IRAF NEWSLETTER

June 1988 Number 4

Central Computer Services National Optical Astronomy Observatories* P. O. Box 26732 Tucson, AZ 85726

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* Operated by the Association of Universities for Research in Astronomy, Inc. (AURA) under contract with the National Science Foundation

System News

1. Systems Support

A new version of IRAF, Sun/IRAF version 2.6, was released in early March. All Sun sites were encouraged to update their systems to this new version of Sun/IRAF so they could take advantage of the upgrades made to the image display software for the Sun (the IMTOOL virtual display server and associated software), as announced in the February 1988 IRAF newsletter. This release included a new version of Sun/IRAF capable of supporting both Sun-3 and Sun-4 nodes simultaneously from a single version of the system, automatic sensing of changes in the GTERM (terminal) window size, and a number of other revisions, mostly Sun/IRAF related. There are no plans to release IRAF version 2.6 for any other operating system, and indeed IRAF version 2.7 is already undergoing testing within NOAO.

IRAF was ported to the Hewlett-Packard HP 9000 series 800 (Risc based) workstation in February, in collaboration with the HP office in Cupertino, Calif. The HP/IRAF port is currently undergoing testing at the Canada-France-Hawaii Telescope (CFHT) headquarters in Hawaii and should soon be available for release to other sites. Since the original port in February CFHT has completed an additional port to the HP 9000 series 300 (mc68020 based) workstations, and has begun using a network of HP and Sun workstations running a combination of IRAF and locally developed real time software for data acquisition and reduction while observing. The release of HP/IRAF will be a collaborative effort between CFHT and NOAO; sites wishing to obtain HP/IRAF should contact NOAO or CFHT for further information on the availability of the software.

Other new ports currently in progress are those for the Convex vector computer and the Apollo workstation. The basic Convex port has been completed and appears to be bug free, but further testing at an interested user site (that happens to have a Convex) is required before the system can be made generally available. The alpha test version of Convex/IRAF is in the process of being installed on a Convex at the VLA (NRAO) and a group from NOAO is planning to visit the VLA briefly later this summer or fall to carry out further testing on this system. This will be the first opportunity we will have had to use the Convex other than over a 1200 baud modem!

Since Sun Microsystems announced the new Sun 386i (RoadRunner) there has been a great deal of interest from the IRAF community in a port to this new machine. Our experience with the machine has thus far been limited, but all indications are that it will make an excellent IRAF workstation, DOS capabilities aside. Since NOAO does not have any immediate plans to purchase a RoadRunner and we will need ready access to the machine over a long term to support it well, we have decided to buy one for IRAF using the NASA grant monies mentioned elsewhere in this newsletter. It will probably be at least August before both the machine and Fortran compiler materialize, and the port will follow shortly thereafter.

Several major upgrades to supported host operating systems are expected this year. Sun Microsystems is currently shipping version 4.0 of SunOS, and DEC is expected to announce shortly the release of VMS 5.0. These new releases contain items of much interest to IRAF users, e.g., SunOS 4.0 provides shared libraries and file mapping, and VMS 5.0 will (hopefully) provide support for the X window system and DECWINDOWS. We have SunOS 4.0 in house and plan to support it shortly, and will do the same for VMS 5.0 when it becomes available.

We cannot say at this time if the current IRAF binaries will run under these new operating systems, but we expect that they may not; sites wishing to upgrade to SunOS 4.0 or VMS 5.0 will need to obtain a new version of Sun/IRAF or VMS/IRAF and install it as part of the upgrade. Sites planning an upgrade should contact us for further information regarding the availability of IRAF for these systems.

2. Systems Software

An excellent start has been made on the major IRAF systems projects planned for this year, the display interfaces and new image structures projects, required to complete the development of IRAF as a general interactive image processing system. Two major new system interfaces were specified and one implemented (the PMIO or pixel mask interface, part of the new image structures project). Completion of the new system software is expected to take the rest of this year, with most applications development using the new interfaces not expected to take place until 1989.

Work is currently underway to extend the IRAF networking facilities to provide support for DECNET in UNIX/IRAF, so that IRAF running on a UNIX host can access the facilities of a VMS server in the native networking language of VMS. The first implementation will be for the SunLink/DNI interface found on Sun workstations. Once completed this should give us the capability to access remote files, image displays, magtape devices, etc., located on VMS servers, much as we currently access such resources on UNIX servers (note however that some problems remain with incompatible host binary data formats, e.g., a VAX and a Sun cannot yet share images on disk).

