IRAF NEWSLETTER

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System News

Preparation of version 2.9 of IRAF, scheduled for release in March 1990, is now underway. This will be primarily a development release, used to support the production of the final launch-ready versions of the PROS X-ray data analysis software for ROSAT, and the STSDAS data analysis software for HST. A more general release of IRAF is planned for the fall of 1990 when, if all goes well, the first data from HST and ROSAT should start reaching observers. The fall 1990 release of IRAF will be available on all supported systems and will contain much new software of interest to both the ground based and space sciences communities. No date for the fall release has yet been set.

The IRAF Users' Committee held its first meeting in Tucson on September 11. The committee report is given elsewhere in this newsletter. The main emphasis of the committee was on making IRAF easier for inexperienced users to learn to use. We support this goal and have a number of plans to deal with the problem, e.g., better introductory documentation, and development of online tutorials to interactively demonstrate the complex reduction and analysis packages. Improved support for workstations running the X window system, and improved support for software development by the IRAF user community (including scientists) were also emphasized.

A new VOS (IRAF programming environment) interface, providing general system support for linear and nonlinear world coordinate systems including the sky projections, has been written and will be included in the V2.9 release. Full integration into the system and applications will take some time, but when this is complete the problems experienced in the past with coordinate systems being lost, or with incompatible coordinate system representations in different applications, will be over. This new VOS interface, called MWCS, along with the QPOE (event list image), PLIO (image mask), and FMIO (file manager) interfaces developed last year, is a part of the new image structures project, which when completed will have a major impact on all IRAF image processing applications.

In other news, the new DIGIPHOT package, which includes the IRAF version of DAOPHOT, is now available as a beta test release (see accompanying article in this newsletter). This software has been in development for over a year by Lindsey Davis and Dennis Crabtree, with help from Peter Stetson and Phil Massey. Lindsey should soon be resuming work on the general image registration and mosaicing package, which was delayed because of DAOPHOT. Mike Fitzpatrick is continuing development of the radial velocity analysis package (RV). The RV package is available to user sites for testing at this time, although it should be emphasized that this user test version of the package is not production software and some bugs can be expected. See the accompanying article in this newsletter for further information.

Dyer Lytle is working on the DECOMP package, used for spectral line deconvolution, fourier filtering, etc., of high resolution and high signal to noise spectra. Frank Valdes has been working on reduction scripts for a variety of instruments from KPNO and CTIO. Frank has also been working on a new artificial data package (ARTDATA). Steve Rooke has been helping with SAOimage testing and is currently working on the Apollo port, while carrying a heavy systems consulting and site support load. Suzanne Jacoby, who has been out for the past several months on maternity leave, is now back half time (mornings) on the IRAF HOTLINE.

We are planning an IRAF display/presentation for the winter AAS meeting, to be held in Washington D.C. in January. This will be a joint demo with Space Telescope Science Institute and the Center for Astrophysics, who will demonstrate STSDAS and PROS. We look forward to this once a year opportunity to meet with the user community and hear your comments and suggestions.

Doug Tody

Things to Watch Out For with IRAF V2.8

Our purpose here is to highlight any system bugs or common user problems which we want to make sure the user is aware of. Only the most notable bugs or problems are mentioned here. A complete bugs list, as well as detailed information on most of the items mentioned here, is given in the system buglog.

IMFORT pixel directory bug

A serious IMFORT bug exists in V2.8 which can result in the loss of image data. The bug occurs *only* when 1) the IMFORT "imdir" is set to point to a common global pixel storage directory, and 2) images of the same name are created in different directories. If this occurs the pixel file of the second image will replace that of the first. Note that there is no problem if the default interface parameters are used. See buglog entry #99 for additional information.

Sun386i/IMFORT

The "imdir" feature does not work with the Sun386i version of IMFORT due to a problem with the library. The solution is to rebuild the IMFORT library. See buglog entry #89.

Convex/IRAF Bugs

Two bugs affecting only the beta test Convex/IRAF system have been discovered. IMFORT programs compiled with Convex OS version 7.1 and version 5.1.1.0 of the the FORTRAN compiler (i.e., the latest release of Convex OS) will fail immediately due to a problem retrieving the host command line. The tasks IDENTIFY and REIDENTIFY can fail with a bus error in some circumstances. See buglog entries #90 and #93.

STF format images on the Sun-4

On a Sun-4 running IRAF V2.8, any attempt to create an STF format image (IMTYPE=hhh) will result in a [floating overflow] error. See buglog entry #104.

