

BIMA Xfiles: Empowering the Observer with Tcl/Tk Applications

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Abstract. Described is a Tcl/Tk application suite that helps expedite operations at Hat Creek Radio Observatory (HCRO). This is the site of a ten element millimeter interferometer operated by the Berkeley-Illinois-Maryland Association (BIMA). Xscribe provides an integrated environment for maintaining the schedule and summary of observations. Xplore is a sky chart based calibrator selector. Xplotwatch and Xfixwatch are a telemetry monitor and critical alarm interface respectively. Xaudio is an audio reminder selector.

1. Introduction

The predecessors of the BIMA Xfiles¹ were Unix C-shell (csh) scripts with command line interfaces. Tcl/Tk scripting allowed for rapid development of graphical user interfaces (GUIs). By leveraging existing programs rather than rebuilding everything from scratch, Tcl/Tk also allowed for rapid deployment. Observers familiar with the predecessor scripts quickly grasped the new functionality and appreciated the ease of use. By bundling together many previously separate tasks under a common graphical interface, these applications have made for a much more efficient and pleasant experience for the BIMA observer.

2. Xscribe

Before Xscribe, the BIMA schedule was composed simply by using a text editor. Time was allocated in an ASCII graph format and Scribe then parsed this into an observing program that drove the array. Scribe was Xscribe's predecessor, a Unix csh script which relied heavily on the awk and sed pattern matching utilities. This scheme was deployed for three years until it could not cope with new scheduling pressure.

The availability of 1 mm receivers meant there was a need for dynamic scheduling. Successful 1 mm observing requires lower atmospheric opacity and higher atmospheric stability than for 3 mm observing. Because such conditions are unpredictable in the long term, 1 mm observing cannot be scheduled *a priori*. Thus, when the atmospheric window opens and closes, there must be a scheme to efficiently substitute appropriate projects.