As we go to press we are pleased to report some important new developments regarding interactive image processing with IRAF. Fully interactive image cursor readback is now available internally at NOAO in the version 2.7 development systems, with interfaces for the major NOAO display devices (IIS displays and the Suns under SunView and IMTOOL). Look for further developments of this nature throughout the next year as bits of the new display interfaces begin to come on line. User sites should be aware, however, that it may be sometime in 1989 before we can make such capabilities generally available on all IRAF host systems, with a fully device independent image display interface.

3. User Contributed Software

We recently received an early version of the STSDAS software from STScI for in-house evaluation, including IGI (an implementation of the MONGO graphics language, fully integrated into the IRAF environment and with a number of extensions), the table tools package (TTOOLS), and the TABLES and F77/VOS libraries. All of this new software is written in SPP and hence is fully compatible with IRAF. Interested sites should contact STScI for further information.

We have received a release of the prototype XIMAGE image display server for the X Window system from CFA (see accompanying newsletter article for more information). We are also collaborating with CFA on an implementation of the long-planned IMCALC (image calculator) program, a tool for performing image arithmetic operations expressed as general algebraic expressions. This will make a major addition to the IMAGES package when it is done.

Good progress has been made on the IRAF version of DAOPHOT, being worked on by Dennis Crabtree at DAO. An alpha test version of this package is expected sometime later this year; general availability of DAOPHOT/IRAF will not occur until sometime after that, following a period of systems integration and testing.

We have heard of a number of other sites which are working on or have completed smaller programs. In the future we will be trying to assess more carefully the amount of such software being written, and we will provide a mechanism (this newsletter, or the planned electronic bulletin board) so that other users can find out about and obtain such software. We are pleased to see the astronomical community beginning to develop such software within the portable IRAF environment, so that the entire IRAF community may benefit.

Doug Tody

Summary of Applications Software Developments

The new ECHELLE package has been installed in IRAF version 2.7 and is now undergoing in-house testing. The details of this package were discussed in the last newsletter (February 1988). It is unclear at this time if this package will be available as an add-on to IRAF versions 2.5 and 2.6, or if sites will have to wait until the next major release to acquire the software.

Many changes were also made to the ONEDSPEC package in support of the new ECHELLE package. The task DISPCOR has been modified and its functionality replaced by two tasks, REFSPECTRA and DISPCOR. The tasks STANDARD and CALIBRATE were rewritten for greater versatility. The package was reorganized, eliminating dead code and replacing the multiple ONEDSPEC executables by a single executable, reducing the disk and memory requirements for the package. These changes required related changes in other IMRED packages such as COUDE, IIDS, IRS and SPECPHOT. Thus, as with the ECHELLE package, it is doubtful if this new software can be made available as an add-on to an earlier version of IRAF.

The old line deblending procedure in the ONEDSPEC SPLOT task has been rewritten to remove numerous restrictions and to provide greater flexibility in fitting blended lines. (See the accompanying article in this newsletter.)

A number of important changes have been made to the APEXTRACT package. These included better interpolation, use of a separate profile image for more optimal extraction and cosmic ray rejection, better background subtraction, and major reorganization of the code for easier maintenance. (See the accompanying article in this newsletter.) This package, after sufficient user testing, will be available as an add-on to the current exported versions of IRAF.

A new version of the APPHOT package is being prepared. Major changes include a link to the LINTRAN program to transform coordinate lists, a new task POLYMARK to create and display polygon and coordinate lists interactively, cleanup of the output file writing code, and the addition of an interactive mode to the DAOFIND algorithm. Minor changes have been made to the parameter sets for the benefit of the forthcoming IRAF DAOPHOT package. The recent addition of interactive image cursor readback to the system will be especially useful for APPHOT users.

Work has begun on designing the general image registration and mosaicing facilities for the IRAF IMAGES package. In related developments, a new task IRMATCH, designed to match intensities as well as positions of mosaiced images, has been written and is in user testing by the IR group. Work is still underway to make the algorithm less sensitive to bad data rasters. A prototype task to mosaic images using coordinate information in the image header has also been written. The user specifies which image header keywords contain the reference pixels and their values, and the scaling factors for the axes, and the program combines the separate images.

The DTOI package has been modified in response to user requests. A choice of algorithms is now available in the SPOTLIST task for determining spot densities. The method of scaling the output intensities in the HDTOI task has been improved. Several bugs have been fixed. (See the accompanying article in this newsletter).