Termination of Background jobs

IRAF background jobs may abort on some UNIX/IRAF systems if they send output to the terminal after the user has logged out. See buglog entry #105.

IRAFARCH and BIN

On systems that concurrently support multiple architectures, e.g., Suns, IRAFARCH *must* be defined to do any software development, including for IMFORT. In addition, if the system is a Sun-3, FLOAT_OPTION should be defined (with the same value as IRAFARCH) to tell the host system what architecture to compile for. Do *not* manually set the link iraf$bin to point to your favorite bin directory. In the default system configuration this link should point to bin.generic, which is an empty directory. See the *Site Manager's Guide* for more information.

Loading packages at login time

Loading packages which have package parameters, e.g. CCDRED, from the "login.cl" or the "loginuser.cl" files can cause mysterious behavior when the user attempts to modify these package parameters during the IRAF session. The old parameter values may continue to be used even though it appears as if the package parameters have been updated properly. Thus you should not load CCDRED or any other package, in which you might need to change package parameters, in your login setup!

Exiting SunView

Exiting SunView (and probably other window systems) without first logging out of IRAF causes all the IRAF processes to be killed. This can result in parameter sets not being updated, buffered graphics not being flushed, and so on; if you care about these things be sure to log out of the CL before exiting the window system!

Doug Tody

IRAF Version 2.9 in Preparation

IRAF Version 2.9 is now in preparation with plans for a release in March 1990. The main objective of this release will be to support development of the final launch-ready versions of the HST and ROSAT data analysis packages. See the *System News* article in this newsletter for details. IRAF version 2.9 will be available only for the more popular host systems, e.g., Suns running SunOS-4, VAXes running VMS-5, and DECstation/Ultrix. A general release of IRAF on all supported systems is planned for the fall of 1990.

More information on the contents, availability, and desirability of upgrading to IRAF version 2.9 will be given in the February 1990 issue of the IRAF newsletter.

Doug Tody

New IRAF Distribution Policy

Due to the increasingly tight budget situation at NOAO, and the growing number of IRAF sites (over 300 copies of IRAF V2.8 have thus far been mailed), it has become necessary for us to try to recover the cost of future IRAF distributions. This new policy will go into effect with the release of IRAF version 2.9 in March 1990. Our objective is to recover the costs of the actual distribution, i.e. tapes, mailing charges, printing costs, and associated labor. Note that our intention is to charge only for the cost of the actual distribution service. We are continuing to streamline our distribution process to minimize these costs. We are also exploring the possibility of offering free network distribution of the software and most documentation in the future as an alternative to receiving a mailed distribution. Details on the distribution fees, and a new order form incorporating the revised ordering and billing information will be given in the February issue of the IRAF newsletter.

Steve Ridgway
Manager, CCS

IRAF Users' Committee Report - 1989

The IRAF Users' Committee met on 11 September in Tucson. Present were Bruce Bohannan (Colorado); Carol Christian (UC Berkeley); Susan Kleinmann (U Mass); Dave Koo (Lick Obs.); Bob Schommer (Rutgers); and Pat Seitzer (ST ScI).

The committee decided to take a broad look at IRAF on two timescales: where do we want IRAF to be be in one year, and what do we (as users) want it to look like in five years?

The committee acknowledges and appreciates the importance of IRAF in trying to fulfill the needs of a very large segment of the astronomical community that is interested in getting through many aspects of the data reduction process as quickly as possible without developing their own algorithms or writing their own codes. The availability of a standard system for image processing means that observers can use the same software while at the telescope, in downtown Tucson and La Serena, and at their home institutions.

IRAF has as high a visibility as any other NOAO project or telescope. With a distribution to well over 200 sites, there are many more astronomers that use IRAF on a day to day basis than come into contact with NOAO's telescopes. It can be a source of considerable pride to NOAO that IRAF has been adopted as the standard image processing system by major external groups,

notably the Space Telescope Science Institute and the ROSAT project. All of this has been accomplished with a very small fraction of the annual NOAO budget. The current size of the IRAF programming staff in Tucson is seven, who are responsible for systems programming, science programming, software distribution, and site support (including the IRAF Hotline). An additional three people assist with data reduction support (largely NOAO data but some outside). [Editor's note: in addition to assisting visitors with IRAF and other CCS facilities, these three persons test, evaluate and distribute IRAF software.]

