms, merging the selected attributes into a single query. Arbitrary selection of attributes for querying is supported. The user will be able to select how query results are viewed. A standard form or table-row format may be used. Navigation capabilities are provided to aid the user in viewing query results.

Object oriented analysis and design techniques were used in the design of StarView to support the mechanisms and concepts required to implement these features. One such mechanism is the Model-View-Controller (MVC) paradigm. The MVC allows the user to have multiple views of the underlying database, while providing a consistent mechanism for interaction regardless of the view. This approach supports both CRT and X interfaces while providing a common mode of user interaction. Another powerful abstraction is the concept of a Query Model. This concept allows a single query to be built from single or multiple forms before it is submitted to ST DADS. Supporting this concept is the adhoc query generator which allows the user to select and qualify an indeterminate number attributes from the database. The user does not need any knowledge of how the joins across various tables are to be resolved. The adhoc generator calculates the joins automatically and generates the correct SQL query.

Tests of a Simple Data Merging Algorithm for the GONG Project

W. E. Williams and F. Hill (NOAO/NSO)

The GONG (Global Oscillation Network Group) project proposes to reduce the impact of diurnal variations on helioseismic measurements by making long-term observations of solar images from six sites placed around the globe. The sun will be observed nearly constantly for three years, resulting in the acquisition of 1+ terabyte of image data. To use the solar network to maximum advantage, the images from the sites must be combined into a single time series to determine mode frequencies, amplitudes and line widths. Initial versions of combined, i.e., merged, time series were made using a simple weighted average of data from different sites taken simultaneously.

In order to accurately assess the impact of the data merge on the helioseismic measurements, a set of artificial solar disk images was made using a standard solar model and containing a well-known set of oscillation modes and frequencies. This undegraded data set and data products computed from it were used to judge the relative merits of various data merging schemes.

The artificial solar disk images were subjected to various instrumental and atmospheric degradations, dependent on site and time, in order to create a set of images simulating those likely to be taken at the site. The degraded artificial solar disk images for the six observing sites were combined in various ways to form merged time series of images and mode coefficients. Various forms of a weighted average were used, including an equally-weighted average, an average with weights dependent upon air mass and averages with weights dependent on various quality assurance parameters.

Both the undegraded solar disk image time series and several time series made up of various combinations of the degraded solar disk images from the six sites were subjected to standard helioseismic measurement processing. This processing consisted of coordinate remapping, detrending, spherical harmonic transformation, computation of power series for the oscillation mode coefficients and mode frequency identification.

Visual and statistical evaluation of the merged data sets themselves and differences between the merged and undegraded data set shows good agreement between the two data sets. Some slight differences in image scale and registration appear between the undegraded data set and the various merged data sets. In the set of power series made from the mode coefficients of the merged data sets, some power leakage is observed into the background and into slightly lower l-value modes, especially at higher l-value mode frequencies.

The results of the comparison of time series and mode oscillation frequencies of the undegraded data with those of the data merged using weighted averages indicate that, at least for p-mode solar oscillations, a weighted average of either the detrended remapped images or the mode coefficients gives good determination of the mode frequencies and adequate-to-good determination of the amplitudes and widths of the mode frequency lines. This conclusion is most advantageous to the analysis of the massive amounts of data to be received by the GONG network.

Registering and Resampling Images in STSDAS

R.L. Williamson II (STScI)

Registering different images can be difficult, especially if the images to be registered are images at different wavelengths, where features in one image may look entirely different or be absent from the second image. Using two new packages soon to be added to the STSDAS package, REGISTER and RESAMPLE, this job is done automatically.

The REGISTER package allows the user to determine the amount of translation, rotation, and/or magnification needed to make two images, spectra, or time series congruent.

The methods implemented to compute the registration parameters use:

- A set of the pixel coordinates of the same features identified in two files, or

- The FITS coordinate transformation parameters in the headers of two data files, or

- A single feature identified as the peak of a cross-correlation between two vectors.

The coefficients describing the registration are defined by the equations(for a two-dimensional image):

$$X = a + bx + cy,$$
$$Y = d + ex + fy,$$

where (X,Y) are the pixel coordinates of a feature in the Reference image, (x,y) are the pixel coordinates of a feature in the Secondary image, and the computed coefficients are a, b, c, d, e, and f.

Results may be produced by linking the output of REGISTER to RESAMPLE in a command language procedure. The output from REGISTER and the input to RESAMPLE consists of a matrix of coefficients (a through f above) fully specifying the registration.

The RESAMPLE package resamples simple vector or image data for a given amount of translation, rotation (images only), and magnification, or reflection of the science data. Specific options included are:

- Image rotation about the FITS reference pixel

- Scale changes, i.e. magnification or demagnification (for images, independently on both axes)

- Simple translation

- Reflection (for images, about one or both axes)

- Resampling and registration to a reference dataset

Output from the RESAMPLE task is the resampled image which may then be displayed and compared with the reference image.

