

## FIGARO

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This report covers the period from Jan. 1988 to Dec. 1988.

FIGARO, originally written for VMS Vaxes by Keith Shortridge at the California Institute of Technology, is now maintained and distributed by Shortridge from the Anglo-Australian Observatory as part of the Starlink software library. Many additions and improvements are available in the version of FIGARO supported by the astronomy department of the California Institute of Technology. The current version of FIGARO is 2.3; distribution of version 2.4 has just begun. The unix versions of FIGARO described below are available only from Caltech.

#### I. Code Additions and Improvements

##### a. Additions

Josh Zucker, a summer student at Caltech from Stanford University, working with Charles Lawrence, senior research fellow in radio astronomy, has written FIT, a very powerful spectral analysis program for FIGARO. It is basically a generalized curve-fitting program which is highly interactive and menu driven. It allows fitting of various types of functions, or combinations thereof, and allows specification of equations fixing the ratios of parameters (for example, the line strengths or wavelengths of a doublet). Template spectra can also be used as fitting functions. This package, consisting of more than 8000 lines of code and making extensive use of color line graphics, exists in the VMS and Convex versions of FIGARO.

Jim McCarthy, as part of a PhD thesis submitted to the Caltech astronomy department, has written a substantial suite of routines for the reduction of echelle data. Among these are routines which extract (i.e. collapse) the full two dimensional image into a two dimensional array where the second dimension is the echelle order number, routines which identify arc lines in a collapsed echelle format arc image, etc.

Chris Lee (system manager for the Caltech astronomy department until August of 1989, then senior adviser to the system manager, and now a member of the staff of the computer science department at Caltech) modified the standard FIGARO library associated with reading/writing FITS tapes to allow for the use of blocking factors (see Grosbel et al 1988 for a description of the extension of the FITS standard). This has been implemented in the Convex and VMS versions.

John Cromer, Palomar programmer, coded up a routine similar to the IRAF routine CONTINUUM. This is available in the Convex and VMS versions.

A new routine MEDSKY (coded in Australia) implements the median sky flat technique described by Schmidt, Schneider, and Gunn (1986) and is available in the VMS version in Figaro 2.4 and in the Convex version. For other improvements which are part of the official distribution, read the release notes or consult Keith Shortridge at the AAO.

##### b. Speed Improvements

Since we now have a 2048x2048 Tektronix CCD which is intended for use at Palomar in the Norris spectrograph (and has been used at Palomar for direct imaging), any compromises which affect speed for large frames become noticeable. In the official version of FIGARO distributed by the AAO, the assumption is made that all internal calculations are done with floating point arrays, which is not efficient for large 16 bit integer frames. We have therefore done a considerable amount of (fairly trivial) recoding of various FIGARO commands that operate on images to avoid excessive mapping and unnecessary i/o for 16 bit integer frames. Dramatic speed improvements can be achieved for such frames in this way. These improvements have been incorporated into the VMS version at this time, and essentially all of them have been installed in the Convex version.

We have also done some recoding of the image display words to optimize their speed for very large arrays displayed on much smaller

display devices. These improvements exist only in the VMS version at the current time.

##### c. New Display Device

Chris Lee wrote a device driver and interface software for one additional imaging display for a VMS Q bus system. This is the 1024x1024x8 bit (with 2 overlay planes) Peritek board. The line graphics performance of this board is exceptionally fast.

#### II. Porting

A major activity over the past year carried out entirely by Chris Lee has been the porting of FIGARO to two unix machines. The first port was to a Convex C1-XP. This port is completed, and is available from Caltech upon request. The imaging device supported is the IVAS display manufactured by IIS. The devices supported for line graphics in the unix version of PGPLOT (written and maintained by Tim Pearson of the Caltech VLBI group) include the IVAS, VT125 and Graph-On terminals, Printronix and postscript printers, and Sun workstations. The original unix port of PGPLOT was done by Jon Danskin of Convex Computer Corporation.

A port to the Sun 3 and Sun 4 families is essentially completed. We use the window server programs GTERM and IMTOOL written by Doug Tody of NOAO to service displays. The Sun version should be available for distribution from Caltech in less than 6 months. Among the improvements we plan before a formal distribution is modification of GTERM to support color line graphics and to provide a proper handling for text together with graphics. Many new routines need to be moved into the Sun version from the Convex and VMS versions. We also assume that Sun Fortran 1.2 contains fixes to several bugs that we have found in the Sun compiler.

These ports were achieved largely by modifications of the lower level subroutine packages. Only very slight changes in the upper level of routines were required (mostly in the format of the INCLUDE statements), and these can be handled by automated pre-processors. We can thus rapidly move routines developed for any of the 3 supported hardware platforms from one to the other, as long as they make use of only the standard subroutine libraries. In addition, routines have been written to convert binary files so that transfers of disk files over network links between the 3 machines are possible.

We are also in the process of adding support for an additional imaging device, a single board VME display 1024x1024 pixels 8 bits deep with 2 overlay graphics planes manufactured by Imagraph Co. The device driver for the Convex was written by Sam Southard Jr., system manager for astronomy at Caltech, who is currently working on the interface to TVPCKG, which handles bit mapped graphics. The PGPLOT driver was written by Tim Pearson.

#### III. Plans for the Coming Year

Our highest priority for the coming year is to complete the software for the Imagraph board (expected date is April 1, 1989) and to smooth out the rough edges in the Sun port so that it can be distributed to other sites. We will also produce a mouse interface for the Imagraph board within the next few months. We may also implement this display board as an option in the Sun version.

We plan to work on the ability to retain frames in memory (without resorting to producing a monolith) so as to achieve the optimal speed of the cpu itself. This will be useful only in systems with large amounts of CPU memory.

We also plan to make major improvements in the ability to set up batch jobs and to utilize the screen capabilities of modern windowing systems. These may perhaps be confined to the unix versions.

Grosbel F., Harten R.H., Greisen E.W., and Wells D.C., 1988, *A and A Supl.* **73**, 359.

Schmidt M., Schneider D.P., and Gunn J.E., 1986, *Ap.J* **306**, 411.