We wish to note the excellent quality of the work done at the systems level (both in design and implementation), and science packages such as the ECHELLE package which is recognized as the standard for this type of data reduction. The recent implementation of Peter Stetson's stellar photometry program DAOPHOT within IRAF is a significant achievement. The response given to requests for help or information through the IRAF Hotline and the Data Reduction Support group has been uniformly excellent.

The committee felt, however, that the actual use of IRAF by individual scientists trying to analyze their data is deserving of considerable attention. In particular, the committee identified three areas that it thought should be emphasized during the next year:

1. Documentation and ease of use. It is generally recognized that getting started in IRAF can be quite difficult. The complexity of the system and many of the packages leads to a very steep learning curve and usually results in frustration. There is a clear need for a very basic 'Introduction to IRAF' guide, with a general overall view of what IRAF can do now (and what it can't), how to find the tools that one needs, and getting started in basic operations such as tape reading, plotting, display, etc. This guide should be no longer than a dozen pages. Similar brief guides and longer cookbooks are vital for all of the major science packages. In order to make it as easy as possible for astronomers to write their own applications within IRAF, the systems and programming documentation should be significantly expanded.
2. The systems work that has the highest priority should be the image and graphics display with cursor readback for people with systems running Xwindows. Such an interface is now fully available only on Sun workstations (the imtool/gterm combination). SAOimage (from the Center for Astrophysics) looks to be an excellent step towards satisfying the image display part of this need. Completion of this project would allow VMS users access to the full power of IRAF (via DECwindows).
3. IRAF news (the electronic bulletin board). The committee was strongly in favor of seeing this very valuable source of information distributed to anyone who requests it. All bug reports and queries to the IRAF Hotline are logged here, along with fixes, work arounds, new packages, benchmarks for new machines, and general comments. Many of the specific questions that the committee had were already discussed in this forum, yet only a few sites now receive this distribution of information. The availability of getting updates, fixes, and prototype packages over electronic networks from the FTP archive in Tucson is a significant resource and a proper function of a national observatory.

For the long term (five years), the committee feels that IRAF can best serve the scientific needs of the community if the science programming is decentralized as much as possible. This means that it should be made as easy as possible for astronomers to either write their own packages or to modify existing ones to satisfy their individual needs. There is a tradition of sharing software in astronomy in order to avoid having to reinvent the wheel: the FTP archive in Tucson can fulfill a major service here by serving as a central repository for contributed programs and utilities from sources outside of NOAO. These codes will not have been tested to the level required for incorporation into an official release, but many people may find something close to what they require.

Pat Seitzer

Beta Release of SAOimage Now Available

A beta release of SAOimage, the X11 successor to XIMAGE written by Mike VanHilst at CfA, is now available for distribution to several host systems (see below). SAOimage was developed as part of the ROSAT satellite project and is compatible with IRAF V2.8, functioning as a "display server", similar to IMTOOL in the Sun/IRAF environment. It provides much of the functionality of IMTOOL, including cursor readback, and also has many features of its own. SAOimage can be run standalone, reading FITS or IRAF images or binary arrays. It may also be run in "-imtool" mode for use with IRAF tasks which interactively access the display, e.g., DISPLAY, IMEXAMINE, IMEDIT, TVMARK, tasks in the APPHOT package, and so on. A full description of the SAOimage user interface and capabilities is included in the documentation supplied with the software.

SAOimage is currently available with IRAF 2.8 for the following machines:

- VAXen: Ultrix v3.1 or later
- DECstations: Ultrix v3.1 (UWS v2.1) or later
- Suns: all architectures, SunOS 4.x or later (at present this requires that X be run instead of SunView).

Contact the IRAF mail (iraf@noao.edu, 5355::iraf) for information about distributions.

Steve Rooke

Steward Observatory Announces Local Tape Readers

Steward Observatory at the University of Arizona has developed local magtape readers for the following local instrument-specific magtape formats:

Steward 90" CCD
MMT spectrograph Red channel CCD
MMT spectrograph Blue channel (reticon)

These programs are written in SPP and will run on any machine that supports IRAF. These readers are available by anonymous ftp from *as.arizona.edu* as a compressed tar file in the iraf subdirectory. For questions or problems please contact me at (602)-621-3091 or skip@as.arizona.edu.