In the vacuum telescope package, VTEL, the IMSCAN task has been optimized, and a new task, SYNDICO, has been added to the package to make dicomed prints of the synoptic, full disk, magnetograms and spectroheliograms taken at the vacuum telescope at Kitt Peak. The algorithm used in the destreaking process for spectroheliograms has been improved. (See the accompanying article in this newsletter).

A port of the DECOMP spectral analysis program to the IRAF environment is in progress. DECOMP is a program used for analysis of high resolution and high signal to noise spectra. See the accompanying article in this newsletter for additional information.

Doug Tody

IRAF Awarded Funds by NASA Headquarters

A grant of $100K/year has been allocated to the IRAF project by NASA. The title of the grant is "Extension of Image Reduction and Analysis Facility Software". Funds are to be applied to "...extend IRAF software to operate on new UNIX computers and high end graphics workstations, provide new network access to remote data bases, and develop new hardware interfaces for image display hardware." The intended initial duration of the grant is three years.

Although the new funds are still working their way through the Washington bureaucracy between NASA and NOAO, we are already undertaking new efforts in the areas designated by this grant. We will provide increased support for ports to new systems, and improved verification of applications software performance for new ports. Members of the IRAF staff will be available for visits to community sites for consultation, as time permits, with both novice and experienced users and programmers. The program offering visiting positions within the IRAF group will be extended into next fiscal year (see accompanying newsletter articles).

This grant was initiated by Anthony Villasenor of NASA as part of the Information Systems for Astronomy program. It was stimulated by the strong support for IRAF voiced by IRAF users attending the NASA sponsored Data System Study workshops in August and November of 1987. We offer our thanks to Tony and the IRAF community.

Stephen Ridgway
Manager, CCS

[This is the first in what we hope will be a series of interesting articles that highlight the use of IRAF outside NOAO. If you have suggestions for future articles, please contact Jeannette Barnes.]

IRAF at the Steward Mirror Lab

The rotating furnace at the Steward Observatory Mirror Laboratory at the University of Arizona has the job of spincasting chunks of glass into telescope mirrors. As part of this process, the temperature at hundreds of points inside the oven must be monitored and controlled very precisely over a long period of time. [For example, the ARC 3.5 meter mirror currently in progress requires about 6 weeks annealing time.] Microcomputers mounted on the rotating furnace platform perform the monitoring, but the temperatures and other data must then be collected and presented to the oven operator in an informative and concise format.

The oven operator uses a Sun workstation in his control room to look at the data being transmitted continuously from the oven microcomputers. He uses one window to send controlling parameters to the oven. The locally built C program running in this window not only communicates with the onboard processors, but also receives incoming data that is then written out as IRAF image files using the IMFORT interface.

In another window the operator uses IRAF to monitor and manage the data. He uses several locally built SPP/VOS tasks to retrieve the oven data; he then inspects the data with IRAF tasks such as GRAPH, CONTOUR, or LISTPIXELS. He may plot temperatures of several regions of the oven versus time, or create a pseudo-color temperature distribution map of the oven and display it with IMTOOL. The operator can use IRAF analysis tasks to investigate any aspect of the data he chooses, and so make informed decisions on how to modify the oven controlling parameters. Hardcopies of all graphics can be obtained using existing IRAF facilities.

By using IMFORT to create IRAF images of oven data, we were able to take advantage of the available IRAF graphics and analysis tools, and therefore simplify the task of writing monitoring software for the Steward Observatory Mirror Lab.

Skip Schaller
University of Arizona

Comings and Goings Within the IRAF Group

Frank Valdes, who has been with the IRAF programming group for the past six years and who is the author of many of the NOAO reduction packages, has taken a year's leave of absence. Frank will be spending the next year on a "science" leave first at AT&T Bell Labs in New Jersey, then at the Dominion Astrophysical Observatory in Victoria, and then at CTIO. We wish Frank and Susan and their new son, Gabriel, a very successful trip, and we look forward to their return a year from now!

A new hire, Mike Fitzpatrick, has joined the IRAF programming group, to work in the area of science and systems applications programming and site support. Mike comes to NOAO following several years of software development at the University of Texas, mainly working in the area of spectral reductions and analysis. Mike was part of the Space Telescope project at UT and did software development under SDAS and more recently under STSDAS. The funding for this new position comes from the $100K grant awarded by NASA to the IRAF project for the 1988 calendar year (see accompanying article in this newsletter).

