AIPSLETTER

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A newsletter for users of the NRAO
Astronomical Image Processing System

Written by a cast of *AIPS*

Edited by
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General developments in *AIPS*

Current and future releases

We now have formal *AIPS* releases on an annual basis. Beginning near the end of 2004, we have made available full binary installation methods for both the frozen and development versions for MacIntosh OS/X, Solaris, and Linux. All architectures can do a full installation from the source files. The next release is called `31DEC05` and remains under active development. You may fetch and install a copy of this version at any time using *anonymous* `ftp` for source-only copies and `rsync` for binary copies. This *AIPSLetter* is intended to advise you of developments to date in this new release. Having fetched `31DEC05`, 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. The MNJ will also update sites that have done a binary installation using `rsync`. 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. The binary MNJ also uses the tool `rsync` as does the binary installation. 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.

Patch Distribution for 31DEC04

Important bug fixes and selected improvements in 31DEC04 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 31DEC05 are found, they are simply corrected since 31DEC05 remains under development. Corrections and additions are made with a midnight job rather than with manual patches.

The patch system has changed because we now have binary installations. We now actually patch the master version of 31DEC04, which means that a MNJ run on 31DEC04 after the patch will fetch the corrected code and/or binaries rather than failing. Also, installations of 31DEC04 after the patch date will contain the corrected code.

The 31DEC04 release had a few important patches most of which were released in April when we changed the patch system. These were:

1. OTFUV, OTFIN to handle both byte orders of 12m OTF data *2005-01-06*
2. CXPOLN procedure, CXCLN task need modern image names *2005-04-22*
3. TVFLG and SPFLG required improved error handling and modern FLAGVER default *2005-04-22*
4. WIPER function FLAG AREA aborted on wrong button push *2005-04-22*
5. FIXBX could handle complicated cases but not simple ones *2005-04-22*
6. POSSM used wrong units in output text file *2005-04-22*
7. CL2HF aborts under Linux *2005-04-22*
8. TCOPY used wrong (old) tape LUNs *2005-04-22*
9. BPASS gets wrong solutions when channel 1 of of the first source was flagged *2005-04-22*

Binary installations are easy

The *AIPS* binary installation is so easy that it has confused would-be installers. All one really needs to do is visit the web page

http://www.aoc.nrao.edu/aips/dec05.shtml

and read the instructions. From this page, download the file install.pl putting it in the area you intend to use as $AIPS_ROOT. Then type the instruction

```
perl install.pl -n
```

You will be asked some of the usual questions (see the guide to the Install Wizard available from the cited web page), but with the -n option, the script will skip fetching and unpacking the tar-ball and the compiler queries and usage. It does a variety of rsync commands to fetch a complete copy of the *AIPS* version including libraries and all executables. It marks the installation as a binary one by creating a special 0-byte file in $SYSLOCAL. The MNJ then detects this file and replaces the compile steps with rsync operations on the binary areas. Your firewall must allow you to use the rsync and cvs utilities (ports 873 and 2401, respectively) which are used for installing and updating the binary and text files.

Recent *AIPS* and related Memoranda

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

111 `ATMCA`: Phase Referencing using more than one Calibrator
Edward Fomalont & Leonid Kogan, (NRAO)
January 6, 2005
The VLBI astrometric accuracy and image quality of a target source can be improved if more than one reference calibrator is observed with the target. The improvement is obtained by determining the phase gradient in the sky in the region of the sources, mostly caused by an inaccuracy of the troposphere model. Even if the target is sufficiently strong to use self-calibration methods to determine the image, its precise location can be improved with phase referencing. This memo describes the scheduling strategy for multi-calibrator phase referencing, the reduction of the data, and the use of a new *AIPS* task `ATMCA`, which combines the phase or multi-band delay information from the several calibrators.

The following new EVLA Memorandum is available from the NRAO web pages.