Skip Schaller
Steward Observatory

Beta Release of DAOPHOT/IRAF Announced

A beta release of the IRAF DAOPHOT package is ready for distribution as part of an IRAF external add-on package called TESTPHOT. TESTPHOT contains APPHOTX, a newer version of APPHOT that is more compatible with DAOPHOT (see accompanying article in this newsletter); DAOPHOT itself; TTOOLSX, the STSDAS table tools package used by DAOPHOT for catalog output; and PTOOLS, a group of tasks which operate on the output of DAOPHOT and APPHOTX. TESTPHOT will eventually be installed in IRAF as the new version of the DIGIPHOT package.

The beta test release of DAOPHOT should be regarded as an experimental package. We are still in the process of porting and thoroughly testing it on all the various in-house machines and architectures. Although DAOPHOT has been in regular use on our Sun-4 (sparc) and Sun-3 (f68881) machines for some time and has undergone extensive testing on these machines, only limited testing has thus far been done on other machines such as the VAX and DECstation. Bugs may still be present for the lesser used machines or for certain types of data.

Inquires about obtaining the IRAF DAOPHOT package should be sent to the IRAF mail account (iraf@noao.edu, 5355::iraf).

Lindsey Davis

New Developments in the IRAF Reduction of Multiple Object Spectroscopy

There have been many important improvements aimed at the reduction of multiple object spectroscopy using IRAF since the release of V2.8. These improvements are in the general aperture extraction and dispersion calibration tools and in new streamlined reduction procedures for specific instruments. The reduction procedures are particularly interesting. The goals of the procedures are:

(1) Combine all of the reduction steps from extraction to full calibrated spectra in one task.

(2) Do the interactive calibration steps first, and only as needed, and then do most of the processing noninteractively and, possibly, in batch.

(3) Take care of all the record keeping and do only the specified operations on only the unprocessed spectra.

(4) Implement special algorithms and operations for the particular type of data.

The instruments/packages under development are Argus (CTIO), Coude (KPNO), Echelle (generic), Goldcam (KPNO stellar longslit), Nessie (KPNO), Slitlets (KPNO), and Specred (CTIO stellar longslit). These packages can be used as templates for other instruments.

The reduction procedures are complicated and depend on substantial changes to the APEXTRACT and ONEDSPEC packages. Because of this there needs to be a large amount of testing and experience by local users as well as updated documentation and new user's guides before it becomes part of the standard IRAF release. However, if someone wants to acquire the software as a test package then it will be available as an add-on external package in January. Please contact me for more information (fvaldes@noao.edu, 5355::fvaldes).

Frank Valdes

RV Package Available for Testing

The Radial Velocity Analysis package is now available for testing on a user-beware basis. While not yet fully complete, the cross-correlation tasks and support software are in place and have produced reliable results in testing at NOAO. The package is currently able to cross correlate both one and two dimensional spectra (both longslit data as well as multispec and echelle format data), and a Fourier Quotient task is available for galaxy work. The package is currently configured as an external package for use with IRAF versions 2.8 and higher.

Planned work includes the implementation of a Fourier Difference task, a task to fit emission line profiles for velocity analysis, a task to remove telluric (or other artificial) features, and a task to select fields from the output database, as well as enhancements to the FFT plotting capabilities and input data formats. Suggestions for new tasks or improvements to existing tasks are welcome. The package has only been tested on a limited set of data so problems are expected, but most problems encountered so far have been minor and a patch or workaround can be supplied relatively quickly.

Users who already have the package should be aware that a newer version is available with many bug fixes and improvements. Updates and patches are scheduled somewhat irregularly, but requests for particular patches can be sent out almost immediately.

For more information on this package or how it may be obtained, or for information on updates, please contact Mike Fitzpatrick at (602) 325-9387 or through e-mail at fitz@noao.edu or 5355::fitz.

Mike Fitzpatrick

IRAF Demos Available for Distribution

Several IRAF demos have been packaged together into an IRAF external add-on package to IRAF version 2.8. The package includes demos for the APEXTRACT package, the CCDRED package, Echelle reductions, absolute flux calibration, wavelength calibration, distortion corrections, aperture photometry, and the PDM task. Also included in the package is a Sun/IRAF IMTOOL tutorial.

The demos are prerecorded IRAF sessions. IRAF commands were recorded in "playback scripts" using the IRAF task STTY. These scripts can now be repeatedly run as demos executing the tasks in the scripts in the same sequence as the original sessions. The tasks are actually being executed as if the viewer himself were typing the commands at the terminal. The playback scripts have been programmed with time delays to make them more readable.

