The Graphical X-form Editor

The graphical x-form editor (GXE) is an easy-to-use, WYSIWYG, graphical user interface for the creation and modification of x-forms. It is user-friendly, with ample prompts and warnings guiding the user through the design of a new x-form or the modification of an existing one.

Before GXE, an x-form window could only be designed by hand-editing its parameters-file (known as its .par file). The .par file contains the code specifying the position of each metawidget within the window, as well as the labels and variables necessary for the proper functioning of the window, and the programs to be invoked as a result of the choices selected by the end user of the x-form. With GXE, a .par file is automatically created (or modified) when the user does a "Save" during a GXE editing session.

Previously, .par files were tedious to create and maintain, primarily because of the relative screen geometry involved. The GXE has been designed to alleviate this problem, making the task of designing an x-form quick and easy. With GXE, the designer of an x-form places the desired metawidgets within the GXE "drawing area", where they can also be moved around at anytime. This "drawing area" directly represents what the actual x-form will look like, so there is never any guesswork involved.

In addition to simplifying the x-form layout, the GXE also helps make it possible to design an error-free x-form on the first try. For every metawidget created (or modified), a dialog box is displayed which has prompts for the exact labels and other parameters needed for the proper creation of that specific metawidget. Instant feedback is provided to the user if an entered parameter is invalid, or if insufficient data has been entered.

Some of the features within the GXE are:

- a palette of available metawidgets from which to choose
- a drawing area on which to place metawidgets and show their spatial relationships with respect to one another in the x-form
- pull-down menus for easy file creation, editing, etc.
- dialog boxes that prompt the user to input the appropriate information required for each metawidget, such as variable names, etc.
- the ability to select previously drawn metawidgets so that they can be moved and reconfigured

GXE has three modes of use: a design mode, in which metawidgets are chosen and configured, an edit mode, in which metawidgets can be reconfigured, added, or deleted, and a test mode, in which the newly created or edited x-form is run through the x-form program.

There are well over 100 x-forms used by the Pegasus Session Manager (PSM), and these need editing whenever the capabilities of existing instruments are modified. New instrumentation also requires the creation of many new x-forms. Maintaining and creating this huge number of x-forms was, and would be, an overwhelming task without the time-saving, user-friendliness of the GXE. With GXE, astronomers, engineers, and anyone designing an x-form, even new users, now have the ability to easily create usable x-forms in a short amount of time.

L. Evans, J. Kerr

Interferometric Testing of Optics

A Phase Shift Technology interferometer has recently been set up and demonstrated as a new and versatile tool in the testing of the quality of large optics. This particular interferometer is of the phase shifting type using a modified Shack's cube in a Fizeau configuration with a high quality wavefront reference surface that provides the necessary reference beam yet allows for very good wavefront quality exit beam. Over an f/2 beam this interferometer has an accuracy of 1/30th wave or better.

The interferometer as a whole consists of the laser head, which contains the stabilized HeNe laser, the Shack's cube, telecentric and alignment lenses, spatial filters and the CCD camera. The controller unit allows control over the stability and intensity of the laser and is an interface between the laser head, the monitor, the video digitizer and controller interface boards in the computer. The software is menu driven and aids in the acquisition and analysis of interferometric data.

Setting up the interferometer and test optic is straightforward but in practice may not be easily accomplished. The internal reference beam and the return beam from the test optic must be allowed to focus and create and interference pattern on the CCD. Any intermediate optics must be tested before the optic of interest so that their contribution of errors in the interference wavefront can be subtracted out.

The use of computers in measurement systems has helped bring about phase shifting interferometry (PSI) not because it is a specific optical setup but rather a method of analysis and data collection. Where static interferometry falls short is in the need to collect data only along fringe centers which causes a trade-off between the number of data points and precision. Most interpolating data analysis programs require data to be taken on a regulated grid, and this is where PSI can surpass static interferometry. PSI collects a set of interferograms while a time-varying phase shift is created in a known manner and direction between the reference wavefront and the test wavefront in the interferometer.

In the Fizeau configuration, the phase shift is accomplished by translating the transmissive reference objective with a piezo-electric transducer and an externally applied voltage. The wavefront phase is found in the variations in the intensity of the recorded interferograms, and a point-by-point calculation can recover the phase map recorded on the entire CCD. This method of analysis eliminates the need to locate fringe centers and acquire additional information to determine the wavefront polarity.

In addition to higher precision and wavefront polarity determination, there are other advantages of PSI. Mapping distortions of the wavefront and the test surface are eliminated because the solid state detector array ensures the geometric precision of the sampling positions. This is important when averaging wavefronts to reduce the effects of air turbulence and vibration. Aperture determination is easily found due to the fringe modulation of the interference pattern during phase shifting where points within the aperture will be modulated while points outside will not deviate from an average intensity. The phase map calculated from each point on the detector eliminates problems with intensity variations across the pupil. Because a detector array is used, the phase detection algorithm is simple and can reduce large amounts of data very quickly and is not sensitive to the many flaws that may exist in the array.

