AIPSLETTER

Volume XXIII, Number 1: June 30, 2003

A newsletter for users of the NRAO
Astronomical Image Processing System

Written by a cast of *AIPS*

Edited by
Eric W. Greisen
National Radio Astronomy Observatory
P.O. Box O, Socorro, NM 87801–0387
505–835–7236; Fax 505–835–7027
`daip@nrao.edu`
`http://www.aoc.nrao.edu/aips`

General developments in *AIPS*

Linux news: bad and better compilers

Instructions for fetching and installing the GNU 2.95.3 compiler are given on the *AIPS* web page. The tar file is directly available from NRAO. This is needed since the 2.96.x compiler, shipped with some versions of Linux, does not optimize code properly. Users of more recent Linux versions, *e.g.*, RedHat 9, will probably want to use the GNU 3.3 compiler which comes with it. Setting `OPT2` simply to `''-O2''` in `$SYSLOCAL/FDEFAULT.SH`, produces code as fast on the `DDT test` as 2.95.3 with its complex `OPT2`. On the larger `Y2K` test, 3.3 is about 5% slower in real time and 13% slower in cpu on a RedHat 7.2, Pentium IV 1.3 GHz computer. The 2.95.3 libraries are very dated compared to the more recent operating systems, suggesting that it is finally time to update despite the modest loss in performance.

Current and future releases

We now have formal *AIPS* releases on an annual basis with binary releases only for Solaris and Linux. All architectures can do a full installation from the source files. The next release is called `31DEC03` and remains under active development. You may fetch and install a complete copy of this version at any time. This *AIPSLetter* is intended to advise you of developments to date in this new release. Having fetched `31DEC03`, you may update your installation whenever you want by running the so-called "Midnight Job" (MNJ) which uses transaction files to copy and compile the code selectively based on the code changes and compilations we have done. We expect users to take the source-only version of `31DEC03` *AIPS* over the Internet (via *anonymous* ftp); there is a guide to the install script and an *AIPS* Manager FAQ page on the *AIPS* web site.

The MNJ has been changed. It now serves up *AIPS* incrementally using the Unix tool `cvs` running with anonymous ftp. Linux sites will almost certainly have `cvs` installed; other sites may have installed it along with other GNU tools. Secondary MNJs will still be possible using `ssh` or `rcp` or NFS as with previous releases. We have found that `cvs` works very well, although it has one quirk. If a site modifies a file locally but in an *AIPS*-standard directory, `cvs` will detect the modification and attempt to reconcile the local version with the NRAO-supplied version. This usually produces a file that will not compile or run as intended.

AIPS is now copyright © 1995 through 2003 by Associated Universities, Inc., NRAO's parent corporation, but may be made freely available under the terms of the Free Software Foundation's General Public License (GPL). This means that User Agreements are no longer required, that *AIPS* may be obtained via anonymous ftp without contacting NRAO, and that the software may be redistributed (and/or modified), under certain conditions. The full text of the GPL can be found in the 15JUL95 *AIPSLetter*.

Patch Distribution for 31DEC02

As before, important bug fixes and selected improvements in 31DEC02 can be downloaded via the Web beginning at:

http://www.aoc.nrao.edu/aips/patch.html

Alternatively one can use *anonymous* ftp to the NRAO server ftp.aoc.nrao.edu. Documentation about patches to a release is placed on this site at pub/software/aips/*release-name* and the code is placed in suitable subdirectories below this. As bugs in 31DEC03 are found, they are simply corrected since 31DEC03 remains under development. Corrections and additions are made with a midnight job rather than with manual patches. Remember, no matter when you received your copy of 31DEC02 *you must* fetch and install its patches if you require them.

The 31DEC02 release had a few important patches including new ones in June. These were:

1. KNTR to handle LTYPE not 3 for polarization vectors *2003-01-03*.
2. FITLD to handle multiple data types in one tape *2003-01-03*.
3. IRING to correct the centering *2003-01-10*.
4. LWPLA to use ASPMM for new GREYS, KNTR, PCNTR plots *2003-01-16*.
5. FILLM and PRTTP to read short records in VLA archive disk files *2003-03-20*.
6. INDXR to fill VLBI CL table properly *2003-05-21*.
7. RedHat 9 to link edit requires fixed Z routines *2003-06-24*.
8. SETFC to format field numbers > 999 correctly *2003-06-27*.

Recent *AIPS* and related Memoranda

The following new *AIPS* Memorandum is available from the *AIPS* home page.