¹<http://bima2.astro.uiuc.edu/tcltk/xfiles.html>

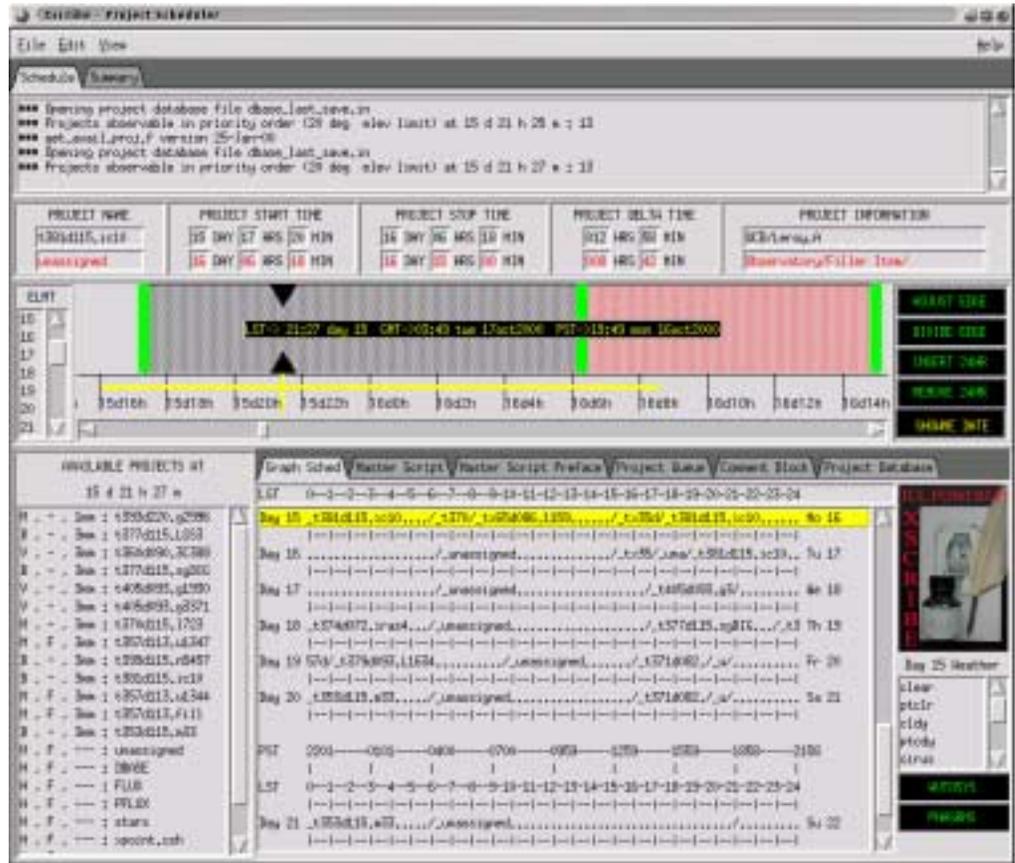


Figure 1. Xscribe GUI: the schedule maintenance page.

2.1. A New Paradigm

Xscribe addresses this need by rendering the schedule in a graphical editor. The Xscribe GUI is modeled as a tabbed notebook, with two primary pages for maintaining the schedule and summary of observations. Figure 1 shows the schedule page, which includes the graphical editor. The editor is a scrollable viewport with vertical (green) bars representing project time boundaries. Using click and drag mouse operations:

- All available projects in priority order and their LST ranges may be viewed at any given time.
- Existing slot boundaries may be adjusted and new slots may be created.
- Projects may easily be substituted.
- The schedule may be displaced at any point by arbitrary 24 hr LST increments.

The schedule page also features a secondary tabbed notebook. There are pages here for exporting the Xscribe native graphic format into ASCII list, ASCII graph, and master script formats. The ASCII formats are automatically made

