Software for the Australia Telescope Project

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Although it has long been the practice in radio astronomy to take advantage of hardware developments in other radio astronomy laboratories and from industry this is still not generally true for software development, even though software costs may exceed computer hardware costs. Two factors which contribute to this situation are: i. Each telescope is a little different and since software always seems to be very flexible there is a tendency to make a customized product and ii. It is both possible and good fun to develop a new software system. Each new system will have some improvements and will have some new innovative features. Most good software architects will wish to construct a new system even though the development of such a system may be neither cost effective nor expedient. In the following comments I have tried to indicate what existing software would be available for the various stages of the AT project. Some of the salient features of existing systems are summarized in enclosed table.

There are three fairly distinct areas of software development needed for the AT.

1. The on-line system

This handles the interface to the array hardware, collects data and monitor information and allows control of the array. The on-line software will be quite specific to the AT. It may borrow algorithms from other systems (eg. WSRT, VLA) but much of the system will have to be designed for AT hardware and opertional requirements. This is a real-time processing enviroment and the software and hardware architecture will be different compared with the rest of the system. It may be useful to set up a separate software group for this area because the different programming style in this enviroment.

2. Calibration and mapping system

These operations are specific to a radio sysnthesis telescope and only software systems developed for synthesis telescopes could be easily used. There is no single system in use which could do all this. The VLA calibration software is unsuitable since it is written in SAIL, an ALGOL type language, which is no longer adequately supported. The WSRT calibration software is correlator based and contains WSRT specific features.

After the visibility function has been edited and calibrated the NRAO AIPS system could be used. It has a large amount of well tested software to do all the basic synthesis telescope tasks, and has the advantage of being a well debugged and an exportable system. It has good quality control, does not assume VLA specific features, and is CPU independent. AIPS currently operates on a large number of VAX system under VMS, a few UNIX systems and on two MODCOMP cpu's. Its major disadvantage is its unsuitably for use as a programming enviroment and its intensive use of two non-standard peripherals; the FPS array processor and the I^2S image display. Of these only the array processor is critical for the main sysnthesis processiong tasks. Although a non-AP version is available it is not optimized and would cause an unacceptable loss in efficiency.

The WSRT mapping package (LINEMAP) would be harder to transplant since it contains many WSRT specific concepts. It currently exists in two versions, one for an IBM and one for a CDC computer.

3. Post-processing

These are the map analysis programs, the display programs and the various programs to estimate specific parameters from the image. This is the area in which there will be the most user generated software. Here there are many possibilities since the radio and optical requirements merge. At this stage a good enviroment for software development is more important. Although AIPS has a reasonable amount of image processing software it does not provide a good development enviroment and has a limited database structure. The GIPSY system would provide a better programming enivorment and has the most developed software for spectral-line observations. However the current implementation of GIPSY uses features of the PDP11 RSX operating system. A patched version of GIPSY for VMS is operating on a VAX in Bonn and a redesigned VMS version is under consideration in Groningen. STARLINK is the most sophisticated of the processing environments currently in use. Although it will not contain many of the synthesis telescope specific reduction packages it should be a good enviroment for software development. Up to the present time STARLINK has suffered from considerable instability in its design and interface definitions and the better enviroment provided by the most recent version has only had limited field testing. The new DWARF system combines some of the STARLINK and GIPSY features and again concentrates on providing a good software development enviroment. It is still under development, has no application software and has not been tested in the user enviroment.

Also under development is the the Space Telescope Institute reduction system. This is being written by TRW, a commercial software company, to specifications set up for the space telescope. No working system is available for evaluation at present.

In conclusion I would like to propose the following software development plan for the AT:

1. An on-line system developed by CSIRO. It should take advantage of algorithms and concepts developed elsewhere but otherwise be designed around the AT hardware.

2. The standard calibration and editing software will also have to be written by CSIRO. A FTN version of the successful VLA command scanner package (Appendix 2) has now been developed and might be a good user interface for this system. It is not machine depedent and is well structured. Although the implementation is quite different from AIPS it appears similar to the user.

3. The edited and calibrated visibility data could be converted to the uv FITS format and passed on to the AIPS system which would take care of all the more complex synthesis telescope task. It would provide all the necessry software to obtain selfcalibrated images from the AT without significant software effort. The uv FITS format will become the standard tape format for visibility data from the VLA. The format to be used is specified in Appendix 3.

FIGURE 1

IMAGE PROCESSING SYSTEMS

Name	Origin	Contact	Hardware	Peripherals	Software	Main Field	Status	Systems in Use	Notes
AIPS	NRAO Charlottesville USA	E. Greisen	Any 32 bit machine with 64K address space	I^2S + AP	FTN66	Radio Synthesis	Operational	23	Extensive software for VLA reduction from calibrated visibilities.
GIPSY	U. Groningen NL	R. Allen	PDP11/70	I^2S	SHLTRN (Fortran precomp)	Radio Synthesis	Operational	2+1?	Extensive software for reduction fro images, especially spectral line.
WARF	SRZM Dwingeloo NL	R. Harten	VAX/VMS	DeAnza	FTN77	Radio Synthesis	Development	0	Mixture of STARLINK and GIPSY concep
STARLINK	Rutherford UK	P. Wallace	VAX/VMS	-	FTN77		Operational	8+	Good software development environment.
PIC	"	"		ARGS	"	Optical	Operational	8+	The STARLINK image processing progra
MIDAS	ESO Munich W. Germany	P. Crane	VAX/VMS	DeAnza	FTN77	Optical	Operational	2	Includes a well developed table syst Based on earlier version of STARLINK.
DAS	S.T.I. Baltimore USA	R. Albrecht	VAX/VMS	DeAnza	FTN77	Space Telescope	Development	0	TRW Software contract. Not availabl until 1985. Uses IDM500 Database system.
IVR	Inter-American Obs. Cerro Tolo Chille	R. Albrecht	VAX or PDP11		FTN	Optical Spectroscopy	Operational	11	1D and 2D.
IRAF	KPNO Tucson USA	D. Tody	VAX/UNIX	I^2S	RATFOR (Fortran precomp)	Optical	Development	0	First system expected in 1984.
SIPS	ASTEC Noordwijk NL	F. Machetto	VAX/VMS	?	FTN	Space Telescope (FOC)	Development	0	Uses STARLINK Standards.
DOMAIN	KPNO Tuscon USA	F. O'Neil	VAX/VMS	Grinnell	FTN77	Optical	Operational	1	Commercial software contract.
IPPS	KPNO Tucson USA	D. Wells	Cyber + Varian	Comtel	FTN + FORTH	Optical	Operational	1	First generation image processing system.
POD	Jodrell Bank Manchester UK	G. Haslam MPI, Bonn	VAX or CDC	-	FTN66	Radio	Operational	5+	Single dish mapping. Requires entire image in central memory.