Astronomical Data Analysis Software and Systems VI
ASP Conference Series, Vol. 125, 1997
Gareth Hunt and H. E. Payne, eds.

NOVIDAS and UVPROC II—Data Archive and Reduction System for Nobeyama Millimeter Array

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Abstract. A workstation-based data archive and reduction software system is developed for the Nobeyama Millimeter Array (NMA). NOVIDAS is used for archiving the output data from the interferometer onto 8 mm tapes. It also provides a search utility for the archived database. The calibration and reduction of the data are handled by UVPROC II. It uses the $\mathcal{AIPS}$ file system via a set of interface modules called *vif library* developed by us in order to make an easier transition from the calibration processing to further imaging and analysis using $\mathcal{AIPS}$. Basic functions of the UVPROC II are: correcting bandpass characteristics and time variations of complex gains, correction of variations in system temperature due to atmosphere, subtraction of continuum from spectral data, data flagging, and flux scaling.

A key concept for designing the software is that the system should be user-friendly. We adopted a GUI based on X-windows system with a menu-button feature for execution of commands and PGPLOT for graphical display. This allows users to examine the data quality visually and edit the data interactively. The *vif library* consists of simple FORTRAN programs to open/close and read/write the $\mathcal{AIPS}$ files. Therefore it can also be used by users to develop their own codes for manipulating the $\mathcal{AIPS}$ data without calling the $\mathcal{AIPS}$ routines directly.

The system currently runs on SUN-Solaris and will be ported to SGI-Irix with a disk array.

1. Introduction

Nobeyama Millimeter Array (NMA) is an interferometer consisting of six transportable 10 m antennas operated in the frequency bands of 100 GHz, 150 GHz, and 230 GHz by Nobeyama Radio Observatory (NRO). We recently upgraded the correlator system which consists of two types of digital spectroscopic correlators, FX (with 1024 channels, bandwidth of 32 MHz) and XF (128 channels, bandwidth of 1 GHz) correlators. The cross correlated signals from each pair of the array elements need to be calibrated to correct for instrumental and atmo-

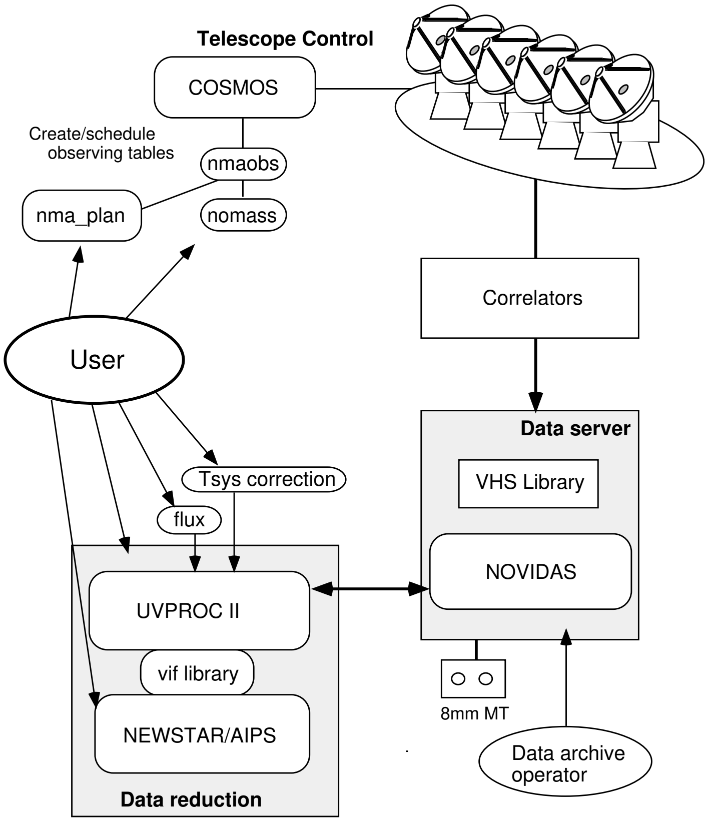

Figure 1. Software systems for NMA.

spheric effects and to be edited for bad data before applying a Fourier transform to produce images.

UVPROC II and NOVIDAS in relation to the other software systems for NMA are schematically described in Figure 1. Since we have the 45 m Telescope and the array at the same site, some of the software is shared between the two instruments.

For observation scheduling, users use *nma_plan* and *nomass* interactively. COSMOS is the telescope controlling system for both the 45 m and NMA. The output data from the correlators are written in the standard FITS format (random group FITS). A single FITS file is created for each source for each observing run. The data archived by NOVIDAS are calibrated using UVPROC II. The calibrated data are processed using NEWSTAR[1] for imaging and analysis. The core of NEWSTAR is the $\mathcal{AIPS}$ package. But it has been customized for the reduction of the 45 m single dish and NMA data by implementing X-windows-based GUI and by adding new tasks to be used for the single dish data.

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[1]It stands for Nobeyama Engineering Workstation Systematic Tool for Astronomical Reduction. It should not be confused with NFRA's software known by the same acronym.