This small amount of hardware combined with the extensive software will allow us to scrutinize the important optics that we use here at CFHT including the primary mirror. By measuring the lines of constant optical path difference between the test and reference wavefronts, imperfections and flaws of the optic under the test can be determined and then possibly fixed or corrected with another optic. The knowledge of inherent flaws within an optical system is important, especially when light is being magnified and focussed.

Use of this interferometric tool will help us to maintain a telescope facility with the highest imaging capabilities.

J. Seerveld

Computer Based Telescope Operations Log

Since the Canada-France-Hawaii Telescope first opened, telescope operators have recorded a variety of data in handwritten logs. The current effort to create a computer-based version of these logs has been inspired by the desire not only to make the recording process easier, but to make better use of the data thus accumulated by easing retrieval.

The actual logging of telescope operations is made easier under the new system, as many items previously entered by hand can be made to be recorded automatically by existing equipment. Telescope positions, for example, will no longer be transcribed from computer screens to handwritten logbooks, but recorded from the telescope operating system directly into the electronic "log."

Retrieval of data is also to be easier under the new system. Remote access of records will be possible and the application of computerized search techniques will enable the user to locate desired entries much more quickly than is possible with a non-computerized system. Statistical analysis of records using databases and spreadsheet programs — formerly only possible after extensive keypunching of handwritten data — will also be facilitated. The night report is also part of this system, allowing the telescope operator to describe problems, suggestions and data quality evaluation during the night.

Every morning at 7:00 AM, the log is distributed by electronic mail to all engineering and astronomers staff. The present system has been in operation for almost 2 months, but still under evaluation and several suggestions for improvements are under consideration.

B. Grundseth, K. Bartlett

Data Reduction Facilities

The data reduction facilities have advanced in a number of areas since the last CFHT Information Bulletin. In summary:

- The summit Sun data reduction machine, 'wiki,' has been upgraded from a SPARCstation-2 to a SPARCstation-10 model 41. The new cpu is up to 3 or 4 times faster than the old one.
- As predicted in the last Bulletin, a SPARCstation-2 hosting an Exabyte tape drive, a SPARCprinter, and disk work space for users has been installed at the CFHT office at Hale Pohaku.
- Uwila, one of the three Sun servers in Waimea, has been upgraded from a SPARCserver 490 with one cpu and 32 Mbytes of memory to a SPARCserver 690 model 140 with 4 cpu's and 64 Mbytes of memory. In addition, four old SMD disk drives have been replaced with new SCSI disk drives.
- Nuilolo, a Sun SPARCserver 690 located in Waimea, has been upgraded from a model 120 to a model 41. The new cpu runs at 96 MIPS and is about three times faster than the old pair of cpu's.
- A SPARCstation-10 model 30 has been added to the pool of machines available to all users in the Waimea computer room. This machine has been very popular for cpu intensive tasks since it is about 3 times faster than the other machines available to users in the computer room.
- Network backups of Sun-hosted data reduction disks are now performed on an Exabyte EXB-10i Jukebox which has a capacity of 50 Gbytes (10 cartridges). Previous network backups were performed on a single Exabyte drive which had to be shared with other users. The new system allows much of the network backup task to be automated.
- Major new software additions include the Interactive Data Language (IDL) and the Statistical Analysis System (SAS).

R. Link

A Ray-Tracing Model of PUEO

A ray tracing model of the proposed Adaptive Optics Bonnette (PUEO) has been developed using the ZEMAX ray tracing software. The models are based on the "Report on Optical Design of Adaptive Optics Bonnette" of 14 September 1992 by E. H. Richardson. Models which have been produced based on this report are of the main optics and the wavefront sensor module.

The wavefront sensor module model is based on the smaller lenslet array design. Lenslets from both the inner and outer circles of lenslets have been modelled in different versions of the wavefront sensor model. Appropriate apertures have been placed in front of the lenslets to give the lenslet the correct shape.

Interferograms have been produced from the models for the main optics and also for the wavefront sensor with a lenslet in the inner ring modelled (Figure 8). The interferograms shown are simulations of the output of a double pass interferometer. Very little aberration is present in these systems. Without added tilt, there is approximately 0.2 waves of optical path difference in the main optical system and 0.3 in the wavefront sensor module. Other tools available in ZEMAX show that the main optics, as designed, are diffraction limited.

Plans for the model include performing a tolerance analysis on both the optical elements of the system and the mechanical placement of the elements. Also, an investigation of the effect of moving the wavefront sensor module to view a star not at the center of the field of view of the telescope is planned.

G. Barrick