108 Weights for VLA Data
Bryan J. Butler (NRAO)
January 21, 2003
A method for calculating the properly calibrated weights for VLA data in *AIPS* (or AIPS++, or any other package) is presented, along with some related information on the "nominal sensitivity" quantity stored in the VLA archive data. A method of determining the quantity T_{sys}/η_a for each antenna using the properly calibrated weights is also presented.

AIPS Distribution

We are now able to log apparent MNJ accesses and recently acquired a tool to log downloads of the tar balls. The software that managed the registration database is broken and appeals to have it fixed have fallen on deaf ears. There appear to be about 71 sites/machines that have run the MNJ on 31DEC03 at least occasionally. In the period May 19 — July 1, there have been downloads to 30 sites of the 31DEC02 tar ball and downloads to 91 sites of the 31DEC03 tar ball. This is at a rate of 0.7 and 2.0 download sites per day.

Improvements of interest to users in 31DEC03

We expect to continue publishing the *AIPSLetter* approximately every six months along with the annual releases. There have been a number of changes in 31DEC03. A package of *AIPS* procedures, called VLARUN, to reduce VLA data in a pipeline, similar to the one in use for VLBA data, was added. Two experimental display tasks were created; SCLIM scales images to be used as inputs to LAYER which creates a colored image "layering" up to 10 input images. The new task SHADO determines the loss in sensitivity due to shadowing for prospective array designs. New task DQUAL gets rid of all qualifier numbers on sources in a *uv*-data file. The new verb IMDIST determines the angular distance between two image pixels and new procedure TVDIST uses the TV to select the two pixels for IMDIST. New verb IM2TV converts image pixel to TV pixel coordinates, while new verb TVILINE draws a line on the TV between two image pixels.

AIPS has been ported to the Apple MacIntosh OS/X operating system and its use on the latest RedHat (version 9) has been established. The Mac performance needs to be improved, but awaits compiler studies.

Other than relatively minor differences, 31DEC03 is compatible in all major ways with the with the 15OCT98 and later releases. There are significant incompatibilities with older versions.

UV data calibration

CLCAL, SNSMO, CLSMO

The subject of the smoothing of calibration tables received significant attention. The calibration routines depended on flagging records in SN and CL tables and then adding new records. The routine that re-references phases for CLCAL and CALIB was found to ignore the flagging of records, restoring them to full status. SNSMO also had this problem. They were fixed, but, to avoid similar problems elsewhere, CALSEL (used in CLCAL, CALIB, FRING and KRING) was changed so that tables are re-written with no flagged records. The smoothing routines previously used went to great lengths to return values at all times, even if the times were very distant from any valid data. They were replaced with a wider variety of functions that strictly honor a support size and return blanked values when appropriate. The new routines offer the choice of smoothing data from different sources together or keeping them separate. They also understand about blanked values; some of the earlier functions did not.

Tasks SNSMO and CLSMO were changed to smooth larger data sets, to offer the new smoothing functions, to set the support size and function parameters, to control smoothing between sources, and to control what data in the tables are replaced by the smoothed values. The last has already been a source of user confusion: if DOBLANK ≥ 0, then previously blanked solutions are replaced by smoothed values and if DOBLANK ≤ 0, then previously good solutions are replaced by smoothed solutions. Thus the user can choose to keep or replace failed solutions and can choose to smooth the good data or not.

CLCAL suffered from an attempt to combine operations involving the smoothing of the merged SN table with operations applying that smoothed table to the CL table. These operations are now specified with a variety of additional adverbs. The smoothing is controlled by the adverbs also used in SNSMO. The default CL table versions have been changed and, if GAINUSE = 0, the input CL table is copied as a whole to the new output table before the interpolation operations. Smoothing for phase now uses the real and imaginary parts rather than a somewhat modified smoothing of actual phases. CLCAL was given the option to do its things for a range of SN table versions, rather than using only one or all. The 'SMOO' operation was dropped — 'MERG' will do fine with the separated smoothing control adverbs. The use of CLCAL for single-source files was corrected. Previously it had odd bits that seemed to limit it to a single input SN table with no smoothing.

VLARUN

VLARUN is a RUN file that consists of a collection of procedures allowing straightforward calibration and simple imaging of continuum and spectral-line VLA data. It is particularly useful for a quick look, *e.g.*, to decide whether particular VLA archive data are useful for the intended science without spending too much time calibrating and imaging. It will apply the calibration scheme as outlined in Appendix D of the AIPS

Cookbook, *i.e.*, it will calibrate the visibility phase first which makes it suitable for high-frequency data as well.