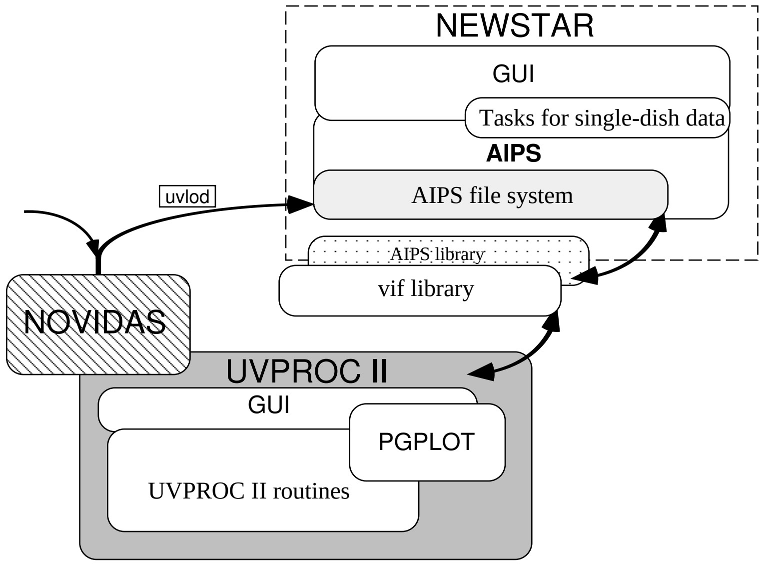

Figure 2. Structure of UVPROC II.

2. UVPROC II

2.1. Why UVPROC II?

As described in the previous section, $\mathcal{AIPS}$ has been used as a basis of the data reduction tool for imaging at NRAO. However, the earlier versions of $\mathcal{AIPS}$ did not have utilities for calibration and editing of visibility data. Also, writing new programs and implementing in $\mathcal{AIPS}$ was difficult for those not familiar with the system.

UVPROC, which was the predecessor of the UVPROC II, was developed at NRO as the calibration software for the NMA data. It was designed to run on IBM compatible main-frame computers. Lack of a GUI and use of its own file system made it somewhat difficult to use. UVPROC II was developed to replace its predecessor with a full GUI support based on X-windows system and use of $\mathcal{AIPS}$ file system.

The basic structure of UVPROC II is shown in Figure 2. $\mathcal{AIPS}$ does all the file management for the data used in UVPROC II. Thus for users, UVPROC II appears as a subsystem of $\mathcal{AIPS}$.

2.2. Key Features

UVPROC II runs on SUN-Solaris platform. An example of UVPROC II windows is shown in Figure 3. For graphics, PGPLOT was implemented with functions such as interactive flagging of data points and zooming in/out by defining a region by a mouse. To use the $\mathcal{AIPS}$ file system, the interface FORTRAN library (*vif library*) was developed. Some utilities included are standard calibration processes such as bandpass calibration and time-dependent gain calibration.

Because of the *vif library*, the addition of new tasks to UVPROC II becomes relatively easy. The library can also be used to access the $\mathcal{AIPS}$ data files outside UVPROC II.

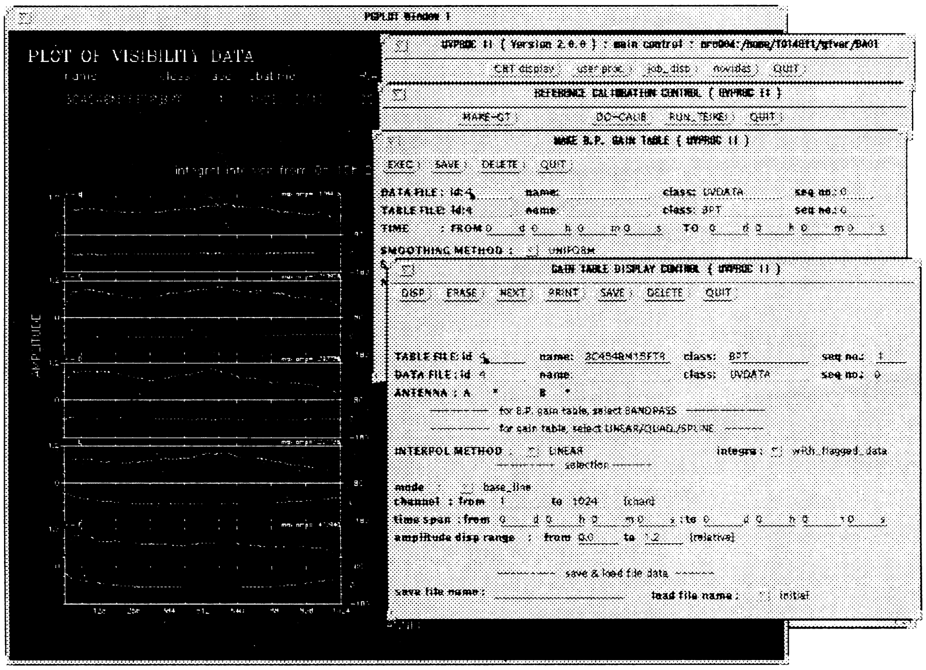

Figure 3. Example of UVPROC II windows.

3. NOVIDAS

NOVIDAS is an X-windows-based data archiving system for the NMA. The output data from the correlators transferred via an FDDI network to a data server (Sun Sparc-1000 compatible). The raw data are currently stored on 8 mm tapes but we plan to upgrade the data storage system to 1 TB VHS tape library. When NOVIDAS archives the data, the FITS headers are added to the database. NOVIDAS also provides a search utility for the archived database.

Core programs of NOVIDAS are installed on the data server. However the search utility (data search, downloading from the MT) can be accessed from individual user's workstation by starting up a new panel within UVPROC II.

4. Upgrade Plans

Documentation and on-line help need to be enhanced. Currently there are no history or log files to record what UVPROC II processes have applied to the data, thus this needs to be changed. Also, for better performance we plan to port UVPROC II to an SGI-IRIX disk array system.