These demos should be considered experimental since we realize that there is still much to be done in this area of supplying on-line demos and tutorials to the user community. But there has been some demand for these existing demos so it was decided to make them available to the user community and get some feedback as to what people liked and disliked about these demos and what they would like to see in the future.

For more information about this package please contact me (602-325-9381, jbarnes@noao.edu, 5355::jbarnes).

Jeannette Barnes

APPHOT Update

Several new features have been added to the APPHOT package since the IRAF version 2.8 release. All these facilities will be available in IRAF version 2.9 and are currently in the beta release of the TESTPHOT package (see accompanying article in this newsletter).

The "datamin" and "datamax" minimum and maximum good data parameters are now active in all the APPHOT tasks except DAOFIND. "Datamin" and "datamax" can be used to identify or

reject bad pixels and specify the linearity regime of the detector. Centering or magnitude measurements affected by bad data are flagged with a nonzero error code and an error message in the APPHOT database. The APSELECT task can be used to remove these suspect measurements. Bad pixels are automatically eliminated from all the sky fitting algorithms, from the psf modelling algorithm in the FITPSF task, and from the radial profile modelling procedure inside the RADPROF task. The "datamin" and "datamax" parameters facilitate the identification of saturated stars, a feature necessary for the DAOPHOT package.

Several new keywords have been added to the DATAPARS parameter set to permit the filter number and airmass to be picked up out of the image header and recorded in the APPHOT database by the appropriate APPHOT tasks. APSELECT can then be used to pick the required quantities out of the database for input into user photometric calibration routines.

A new parameter "update" has been added to all the APPHOT tasks. If "update" is set then any changes made to the parameters in verify mode will be saved in the parameter sets when the task finishes. "Update" is only active if the task is run in noninteractive mode and was made mainly to aid users writing scripts.

In interactive mode the default help page no longer comes up on the screen by default. This feature was annoying to users doing photometry from contour plots as it would erase the contour plot on entry to the program. Help can always be generated by typing the ? keystroke as before.

Lindsey Davis

First Version of ARTDATA in Progress

Work is in progress on the first version of the IRAF artificial data package, ARTDATA. The first version will include generation of direct images and one and two dimensional spectra as well as some simple test patterns. The effects of pixel sampling, seeing, Poisson noise, readout noise, and cosmic rays will be included. The direct images will provide Gaussian and Moffat elliptical profile PSFs, exponential and De Vaucouleurs profiles, and arbitrary radial profiles read from a file or two dimensional image templates. The spectral images will include Gaussian lines and sloped or blackbody continuums along the dispersion, and Gaussian or slit profiles across the dispersion.

We hope that the first version will be part of the next release but, since it still under development and needs to be tested and reviewed, it cannot be guaranteed.

Frank Valdes

Using the Image Section Notation

Users are often puzzled when they need to flip or rotate an image. They find the IMTRANSPOSE task in the IMAGES package which will transpose two dimensional images about their major diagonals, and the ROTATE task doesn't seem to be at all what they want: a variant of GEOTRAN, it rotates and shifts by any angle. They fail to find a FLIP or IMFLIP task at all.

The solution to this mystery is that the *image section notation* itself allows images to be flipped at any point, i.e., as the input to any task and as the output of some. In combination with IMTRANSPOSE, the section notation allows any right angle rotation:

`imtranspose test[-*,*] cw90`	-	rotate 90˚ clockwise
`imtranspose test[*,-*] ccw90`	-	rotate 90˚ counter-clockwise
`imcopy test[-*,-*] rot180`	-	rotate 180˚
`imcopy test[-*,*] vflip`	-	flip about the vertical (y) axis
`imcopy test[*,-*] hflip`	-	flip about the horizontal (x) axis

The section notation also allows the user to *subsample* an image "on the run". This can be used when the full resolution of an image is not needed and block averaging (using BLKAVG) is not desired. For example:

`imcopy test[*:3,*:4] test`	-	subsample horizontally by a factor of three and vertically by a factor of four, overwriting the original image
`imstat test[2:100:2,7] fields=max`	-	find the maximum data value in the first fifty even numbered pixels of line seven

The image section notation is discussed more fully in §4 of *A User's Introduction to the IRAF Command Language* and in Appendix V of *An Introductory User's Guide to IRAF Scripts* in Volume 2B of the IRAF User Handbooks.