VLARUN assumes that flagging has been performed. If flagging in the line data is needed, it is assumed that these flags are copied to the "channel-0" file flag table before VLARUN is started. Furthermore, only a single frequency ID should be present in the file(s). The observations must include at least one of the default VLA flux calibrators (as known by SETJY); for other flux calibrators a simple edit of the procedure is necessary.

The procedure will automatically calibrate the continuum or ''channel-0" and line part of a spectral-line data set. At several stages during the process, VLARUN creates plot files which can be viewed to assess the calibration. The user may also opt to perform simple imaging, *e.g.*, to obtain a first model of the targeted sources for self-calibration.

Current practice suggests calibrating the data, assessing the calibration, and including additional flagging in flag table number one. Then re-run the procedures. Note that for scientific purposes, it is assumed that the user will flag and re-image the data properly instead of using VLARUN's output.

Other matters

CLCOR now has a new OPCODE='ATMO'. Using an input text file, this option corrects the data for excess zenith path delays.

TECOR was corrected to handle a change in the format of IONEX input files.

LOCIT is now in production use finding antenna locations at the VLA. As a consequence, bugs revealed by odd circumstances in the data were found and fixed.

EDITR tried to avoid extra work too much and so failed to flag data under some crowded circumstances. The task now copies the input FG table to a new one and adds the new flags to that version.

WIPER was given defenses against bad windows and the DOCENTER option to control placement of the menu.

UV data handling

FILLM

FILLM received considerable attention over the last few months. Its disk reading handled the case in which there were short physical records in a logical so long as the first physical record was not short. But the first (and only) physical record in a logical can easily be short (continuum with < 26 antennas in the sub-array), so the reading could get off and find no more data. The signal was a read error at the end with fewer than 13*2048 bytes, but "error code" 0. The last physical record could also be short, which required smarter "error" handling to report only real errors. PRTTP was also corrected for these issues. The channel 0 frequency increment was corrected.

FILLM, at the VLA and AOC, is able to load data to *AIPS* as it is observed. This on-line FILLM has depended on a second process to be running to read the data from the VLA and pass it on as if it were the tape device. For a variety of reasons, including when the VLA ModComps would go down, this process would disappear and the on-line FILLM would quit or be left sitting there not getting any data. The second process was revised to make it more robust and various re-try methods were added to the on-line portion of the FILLM tape routines. After that, on-line FILLM ran for over a week surviving a 2-day shutdown and numerous other "irregularities." During this period a new plan was devised which will probably soon be put in place. Under this plan, the archive data will be written to disk at the VLA and to a mirror disk in the AOC. A new file will be written each day. Then on-line FILLM will simply read the current day's disk file and, when it reaches the end-of-file, it will go into a special mode to read data as they are added to the file and even to switch to the next day's file when appropriate.

New options were also added to FILLM. An option to use the data weighting described in *AIPS* Memo 108 was added (DOWEIGHT = 10. This weighting has a better scaling than that present in FILLM since 2000.

Another new option was added to choose to omit visibilities for which one of the antennas failed its last reference pointing attempt (bit 10 of `CPARM(2)`). The default is to do as it does now — load all the data — but then it makes an `OF` table which holds the reference pointing information along with the antenna shadowed bit. We should construct a task to use this table for editing.

Other matters

UVFIX was revised to do multi-source files (with no position shifting), to recognize GMRT data with its different sign convention (they believed *AIPS*' documentation!), to do a more accurate phase shift on position shifts, and to make a more consistent interpretation of the data epoch and array identity.

DBCON did correct phase shifts only for rather small position shifts. It has been corrected to do full-accuracy phase shifts and to recompute (u, v, w) for the new reference coordinate.

INDXR failed to initialize VLA `CL` tables correctly when the weather table was not being used, such as when the user specifies the opacity or only wants antenna gain corrections. Similarly, it failed to initialize VLBA `CL` tables with data from the `IM` and `MC` tables under most cases. This initialization used the dispersive delay from the `IM` table. That is now blocked since *AIPS* applies the dispersive delay in calibration and the delay in the `IM` table has already been applied. A similar blocking was added to `FITLD`. This has not mattered since the dispersive delays seem always to be zero in the `IM` tables.

UVCOP was changed to copy all sources to the `SU` table since it copies all references to sources in `CL` tables. `CLCOR` had trouble with missing sources otherwise. Flagging was not done when the flag table entry specified the `FQ` number, but all `FQ`s were being copied.