Drew Phillips, a graduate student at the University of Washington in Seattle, will be spending the summer at NOAO working with the IRAF programming group. Drew's objective during his visit here is to develop software within IRAF for image matching (coadding images with variant PSFs), learning IRAF programming in the process.

Doug Tody

Invitation to Work with the IRAF Programming Group

We are pleased to offer full or partial salary support to one or more persons who wish to visit NOAO and work in collaboration with the IRAF programming group. Ideally, we would like to arrange visits which result both in concentrated IRAF experience for the visitor, and development of a generally useful piece of software for IRAF. Visits of at least two months would be most useful, and stays up to a year could be considered. Depending on the length of the visit, we could offer some combination of full or partial salary, travel, and partial living expenses. Starting dates are flexible, and at this time we are planning visits through early 1989.

We will be happy to consider either software professionals or astronomers for this opening. In either case the opportunity would be best suited for a person with extensive astronomical software experience.

If interested, please prepare a summary of the reasons for your interest, relevant experience, proposed dates, and funding requirements. Also, feel free to contact me for any further information.

Stephen Ridgway
Manager, CCS

Two New Image Display Utilities for IRAF

Two new image display utilities are available for use with IRAF. The XIMAGE program was developed by the Harvard/Smithsonian Center for Astrophysics as a prototype XWindow-based application. XIMAGE supports an extensive set of options and features, including a variety of ways of manipulating the color table, cursor readback (standalone), pan and zoom, etc. It currently runs on Ultrix, Sun, and HP workstations under X version 10, release 2-4 (note that running XIMAGE and hence X on a Sun prevents use of SunView, e.g., GTERM and IMTOOL). An upgrade of XIMAGE for version 11 of X is planned. XIMAGE can function either standalone, reading images from disk in any of several formats including IRAF and FITS, or as part of IRAF V2.6, acting as an interactive image display server like IMTOOL.

Simon Morris, of Mt. Wilson / Las Campanas, has written a prototype standalone display program that runs on VMS Microvax workstations, using VMS's UIS window system to access the bitmapped display. It can manipulate the color lookup table, report cursor position and pixel values, zoom, and pan, but it is up to the user to specify the range of image pixel values to be displayed, e.g., by first examining the image from within IRAF. The program operates in a standalone mode, using IMFORT to directly access IRAF images on disk, hence interactive use from within IRAF is not currently supported.

Both of these applications may be requested as add-ons by contacting the IRAF group via the IRAF mail, the IRAF Hotline, or by calling Jeannette Barnes.

Steve Rooke

Improved Aperture Summing and Background Subtraction in APEXTRACT

There have been many recent changes to the APEXTRACT package sufficient to consider it a new version. Some of the changes were described in the IRAF Newsletter, Number 3 (February 1988). These changes concerned the use of a different profile template image than the image being extracted and an improved cosmic ray detection by not interpolating the image data until after cleaning. This note describes two more improvements.

The summing of pixels across an aperture has been done using partial pixels at the edges of the aperture. When using narrow apertures, say on critically sampled profiles, in which the edges of the aperture are near the steep slopes of the profile, the extracted spectrum sometimes had small oscillations of a few percent with periodicities related to the change of the spectrum position relative to the image columns or lines. That is, if the direction of the dispersion is not exactly aligned with one of the image axes then as the center of the spectrum moves from one line or column to another a ripple in the extracted spectrum can be seen. Recent investigation has shown that the source of this effect is the partial pixels at the edges of an aperture; this approximation is just not good enough and gives errors of a few percent in the above circumstances.

A related effect also occurs during background subtraction. The pixels defined by the background sample regions used for fitting across the dispersion are fixed while the sample regions shift to follow the position of the spectrum. Thus, for example, the pixel nearest the edge of the background window to the spectrum could be anywhere from exactly on the edge to almost a pixel away. Again, with any residual wings in the spectrum shifting slightly into and out of the background region the background points used might be slightly biased. This leads to small oscillations in the computed background (though by symmetry the background region on the other side is affected in the opposite sense and partially cancels the effect).

Both problems have been solved by ALWAYS interpolating the spectrum to a fixed position within the aperture. The aperture sum is computed by integrating the interpolation function and the background pixels used for fitting are always sampled at the same distance from the spectrum. One reason this was not done previously was for the sake of speed. However, accuracy is more important than speed and the speed penalty is small (a few percent). The improvement in the extraction is dramatic in the case described earlier.