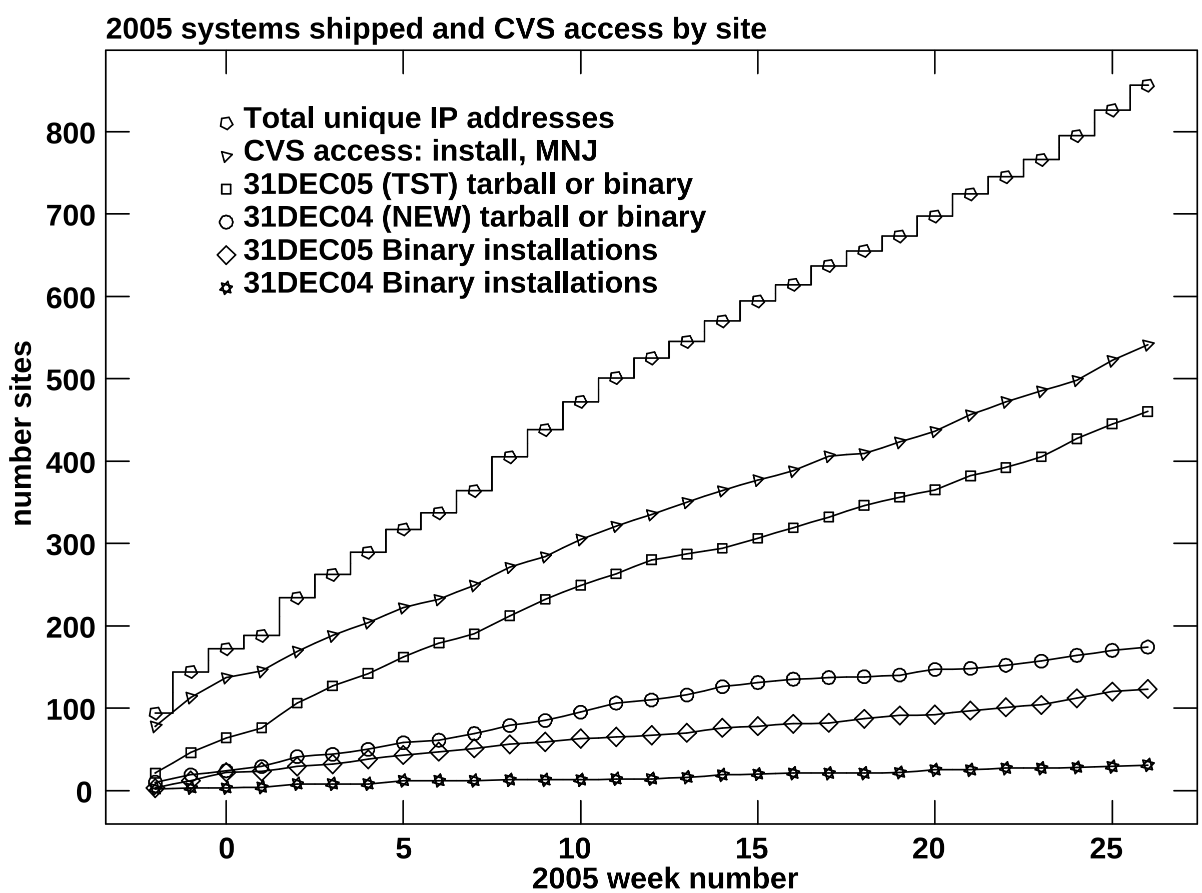
93 Optimization of the LWA Antenna Station Configuration Minimizing Side Lobes
Leonid Kogan & Aaron Cohen
May 4, 2005
This memo is a duplicate of LWA memo #21 and is posted here as well because of its relevance to the optimization of the EVLA phase II arrays. The algorithm for optimization of an array configuration to minimize side lobes, designed by Leonid Kogan, has been applied to optimize the configuration of a dipole station of the Long Wavelength Array (LWA). The results of optimization are given for different areas of optimization on the sky including full sky semi-sphere; for different minimum spacing between the station antennas. For an array phased to zenith, the optimization is done to minimize sidelobes all the way to the horizons by optimizing in a circle defined by the radius $|\sin(z)| \leq 1$, where z is the angle from zenith. *For an array that will potentially be phased to any location above the horizon, the optimization radius should be twice as large to optimize the beam pattern over the entire sky.* Thus for the whole semisphere optimization with a range of array pointings covering the whole semisphere as well, optimization at zenith pointing must be done for $|\sin(z)| \leq 2$!