Rob Seaman

FOCAS News

A database of FOCAS users has been created containing names, address, and status information. Information from mail, surveys, and software requests was used as input. An electronic mail distribution list can be extracted from the database. The first use of this distribution list was a survey to confirm and expand the information in the database. Electronic mail is an effective way to communicate news and ideas about FOCAS in addition to the IRAF Newsletter. Articles in the newsletter will also be sent electronically. If you did not receive the e-mail survey and wish to be added to the electronic mail distribution list please send me (fvaldes@noao.edu, 5355::fvaldes) your name, address, and e-mail address.

We have recently begun distributing the NOAO FOCAS source via FTP (electronic file transfer from a publicly accessible login). This allows quicker and easier access to updates as well as saving on manpower and material expenses associated with tapes. Requests for FOCAS (both by tape and FTP) can be sent to me, Jeannette Barnes (jbarnes@noao.edu, 5355::jbarnes), or through mail to IRAF (iraf@noao.edu, 5355::iraf).

The proceedings of the "1st ESO/ST-ECF Data Analysis Workshop", ESO Conference Proceedings No. 31, ed. by Grosbol, Murtagh and Warmels, September 1989, have now appeared. It contains a paper on the analysis of test images by FOCAS (reprints available through me), some comparisons between several photometry packages, and other useful information. The test images paper and workshop were described in the previous newsletter.

There are three bugs to report. One was a problem with accessing IRAF format images on a Sun 3/80 through the IMFORT interface. The second was a missing mode argument when opening the area file by the resolution task causing the error message "rdarea: Error on seek". These problems only arise in special states due to uninitialized values. If things run for you then don't worry about it.

The third bug is that the default number of levels in SPLITS is described as being 100. However, due to a missing initialization statement, the default is really zero. Therefore if you don't specify the number of levels for splitting it will appear that little or no splitting takes place.

This bug probably crept in during a bug fix in March 1989. The workaround is to always specify the number of levels. Fixing the program (for those who know a little C and want to make the fix) is simply a matter of adding an initialization statement to splits.c and recompiling.

Frank Valdes

Add-on Software Available for IRAF Version 2.8

The following software packages are available as add-ons to IRAF version 2.8.

- IUEECHELLE package - a prototype package to support a particular format of IUE Echelle spectra. See a discussion of this software in the last issue of the IRAF Newsletter (June 1989 Number 7). For further information contact Frank Valdes (fvaldes@noao.edu, 5355::fvaldes).
- NEWIMRED - a test release of the new spectroscopic reduction packages for a variety of KPNO/CTIO instruments (available in January). See the accompanying article in this newsletter. Contact Frank Valdes for further information (fvaldes@noao.edu, 5355::fvaldes).
- DAOPHOT/IRAF - a beta release of the IRAF DAOPHOT package. See the accompanying articles in this newsletter. Contact the IRAF HOTLINE for further information.
- Radial Velocity Analysis package - available for user testing only (see article in this newsletter). This software has only just reached the user test stage and should not be requested for routine scientific use. On the other hand, if you are concerned about the detailed capabilities of the package this is the ideal time to try the software out and let us know what you would like to change or add. Contact Mike Fitzpatrick for more information (fitz@noao.edu, 5355::fitz).
- Volume rendering software - this software has been discussed in previous issues of the IRAF Newsletters (October 1988 Number 5 and February 1989 Number 6). Contact Steve Rooke (rooke@noao.edu, 5355::rooke) for further information.
- IRAF demos - a set of IRAF demos for tasks in the NOAO package as well as an IMTOOL tutorial (see accompanying article in this newsletter). Contact Jeannette Barnes for further information (jbarnes@noao.edu, 5355::jbarnes).
- Kernel server kits - those files necessary to access tapes drives on a non-IRAF host or those files necessary to utilize a Sun workstation as a smart terminal/display without installing the full IRAF system (for UNIX hosts only). Contact the IRAF HOTLINE for further information.
- SAOimage - an X Window System based display server developed by Mike VanHilst at the Center for Astrophysics for workstations running X11 (see accompanying article in this newsletter). Contact the IRAF HOTLINE for further information.
- UISDISP display software for VMS Workstations - this software was discussed in the last issue of the IRAF Newsletter (June 1989 Number 7). For further information please contact Nigel Sharp (sharp@noao.edu, 5355::sharp).
- Gould DeAnza IP8400/8500 display software (VMS only) - contact the IRAF HOTLINE.

The IRAF Group