In the majority of cases the spectra are well aligned with the image lines or columns and/or the apertures are defined wide enough to get all the light of the spectrum. Thus, most users will not be affected by this effect.

A second change is based on user requests. There are now two background estimation techniques. The original method of fitting a function across the dispersion using arbitrary sample regions is still provided (with the improvement of interpolating the fitting points to a constant relation with the spectrum center). The new method allows averaging the background pixels. This is done by using the sample region parameter to define background "apertures" which are then integrated in the same way as the object apertures (by integrating the interpolation function). The background aperture sums are then averaged and scaled to obtain a constant background per pixel value. This method is faster than the fitting method but less general since it does not allow for bad pixel rejection, medians, fitting functions, and all the other options of the ICFIT package.

Frank Valdes

Sun3/IRAF [Floating Divide by Zero] Error

Users of IRAF V2.6 on a Sun 3 may have noticed the error "[floating divide by zero]" occasionally reported by the CONTOUR, HAFTON and other tasks. This error is being generated when the second argument to the atan2 function is zero. The atan2 function is supplied by Sun as part of their standard math library [atan2 is not the only math library function affected by this bug. -Ed]. The second argument to atan2 is zero when the "character up vector" is set to 90 degrees (as in CONTOUR with nhi = 0 or 1, or in HAFTON when the greyscale bar is being labeled), and when contour lines are being smoothed with splines under tension.

It is mathematically correct for the second argument to atan2 to equal zero; only when both arguments are zero should it be considered an error. The fact that this is generating an error is caused by two conditions. First, it is a bug in the SUN implementation of atan2 that an error be generated when only the second argument to atan2 is zero. Secondly, beginning with SUN/IRAF release 2.6, IRAF has enabled the SUN floating point divide by zero exception to avoid IEEE numbers such as NaN and Inf being written to IRAF images. Enabling the exceptions means the error incorrectly being called by atan2 is sensed, and the "[floating divide by zero]" message is reported.

The source of this problem is in the SunOS software and has been fixed by Sun in release 4.0 of SunOS, hence the problem will go away when you next upgrade SunOS on your system (a new version of Sun/IRAF will have to be obtained and installed as part of the upgrade). If you would like to have the problem fixed sooner, contact the IRAF HOTLINE (602-323-4160), and we will supply you with a patch for the current system.

Suzanne Jacoby

Improved Deblending with SPLOT

By popular demand the deblending function in SPLOT has been improved. The changes are summarized below:

- o Independent sigmas may be determined.
- o There are six types of fits which cover all combinations of constrained, partially constrained, and unconstrained positions and sigmas.
- o There is no limit to the number of points in the region being fit.
- o There is no limit to the number of lines. The quick update to V2.5 (described below) however still has a limit of 4 lines because more than this requires additional changes to other SPLOT routines which makes a quick update more complicated.
- o The lines may be specified by cursor or by explicit wavelength.
- o The RMS of the fit is printed.
- o Different fit types may be tried without needing to remark the continuum or lines.
- o The fitting algorithm has been changed to a Levenberg-Marquardt minimization method using Gauss-Jordan elimination. The previous one was some type of simplex method.
- o Naturally, the keystrokes once you enter the deblending option ('d') are different. Since the deblending may be iterated you use 'q' to return to the basic SPLOT menu.

For those who can't wait for these changes in a new release there is a simple update which you can get. This update provides everything but the extension to more than four simultaneous lines. Contact us for more information or to request the update.

Frank Valdes

Density to Intensity (DTOI) Package Modifications

The DTOI package has been modified. A choice of algorithms is now available in the SPOTLIST program for determining spot densities; the method of normalizing intensities to a user specified value in HDTOI has been improved; bugs discovered in recent usage have been repaired.

The SPOTLIST program, which calculates densities of calibration spots, can compute either the median of spot pixels or the mean with pixel rejection. The median option is new, and is expected to be most useful when a small pixel sample is used. The mean with rejection option has been modified to put an upper limit of 10 on the number of iterations performed; this will eliminate the oscillating behavior seen by some users with spots that contain a large number of saturated pixels.

The method of scaling the output intensities in the HDTOI task has been improved. Now saturated pixels are exactly scaled to the user supplied "ceiling" parameter. This improvement results in the user interface to tasks SPOTLIST and HDFIT being modified as described below.