The following paper has been approved for inclusion in the FITS Standard by the regional committees. Submission to *A&A*, *astroph*, and the IAU FITS Committee will follow. It is currently available from Eric Greisen's home page: `http://www.aoc.nrao.edu/~egreisen`

III Representations of spectral coordinates in FITS
E. W. Greisen (NRAO), M. R. Calabretta (ATNF), F. G. Valdes (NOAO), and S. L. Allen (UCO/Lick)
24 May 2005
Greisen & Calabretta (2002) describe a generalized method for specifying the coordinates of FITS data samples. Following that general method, Calabretta & Greisen (2002) describe detailed conventions for defining celestial coordinates as they are projected onto a two-dimensional plane. The present paper extends the discussion to the spectral coordinates of wavelength, frequency, and velocity. World coordinate functions are defined for spectral axes sampled linearly in wavelength, frequency, or velocity, linearly in the logarithm of wavelength or frequency, as projected by ideal dispersing elements, and as specified by a lookup table.

AIPS Distribution

We are now able to log apparent MNJ accesses and downloads of the tar balls. We count these by unique IP address. Since dial-up connections may be assigned different IP addresses at different times, this will be a bit of an over-estimate of actual sites/computers. However, a single IP address is often used to provide *AIPS* to a number of computers, so these numbers are probably an under-estimate of the number of computers running current versions of *AIPS*. We have abandoned the registration system since the software that managed the database is broken and appeals to have it fixed have fallen on deaf ears. In 2005, there have been a total of 541 IP addresses so far that have accessed the NRAO cvs master. Each of these has at least installed `31DEC05` and 152 appear to have run the MNJ on `31DEC05` at least occasionally. During 2005 more than 174 IP addresses have downloaded the frozen form of `31DEC04`, 31 in binary form, while more than 460 IP addresses have downloaded `31DEC05`, 123 in binary form. The attached figure shows the cumulative number of unique sites, cvs access sites, and binary and tar-ball download sites known to us as a function of week — so far — in 2005.



Improvements of interest to users in 31DEC05

We expect to continue publishing the *AIPSLetter* approximately every six months along with the annual releases. There has been a modest number of changes in 31DEC05, essentially all in the form of bug fixes and minor enhancements.

31DEC04 and 31DEC05 use a new numbering scheme for magnetic tape logical unit numbers that is incompatible with previous versions. Thus all tape tasks and the server TPMON must be from one of these two releases. Other than this, 31DEC05 is compatible in all major ways with the with the 15OCT98 and later releases. There are significant incompatibilities with older versions.

UV data calibration and handling

CALIB

Changes to CALIB, begun with the previous release, were enhanced over the last six months. The various routines that actually do the solutions now return the closure rms of the solution, allowing CALIB to display the average rms and its rms. The robust solution methods drop data from the next iteration down to very tight limits. The user, through CPARM(6), may keep the limits less restrictive. The average gain modulus is always reported now whenever amplitude solutions are obtained. It is saved and used to scale the gains only when CPARM(2) > 0. When CALIB created a new flag table to flag data with poor closure, it was able to forget the fact that it had written a new solution table. This was corrected.

When using standard source models, CALIB scales the total Clean Component flux in the model to match that entered in the source table by SETJY. Since some new models include nearby sources as well as the calibration source, the scaling was changed to include only the Clean Components of the primary source. The new model for 3C48 at C-band (6 cm), now provided with *AIPS*, forced us to make this change to the code.

