A I P S L E T T E R

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A newsletter for users of the NRAO
*A*stronomical *I*mage *P*rocessing *S*ystem

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.aips.nrao.edu/

General developments in *AIPS*

Current and future releases

We have formal *AIPS* releases on an annual basis. We recommend a full binary installation method for both the frozen and development versions for MacIntosh OS/X (PPC and Intel chips), Solaris, and Linux (32- and 64-bit) systems, but all architectures can do a full installation from the source files. If you develop *AIPS* code locally, you will need to do a source-level installation. The current release is called `31DEC10` and is now "frozen." If you took a development copy of this version at some earlier date, you should use the "Midnight Job" (MNJ) to bring it up to date. You need to run a MNJ only once in 2011 to convert your copy of `31DEC10` into the frozen version. When patches to `31DEC10` are announced, you may apply them with the MNJ. This *AIPSLetter* is intended to advise you of corrections and improvements in this release.

We have begun a new version, called `31DEC11`, which is now under development by the *AIPS* Group. You may fetch and install a complete copy of this version at any time. Having fetched `31DEC11`, you may update your installation whenever you want by running the MNJ. This uses cvs, rsync, and/or transaction files to copy and compile the code selectively based on the code changes and compilations we have done. We expect users to take their source-only or binary version of `31DEC11` *AIPS* over the Internet (via *anonymous* ftp). Both versions require you to copy the installation procedure `install.pl` via `ftp`; the source-only version also requires you to ftp the 108-Mbyte `31DEC11.tar.gz` compressed tar file. 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.

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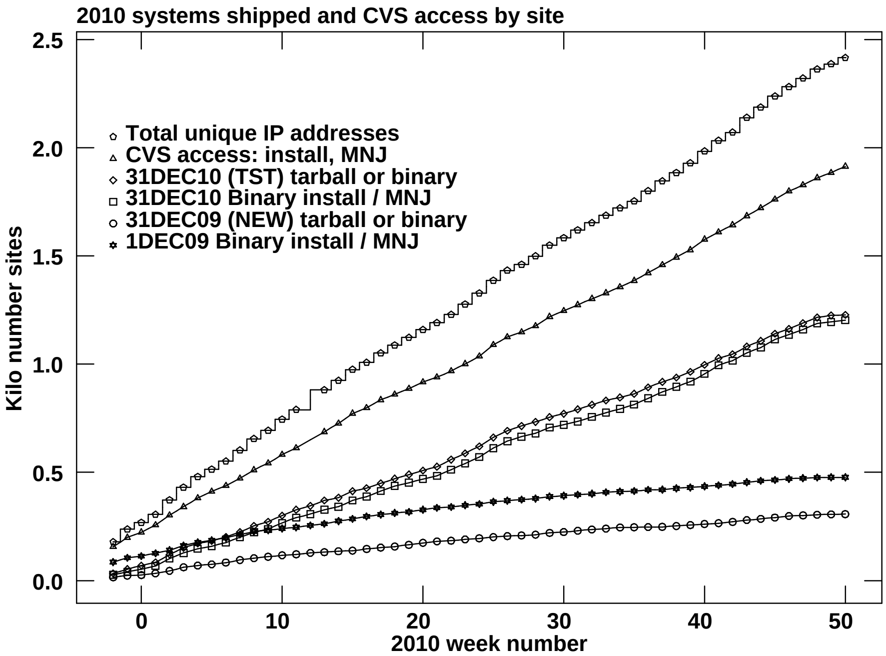
Installing a new version

If compiling locally, new releases must be installed from the tar ball for that release. If using the binary installation, a full new installation must also be done with `rsync`. The `cvs` system requires this. When installing a new *AIPS* release in a system that already has a previous release, we recommend that `install.pl` be used and that the previous release be left in place, at least until the new installation has been seen to work. If you do this, then you will not have to re-edit the disk, printer, and tape lists and can simply skip all those pages in the `install.pl` menus. The old `$HOME/.AIPSRC` file may be left in place, but it will need to be edited. The lines giving the `DOWNLOADED` and `UNPACKED` parameters should be cleared and the `CCOMOPT` line should be changed to point to the current release rather than the previous one — the `-I` parameter really should be `-I$INC` but it gets its full path name instead. This forces a re-edit with each release. If you have made special versions of `UPDCONFIG` and `do_daily.`*host*, you should preserve them under new names and restore them after the install. If you have an odd set of *AIPS* versions, the `$AIPS_ROOT/AIPSPATH.*SH` files may need to be edited after the install to set the desired versions.