When running SPOTLIST, an additional parameter has been added to specify the scale, the upper limit in A to D units (PDS units). Parameter "maxad" is the integer value associated with a saturated pixel. For 15-bit data, maxad should be 24575; the default value of 3071 is for 12-bit data. Using the value of maxad, SPOTLIST calculates the maximum density and writes this to the database. The maximum density value is used by HDFIT to normalize the independent variable vector. (Previously you entered "maxden" as a parameter to HDFIT; now HDFIT reads this calculated double precision number from the database.) The maximum density value is also used by HDTOI as the density whose intensity equals "ceiling". That is, saturated pixels equal 30000 by default. In this way, saturated pixels are precisely scaled to "ceiling", and they are easy to identify in the output intensity image.

A bug in HDFIT was repaired so it is now possible to input more than two databases to the task. Another bug was repaired in HDTOI, where the k75 and k50 transformations were being incorrectly calculated. These bugs have been repaired in (the as yet unreleased) IRAF V2.7; they are present in the distributed SUN/IRAF V2.6. Contact site support if you require the modifications.

Suzanne Jacoby

Modifications to VTEL

The vacuum telescope package has undergone some recent changes and additions.

The task for reading area scan tapes, IMSCAN, has been recoded for optimization. The geometric transformations in the old IMSCAN have been removed as has the option to add identification text to the image. (The ID text can still be added using the VTEL task PIMTEXT.) The output images from IMSCAN must now be rotated and their parity changed by calling IMTRANSPOSE to get their proper orientation.

```
cl> imtranspose input_image[-*,-*] output_image
```

This new version of IMSCAN is now being tested in-house.

A new task, SYNDICO, has been added to the package to make dicomed prints of the synoptic, full disk, magnetograms and spectroheliograms taken at the vacuum telescope at Kitt Peak. Daily grams are processed through this task to create the synoptic catalog kept at NSO.

Finally, modifications are underway on the synoptic processing of the vacuum telescope data. The algorithm used in the destreaking process for spectroheliograms has been improved and the backlog of unprocessed data will soon be cleaned up and Carrington maps made of the last 36 or so rotations. The algorithm used to estimate the mean absolute magnetic field of the sun from magnetogram data is being updated and will give a more accurate measure than before.

Dyer Lytle

DECOMP in IRAF

DECOMP is a FORTRAN program used at NOAO and other sites for the analysis of high resolution and high signal to noise spectra such as those taken with a fourier transform spectrometer (FTS). A project is under way to further enhance this program and port it to IRAF.

One of the major strengths of DECOMP is its ability to accurately locate and find parameters for spectral lines. This ability will be improved in the new DECOMP by allowing simultaneous fitting of Voigt profiles to multiple blended lines. Also, the spectral calculator aspect of DECOMP and its ability to do Fourier transforms, along with many other functions have made it useful for the reduction of other spectra, especially photometric data.

DECOMP is currently in the design stage. Many of the algorithms used in old DECOMP will be reviewed and improved where necessary and possible. A program for reading DECOMP data tapes and producing IRAF images has been prototyped and the final version is now in the coding stage. (Users familier with DECOMP will recognize this program as REDIN.)

Dyer Lytle

Linear Coordinates in SPLOT and IDENTIFY

There are have been several people who have tried to use SPLOT with coordinate systems other than wavelengths. Specifically they wish to use it for radial velocities and cross correlations. SPLOT and IDENTIFY currently support linear coordinate systems specified by keywords in the image header. A problem users have run into, however, is that they sometimes end up with numbers which are off by a factor of 1E10. This note explains what is going on and how to work around the problem.

IDENTIFY uses the FITS parameters CRPIX1, CRVAL1, and CDELT1 exactly as specified. There is no attempt to change the units of the coordinate system. These header parameters are only used if there is no dispersion solution for the image since that is the basic function of this task. IDENTIFY allows you to display the data in various ways and to accurately measure positions of features. If you want to measure equivalent widths and fit gaussian profiles then you must use SPLOT.