CLCAL

CLCAL also received some useful attention in 2005. It "merges" multiple solution tables into one which it then smooths and applies to the output calibration table. Previously, the term merging meant only concatenating and sorting into time order. Thus, if two SN tables had values for a particular time, the merged SN table would have two different records for that time. If one of the tables had good solutions only for one IF and/or polarization, while the other table had good solutions for the other IF or polarization, peculiar results could occur due to the apparent bad solutions. A small amount of time smoothing should have corrected this ambiguity, but an error in handling blanked delays led to bad changes to phase. The new version of CLCAL actually merges any records which match in time, source, subarray, et al. Blanked solutions are replaced with any good ones and, if two records match but have different good solutions, an error message is generated. Recent versions of CLCAL extrapolate solutions and weights to times outside the range of the solution table. This extrapolation was changed to limit how far it is willing to go. Previously two good weights could extrapolate to a negative (bad) weight just because they were different.

TECOR

TECOR has assumed that the ionosphere remains roughly fixed with respect to the Sun and so adjusts longitudes in looking up the values for times intermediate between those provided. Using SNPLT to examine the multi-band delays produced by TECOR revealed that this provided very peculiar interpolations between the data for periods in which the ionosphere was relatively stable. These peculiar interpolations led to large, apparently erroneous phase offsets. In many cases much better results come from assuming the ionosphere moves with the Earth or partly in between. A parameter has been added to select the interpolation to be used. Where 0 selects rotation with the Earth and 1.0 rotation fixed with the Sun, a value of 0.3 gave the best results for the tested data. The multi-band delays should be examined with SNPLT after TECOR to make sure that the large corrections it makes appear to have been interpolated reasonably.

The web site used to provide the ionospheric data for `TECOR` has changed and the help file has been updated. The new data area is at `cddis.gsfc.nasa.gov` and replaces an area known as `cddisa`. The latter may no longer be used for any VLBI data access or submission, uploading or downloading.

Other *uv*-related matters

SETJY was changed to allow the user to use `APARM(3)` times the formal Baars et al. fluxes. The allows for user corrections for resolution in case the user is not using one of the source models.

BPASS was corrected to handle missing data more correctly. If the first channel in the first scan was flagged, the new gain solution methods were not initialized properly. The gains for a missing antenna are now set by the gain solution routines to 1,0 so that those solutions may be recognized later and blanked. Tests were added to stop the task sooner when no data are found.

UVFND and `BLAVG` were given the `SUBARRAY` adverb since they apply calibration and must be able to select the relevant subarray.

WIPER was changed to allow the user some control over where the `CURVALUE`-like display is put (along with the menu). The `FLAG AREA` function aborted under some user-error conditions and flagged data on button `D`, contrary to intentions. These bugs were squashed.

TVFLG and `SPFLG` were corrected to report and ignore missing data when looping over channels, Stokes, baselines, etc. in `CLIP BY FORM` and `REDO FLAGS` functions. `FLAGVER` = 0 now has the meaning of highest version like most other tasks.

UVCOP was changed to copy an extra 30 minutes of data from tables to insure that all table data relevant to the visibility data are copied.

UVCON was enhanced to read and apply elevation-dependent antenna temperatures and efficiencies and to create multi-channel output data sets. The latter may be averaged with other *AIPS* tasks to simulate bandwidth- and time-smearing effects.

CL2HF was corrected for a software error that affected Linux machines. Dave Gordon provided a number of enhancements, mostly to obtain phases from the `SN` table and to add an adverb to specify the integration time.

MBDLY was also updated by Dave Gordon. It now always passes the phases from `FRING` and can be told to pass "failed" observations as well.

PBEAM was changed to allow data observed in either row or column order. The attaching of plot files to some data set was clarified.

Imaging

IMAGR was changed to do more interpolation on TV loads for small sub-images and to make decisions for SDI loading based solely on the histogram and maximum of the current facet.

MAXIMG is the parameter that controls the largest image allowed in *AIPS*. It was changed to 32768 to allow `CONVL` to work on images between 8193 and 16384 in size. `IMAGR` will probably make such an image now, although multiple smaller facets would be faster and more correct.

CXCLN and the `CXPOLN` procedure were corrected to use the modern imaging naming conventions. The procedure was corrected to use more bullet-proof code such as is done in the `VLBAUTIL` procedures.

REGRD also updates the pointing position now.

FIXBX and `BOXES` were corrected to handle simple cases. Both handled multi-facet, complex cases well but neither knew what to do with a virtually empty initial `BOXFILE`.