LISTR was corrected to average phases always with vector methods; it previously scalar-averaged phases literally. Changed the display of the `MATX` average to include the vector average of all the data as well as the literal average of the printed values given previously. Fixed the formating for flagged gain solutions.

weights assigned to combination polarizations, *e.g.*, Ipol, were incorrectly computed as the simple average of weights. The correct weights have been implemented using the real formula.

DQUAL is a new task to remove all qualifiers from a source table, renumbering the sources in the *uv* data and source table.

Data display and analysis

SCLIM and LAYER

`SCLIM` is a new task which creates images scaled from 0 to 1 using corners, function types, pix-ranges, etc. Clipped values — even at the top — may be set to 0 on output. It was written to create inputs to the new and experimental task `LAYER`. That task reads as many as 10 images letting each "absorb" the current image and add to that image by emission with optical depths scaled from the input image values, all optionally colored. This will be tricky to use, but good results should be possible.

Other matters

MOMNT was overhauled to handle blanked pixels correctly. Smoothing with zeros is not correct and `MOMNT` did not even check for magic blanks. Buffer sizes were raised. The option to adjust the cutoff level for the primary beam was added. This allows `MOMNT` to work on the output of `PBCOR` which is required since the primary beam is a function of frequency. a bug affecting the history file was corrected.

IMDIST is a new verb to compute the spherical distance between two pixels in two images. `TVDIST` is a new procedure to read two pixels from the TV and then invoke `IMDIST` on them.

IM2TV is a new verb to convert an image pixel coordinate to a TV coordinate.

TVILINE is a new verb to draw a line on the TV between to image pixel coordinates. (TVLINE uses TV coordinates.)

IMVAL as well as QIMVAL. MAXFIT, TVFLUX and TVMAXFIT now return COORDINA as an output adverb.

IMEAN and IMSTAT can return the statistics of a circular aperture in an image as well as a rectangular one.

plots on the TV that have waited for 30 seconds before showing a new page may now be held indefinitely by pressing button A, while B and C go on immediately, and D exits.

POSSM had a variety of bugs fixed including one that could hang AIPS itself. Bugs triggered by missing data in multiple plots, by plotting amplitudes, and by position shifting were corrected.

TVCPS now has the CMYK (printer colors) option in addition to the usual RGB. Different gamma corrections must be used for the two color schemes.

LWPLA now allows for gamma corrections so that the needs of RGB, CMYK, and various printers may be addressed. The scaling options (DPARMs) were made more intuitive.

PLCUB now has an option to omit the frame axis labeling entirely.

TVRGB has new adverbs to control separately the sub-image for the interactive TV portion and the sub-image to be written out at the end. The limitation to the maximum TV size has been eliminated along with bugs handling TXINC and TYINC.

TVHUI also had its adverbs changed and bugs fixed in scaling the hue and saturation images and reporting the final pix-ranges.

Imaging and miscellaneous

IMAGR had only a few changes. It defends itself now against bad BOX values. It writes out the peak residual left in each field to its history file. It allows beams for Cleaning to be made up to 16384 on a side if IMAGRPRM(10) is actually set suitably.

WISH survey data (southern Westerbork, -25 to -15 or -9 degrees declination) have been inserted into the WENSS source lists used in imaging interfering sources.

SETFC was corrected to use a suitable format for facet numbers > 999.

TASAV now copies all extension files (including plot files) for images as well as *uv*-data files.

output adverbs from verbs and tasks are now viewed with the verb OUTPUTS rather than INPUTS.

Array and data modeling

CONFI was revised substantially. The topography file may now be in free format. The definition of worst side-lobe was changed as well as the technique for finding it. This allows some optimization of the main lobe shape. The gain in the optimization loop was made adaptive under user control. Bugs affecting or caused by user input were corrected or prevented.

SHADO is a new task to estimate the loss of sensitivity due to shadowing of the antennas by each other.

UVSIM was changed to use true IAT times when possible, *i.e.*, when the user provides the array location. The observing date and coordinates were changed to 2000 from 1950. This allows UVFIX to be run on the output file.

UVCON was also changed to compute correct IAT times, allowing UVFIX to work on the data. Random antenna-based phase and amplitude errors may be added to the data.