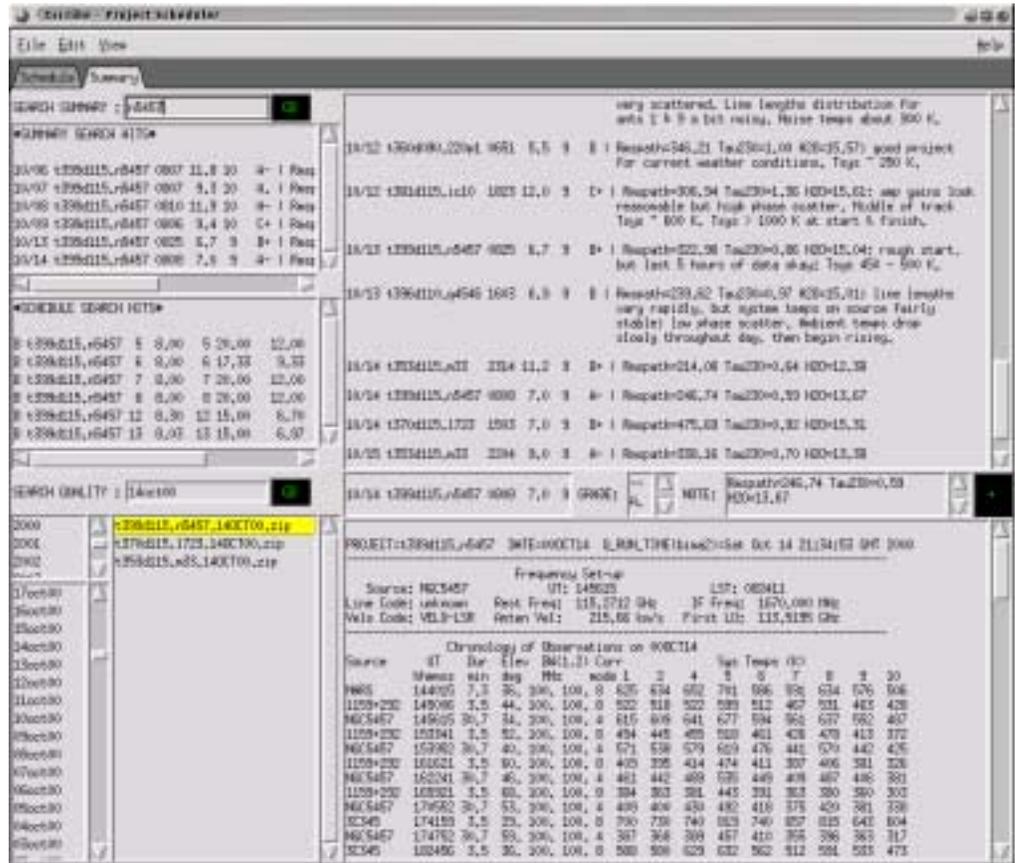


Figure 2. Xscribe GUI: the summary maintenance page.

available on the WWW. There is also a page for editing the project database, which lists priority and coordinate information.

The master script drives the array and launches an automated quality analysis after each project is done. Each archived quality report includes diagnostic plots in GIF format. The entire quality archive is accessible from Xscribe's summary page, shown in Figure 2. Xscribe calls on John Bradley's well known Xv image viewer (not a Tcl/Tk application) to display the GIF plots, and provides a convenient template for summarizing an observation. An advantage of scripting is integration of external components and applications, such as the Xv image viewer.

2.2. On-line and Off-line Usage

The site observer by definition uses Xscribe on-line. At the start of an observing season, the BIMA scheduler sends two initial lists to the observatory: the schedule and project database. These templates are generated as part of the automated proposal pipeline at the University of Illinois. They are imported into Xscribe, after which the schedule and database evolve as the observing season proceeds.

Xscribe is flexible enough to set up for off-line users. For example, the program is installed for the BIMA scheduler at the University of Illinois. It has HTTP transfer capability so that off-line users may download the updated ASCII lists from the observatory and import them into the local Xscribe session.

3. Xplore

Interferometric observations usually require a point source calibrator to be observed together with the science source. The goal is to remove time dependent atmospheric phase fluctuations. To reduce any direction dependent errors, the angular separation between the two targets should be minimal. At the same time, the calibrator should be sufficiently strong to satisfy signal to noise requirements.

To help make a decision, the BIMA calibrator database is plotted in the Xplore GUI, with both symbol color and size indicating flux strength. The scrollable viewport has an adjustable field of view. Clicking on a calibrator shows information such as specific flux and angular separation from the viewport center (science target position). A graph above the star chart shows how much the two targets overlap each other in terms of LST range.

If the Tcl/Tk extension BLT is available, then clicking on a calibrator will also show its flux history on a line graph. If the BIMA data analysis package (MIRIAD) is available, then planetary positions are calculated as well. These optional features again take advantage of external components and applications. Like Xscribe, Xplore is flexible enough to set up for off-line users. It has HTTP transfer capability so that the off-line user may download an updated calibrator database from the observatory.

4. Xplotwatch, Xfixwatch, and Xaudio

Sensors continually monitor the array and the archived data are a valuable resource for diagnosing problems. Xplotwatch is a data mining tool. The Xplotwatch GUI allows the user to easily choose arbitrary combinations of antennas, sensors, and dates. The data are rendered as either antenna based or sensor based plots. The time (abscissa) axis may be a fraction of a day or several concatenated days, for studying short or long scale trends respectively.

Several critical sensors have an associated alarm. An alarm will trigger if the monitored data falls out of tolerance range. Often the problem cannot be repaired immediately. The Xfixwatch GUI may be used to selectively disable the alarm. The GUI allows any combination of sensors and antennas to be easily selected. It is also trivial to disable a given sensor for all antennas, or disable all sensors for a given antenna.

The most critical time of an observation is during the beginning. The Xaudio GUI offers a choice of entertaining sound effects which will be played when a project starts.

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