The thing to know about SPLOT is that first it looks for the keywords W0 and WPC. If those are absent it then looks for the FITS keywords as given above. Because the FITS standard specifies wavelengths be in meters/sec SPLOT tests for this case using W0 < 0.001. If this is true then it multiplies by 1E10 to get Angstroms. Thus if W0 is negative you end up with units multiplied by 1E10. There are four things you can do:

1. Set your W0, WPC (or FITS equivalents) to be 1E-10 smaller.
2. Leave things alone and just assume your measurements are 1E10 too large.
3. If the data goes from negative to positive coordinate values then set W0 > 0.001 and use a negative step size. This may require you flip the pixel data. This can be done using the image section [-*] to SPLOT, the ONEDUTIL task SFLIP, an imcopy using the flip image section, or in SPLOT with the key that flips.
4. If you or your system manager can modify and recompile the IRAF tasks then a simple fix can be made. This might be tricky or impossible if your system has the source code and libraries stripped or the system is installed in VMS. The fix is to change the line:

   ```
   W0(ids) < 0.001  -->  abs(W0(ids)) < 0.001
   ```

   in the file iraf$noao/onedspec/load_hdr.x and then type "mkpkg update". You or your system manager can contact IRAF site support for help with this.

For the near term future, since several people have had this problem, I have changed the current version of SPLOT in IRAF as in 4 above. In the longer term there are plans to have the IRAF system support world coordinate systems (not necessarily just linear) in a more fundamental way including options to change units.

Frank Valdes

Image Interpolation in IRAF

A nice feature of the IRAF tasks which perform image interpolation is that users have a choice of several functions. However, one should be aware that image interpolation is not perfect. In the area of spectroscopy, the use of interpolation in tasks such as longslit.transform, apextract.apsum, onedspec.dispcor, etc., can introduce ringing near sharp, marginally or undersampled lines and object profiles. This behavior is characteristic of the interpolators used and is not a problem with the software.

Users should consider this when deciding how best to reduce and analyze their data. There may be cases where the errors introduced by image interpolation are worse than the distortion errors one is trying to remove (see the accompanying article in this newsletter by Bill Keel). One must balance the need for reinterpolating the data against what needs to be done to extract the desired science. For example, long-slit radial velocity work with resolved galaxies having only weak absorption lines requires good distortion corrections while measuring emission lines in unresolved and marginally sampled objects may be better done without distortion correction.

In the future we plan to experiment with interpolators (such as fourier expansion, sinc function interpolation and splines with nonequally spaced knots) which behave better in the presence of sharp features, but these interpolators have problems of their own, and in the case of noisy or undersampled data there probably is no way to interpolate the data without degrading the signal.

Frank Valdes
Doug Tody

Sky Subtraction in Low-Dispersion Long-Slit Spectra

Many faint-object applications require accurate sky subtraction in the red (where bands of OH emission are the dominant contributor to the night-sky light). The instruments most efficient for faint work at low resolution (the Cryogenic Camera at KPNO, the EFOSC at ESO, the FOS at La Palma) also encourage spectral undersampling or marginal sampling (less than 2 pixels per resolution element). Under these conditions, rebinning long-slit data in the wavelength direction before sky subtraction can seriously compromise the results, since the sky spectrum contains structure close to the resolution limit and with very high contrast. Night-sky subtraction along a resampled row nearly lying along the edge of a strong night-sky feature tells one more about the interpolator used for rebinning than about the sky.

A superior procedure, unless the slit and detector array are misaligned by several pixels along the slit, is to subtract sky (with an appropriate order of interpolation under the object) before rebinning in wavelength. Tests on data from several instruments show that this can dramatically improve the signal-to-noise over much of the region longward of 6500 Angstroms. The difference is most apparent for undersampled or marginally sampled data (such as from the Cryogenic Camera with a narrow slit); this technique is not needed for well-sampled data, in which case full distortion removal by rebinning may be more important.

Bill Keel
University of Alabama

Current IRAF E-mail Addresses

The current electronic mail addresses for sending mail to IRAF are listed below.

UUCP: {arizona,decvax,ncar}!noao!iraf
uunet!noao.arizona.edu!iraf

Internet: iraf@noao.arizona.edu

SPAN/HEPNET: 5355::IRAF or NOAO::IRAF

BITnet: iraf@noao.arizona.edu (through a gateway)

If you have any problems communicating with us electronically, our local in-house consultant is Steve Grandi, (602)-325-9228.

For those of you who like "voice" contact, the IRAF HOTLINE is still going strong - (602)-323-4160.

Jeannette Barnes

The IRAF NEWSLETTER is published three times a year (February, June, and October) by the Central Computer Services, National Optical Astronomy Observatories, P. O. Box 26732, Tucson, AZ 85726. Editors: Jeannette Barnes, Doug Tody