Improvements of interest to *AIPS* managers in 31DEC03

MacIntosh OS/X

AIPS now works on Apple MacIntosh systems running the OS/X operating system. Details of how to prepare a Mac to install *AIPS* are given on a page of the main *AIPS* web page. Basically, one has to acquire a C compiler, a Fortran compiler, and X Windows. The port was relatively simple. One of the major "gotchas" was the fact that OS/X is case insensitive at some, but not all, times. Thus, *AIPS* procedures `AS`, `GREP`, `PWD`, and `WHICH` had to be renamed by prepending `AI` to the name. Numerous procedures had to have references to these (primarily `PWD`) corrected. Architecture case statements required addition of the `MACPPC` architecture. The Mac uses Z routines in `$APLMAC`, then `$APLLINUX`, and so forth up the tree. There are only a few Z routines in the Mac area, including stubbed routines for magnetic tapes.

The performance achieved was less than was hoped. An 800 MHz iBook laptop (the G3 chip) achieved an AIPSMark$^{(00)}$ of 18. For comparison, a 1 GHz Intel laptop is about 40. When *AIPS* was then installed on a 800 MHz PowerBook laptop (G4 chip), the performance was identical! For the moment, we are unable to get the `g77` compiler to optimize properly for Macs, especially the powerful G4 chip. GNU is making progress on their compiler; the latest will at least `make` on Macs, but the optimization so far fails. Wes Young is looking into this for us.

install.pl

The installation script `install.pl` was modified in a number of ways in the past six months. An error in dealing with the question about unpacking the tar ball was corrected. The page about TV sockets was removed; it confused people and did nothing. For the Mac port, it was corrected to use `AIPWD` rather than `PWD`, to recognize the `MACPPC` architecture, and to look for `readline` in the usual place on Macs. For installations on systems already having an *AIPS*, it now renames the `TEXT` directory before starting. Otherwise, the load of that directory failed. The MNJ corrected this but at considerable expense. Registration no longer works, so it was commented out of the script. The default `$AIPS_ROOT` was moved to the current directory.

Other matters

startup procedures were changed to get the host name by calling new scripts `SETNAME` and `SETUNAME`. The main use is for laptop computers since they often get a new name every time they connect to the LAN. The `LOGIN` files may set the variable `LAPTOP` to `YES` in this case.

RedHat 9 forced a few changes to Z routines. These were in the nature of removing direct references to system `external` variables such as `errno`. They are replaced with includes or subroutine calls.

ZLPCL2 was changed to work with the `ghostview` previewer to convert print files to PostScript and then display them correctly.

FDEFAULT was changed for Linux to specify the correct `OPT2` option for GNU 3.2+ compilers. The older 2.95.3 options are present but commented out; 2.95.3 will also work with the new option.

Preview of coming attractions

Subtle colors used to indicate polarization vector angles, channel number in contouring, IF number, etc.

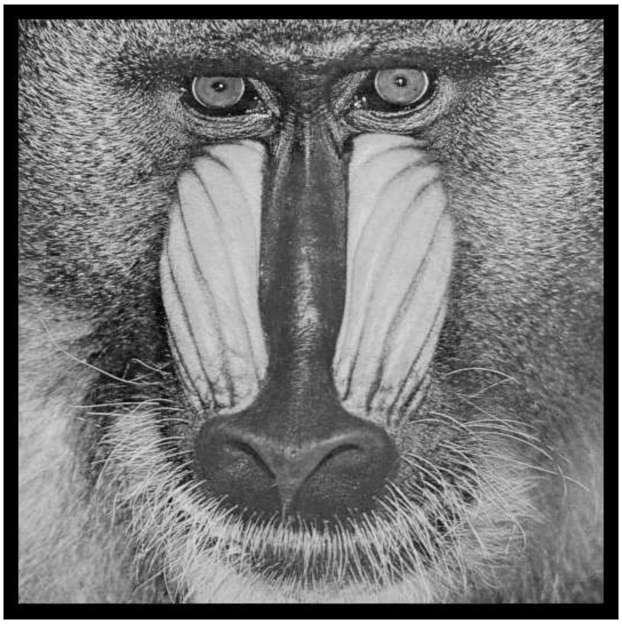
Multiple overlapping solution intervals

Corrections for atmospheric delay and the troposphere

Calibration for the VLA on VLBA data tapes

Improved real-time VLA data filling and improved performance on MacIntosh OS/X systems

Mosaicing in `IMAGR`



June 30, 2003

AIPSLETTER
National Radio Astronomy Observatory
520 Edgemont Road
Charlottesville, VA 22903-2475
USA

FIRST CLASS

To:

DATED MATERIAL-DO NOT DELAY