Title: First MEM Task IRMEO in IRAF

Authors Name: Nailong Wu

Abstract:

The first task for image restoration using the Maximum Entropy Method (MEM) in IRAF, called IRMEO, is described. The underlining algorithm is the approximate Newton method for optimization. The basic input images and parameters for deconvolution are described in some detail. Results of preliminary tests, including the number of iterations, required CPU time on a variety of computers, and deconvolved images are reported and compared with those from other deconvolution methods. The merits and limitations of this task are pointed out. The possible development of better MEM tasks on the basis of IRMEO is also discussed.

Solar Full-disk Magnetic Field Image Receiving System and Observation Software

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Key Words: High Resolution Imaging Processing Data Analysis

Abstract

The paper introduces terminal hardware system of 10cm high resolution full-disk magnetic field telescope among solar multi-channel telescope produced by Beijing Astronomical Observatory, and its software procedure by using imaging processing as well real time data collecting. These data were processed by Sun Workstation 470/4, including doing some spectrum analysis, the system is the unique in the world now. It uses a set of CCD (1320 pixels plus 1035 pixels) of high resolution image explosion, also it has a set of fast and high resolution (1024 pixel plus 1024 pixel) image processor. Moreover, we can obtain higher time and space resolution about solar full-disk magnetic field and velocity field. This will provide excellent means in observation and studies of full-disk solar large-scale magnetic field and velocity field.

IRAF and STSDAS Under the New ALPHA Architecture

N.R. Zarate (STScI)

Digital's next generation RISC architecture---known as ALPHA---presents many IRAF system portability questions and challenges to both site managers and end users. DEC promises to support the ULTRIX, VMS, and OSF/1 operating systems, which should allow IRAF to be ported to the new architecture at either the program executable level (using VEST), or at the source level, where IRAF can be tuned for greater performance. These notes highlight some of the details of porting IRAF to OpenVMS on the ALPHA architecture.

Miyun 232 MHz Survey I —
fields centred at: $\alpha : 00^h41^m, \delta : 41°12'$ and $\alpha : 07^h00^m, \delta : 35°00'$

Zhang Xizhen, Zheng Yijia, Chen Hongsheng , Wang Shouguan (BAO)

A new meter-wave survey of sky region north of declination +30° is carried out with the Miyun 232 MHz Synthesis Radio Telescope(MSRT). The instrument, observation and method of data reduction are briefly described in this paper. A preliminary catalogue, first of a series, for two 8° × 8° regions centred respectively at $\alpha : 00^h41^m, \delta : 41°12'$ and $\alpha : 07^h00^m, \delta : 35°00'$ is presented. On the average 4 - 5 sources per square degree are recorded with position accuracy of 5" / S(Jy). BGPW scale is adopted for the flux density calibration (Baars,et al., 1977). The accuracy of flux determination is limited by background fluctuation which is about 30 mJy. The catalogue is complete for sources with flux larger than 0.25 Jy. The total number of sources listed in the the paper amounts to 687.

Several extended sources, sources with convex spectra, and one GPS source were found. Spectra of sources with flux larger than 0.5 Jy were also given.

ROSAT Data Analysis with EXSAS

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For the X-ray observatory ROSAT, data from survey and pointed mission phases taken with different focal plane instruments and according to a complex mission timeline have to be handled. Data analysis therefore puts high demands on appropriate software tools. With EXSAS – the EXtended Scientific Analysis System developed with an effort of 20 men years by the German ROSAT Scientific Data Center – a comfortable system for the reduction of data from the ROSAT X-ray and XUV instruments has been made available. EXSAS comprises a large collection of application modules as typically required in analyzing data of this wavelength regime and runs as a specific context in the wide-spread ESO-MIDAS environment. EXSAS, completely written in FORTRAN 77, takes full advantage of all the standards used in MIDAS and therefore reflects the same portability (different UNIX installations and VMS). If required, the FORTRAN code also enables users to adapt the software in an easy way to their specific needs. To maintain independence from the specifics of different operating systems also on the data input side, all ROSAT data are distributed in the widely accepted FITS format. Although EXSAS has been developed specifically for data analysis of the ROSAT instruments, its structural design is sufficiently general to serve equally well also data from other X-ray and XUV instruments.

EXSAS analysis modules are grouped into 4 application packages dealing with Data Preparation and Instrument Correction, Spatial Analysis, Spectral Analysis and Timing Analysis. A special EXSAS header, read and updated by each application, maintains the general information transfer on the origin, the history and the parameter space of the data stored in tables and images. About 100 genuine commands (most of which offer several additional options) allow to interactively explore the functionality of the system.

Up to now 40 institutes all over the world have requested the EXSAS software. Maintenance and regular updates of the software and the comprehensive documentation are provided by the ROSAT Scientific Data Center at Garching.

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