Data display

Point plotting tasks were all changed to use a uniform list of point-type codes including new codes for a true plus sign and a vertical bar. Tasks affected include `LOCIT`, `MFPRT`, `PLOTR`, `SNPLT`, `CLPLT`, `VPLOT`, and all tasks which plot star files.

SNPLT was fixed to plot antenna LSTs and hour angles correctly, to offer the option of plotting ionospheric Faraday rotation, and to do simpler and more correct axis labeling. `SNPLT` now offers the choice of point types and can be instructed to connect the points with straight lines.

PLOTR was changed to allow both lines and symbols associated with each data type and to allow full dashed-line drawing.

TAPLT was changed to handle axis labeling more generally, to use degrees rather than radians with arc tangent functions, to allow general scaling and offset of the X axis, to do binned plots with self-scaling, and to plot the sum of the data in bins or the average.

DRAWBOX was changed to plot boxes from a `BOXFILE` if specified, plotting `CLBOX` otherwise.

POSSM was corrected to use km/s correctly in the printed `OUTFILE`.

Analysis

XGAUS, `XBASL` and `XPLOT` were changed to allow plotting and interaction with the TV device instead of the Tektronix emulator. The latter is still available, but is often unreliable at least under Linux. Fixed a bug in `XGAUS` that trashed the header of the first amplitude when no residual image was being written.

MCUBE was revised to allow the user to force a `SEQ.NUM.` axis even when other coordinates differ. The coordinate values on the axis that was ignored will be recorded in the history file.

IMFIT and `JMFIT` were corrected to return baseline parameters when they are fit and to do a better job displaying the baseline parameters and computing their uncertainties.

IMDIST was changed to display the RA and Dec shift parameters between the two points.

Miscellaneous

On the fly data from the former NRAO 12-m telescope are still being generated but they are now written with the Linux byte order rather than Solaris. Changed `OTFUV` and `OTFIN` to automatically recognize either byte order and to handle them correctly.

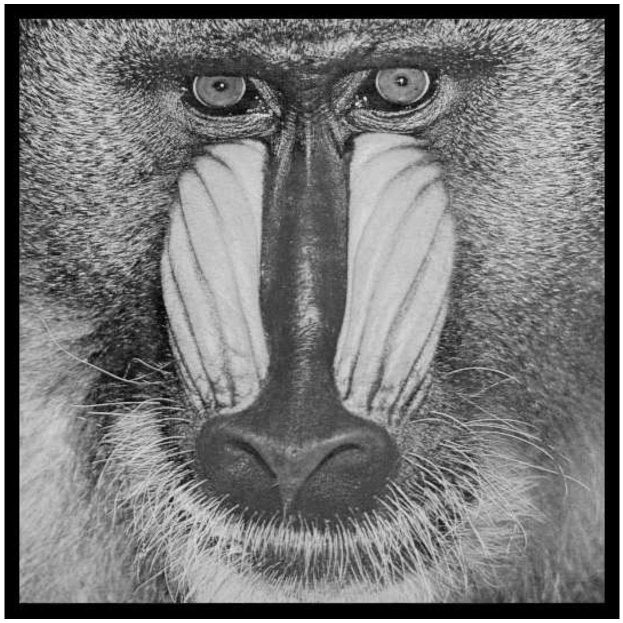
PRINT verb now displays strings only up to the last non-blank character.

EGETHEAD is a new verb that does a `GETHEAD` but sets `ERROR` when there is a missing keyword, rather than causing a procedure-stopping exception to occur. This will allow pipelines to test for the existence of keywords without failing.

TABED was corrected to use the range of line of each file being processed separately. Previously the first file set the maximum line number when that adverb was defaulted.

READLINE is provided with *AIPS*, for those sites that do not have it by more standard routes. We replaced the antique version we were sending with a much more modern version which is more likely to recognize and build on modern operating systems.

MNJ procedures were revised to handle the binary update blocking file correctly and to ignore changes in `READLINE`. Previously, binary MNJs could take place while we were in the process of updating the master areas.



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FIRST CLASS

To:

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