For Linux, Solaris Ultra, and MacIntosh systems, a binary installation could be available from DVD, supported by `install.pl`. Alternatively, the frozen version may be installed with the binary installation method now present in `install.pl`. The ftp site for downloading files directly has been eliminated.

AIPS Distribution

From the NRAO system logs, we count apparent MNJ accesses, downloads of the tar balls, and `rsync` accesses by unique IP address. Since DSL and some university and other connections may be assigned different IP addresses at different times, this will be a bit of an over-estimate of actual sites. However, a single IP address is often used to provide *AIPS* to a number of computers, so these numbers are at the same time an under-estimate of the number of computers running current versions of *AIPS*. In 2010, a total of 307 different IP addresses downloaded the frozen form of `31DEC09` and 1228 IP addresses downloaded `31DEC10` in tarball or binary form. Fully 1914 IP addresses accessed the NRAO cvs master. Each of these has at least installed some version of *AIPS* and 535 appear to have run the MNJ at least occasionally. The total number of unique IP addresses in these three lists was 2416. 477 sites accessed `31DEC09` in binary form, while 1203 sites used the binary form of `31DEC10`. The attached figure shows the cumulative number of unique sites, cvs access sites, tar-ball/binary download sites and binary access sites known to us as a function of week in 2009. These numbers are remarkably similar to those of 2009.



Preview of coming attractions

The 31DEC11 release already contains a few changes that we decided were a bit risky or not needed in 31DEC10. CLSMO and SNSMO have normalization controls, TVFLG has a revision of the next IF option and its image placement, TYSMO applies flag tables to the TY or SY tables on input, a new task REWGT applies user-specified scaling to data weights, and a number of tasks will now select on CALCODE as well as source name.

Improvements of interest to users in 31DEC10

We expect to continue publishing the *AIPSLetter* every six months along with the annual releases. There are a few new tasks released in the last six months, but the biggest changes have taken place in existing tasks used now for EVLA calibration. New tasks include SOUSP to fit spectral indices from the fluxes in the source table, NOIFS to convert a multi-channel, multi-IF data base into one with a single IF, TRUEP to fits for true instrumental polarization using data taken with rotated feeds, and SWAPR to swap real and imaginary parts of visibility data which may be needed due to a bug in the REBYTE program. New verb TVHELIX implements Dave Green's helical coloring scheme said to make perceived brightness increase monotonically. The biggest changes in existing tasks involve implementing EVLA gain calibration from SysPower tables through TYSMO and TYAPL and spectral-channel dependent polarization calibration through PCAL and RLDIF. In the first six months of 31DEC10 the new tasks were UVRFI to apply RFI mitigation techniques rather than simple flagging, EVASN and EVAUV to examine the remains after pipeline reduction to determine how well things went, REWAY to estimate the weight of data from the rms found across spectral channels within the given polarization and IF, RSPEC to determine the spectra of the rms in a data cube, and RLDLY to determine the right-left delay difference.

Normally, bugs which are created in an *AIPS* TST version and then fixed in that same version before its release get little or no discussion in the *AIPSLetter*. Since a rather large number of sites now install the TST version of *AIPS* during its development, this is somewhat of an oversight. We urge you to run the "Midnight Job" at least once after 31DEC10 is frozen to bring it up to date and to fix all bugs of this sort. We urge active sites to use the MNJ and, when something odd occurs, to examine CHANGE.DOC using the cgi tool available from the *AIPS* web page under documentation. Please do not hesitate to e-mail daip@nrao.edu with any questions or suspicions that there are problems.

31DEC09 contains a change in the format of antenna files. Previous releases will not understand the antenna coordinates for arrays that were traditionally left-handed (VLBI primarily). The format change occurs automatically when any 31DEC09 or later antenna-file specific code reads the file, after which older releases will have difficulties. 31DEC04 through 31DEC11 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 a recent release. Other than these issues, 31DEC09 is compatible in all major ways with the with the 15OCT98 and later releases. There are significant incompatibilities with older versions. Note that the only version which we patch for major errors is 31DEC10; even 31DEC09 is no longer changed.

Analysis

While ordinary spectral index is easily defined, the need for spectral index curvature forces us into a much more rigorous definition. That is now

$$\begin{aligned} R &\equiv \log(F/10^9) \\ \log(T/T_0) &= aR + bR^2 + cR^3 + \ldots \end{aligned}$$

where log is a logarithm base 10, F is the frequency in Hz, T_0 is T at 1 GHz frequency, a is the usual spectral index, and $b, c, \ldots$ are the spectral index curvature terms. This change of definition was implemented directly in SPIXR and UVMOD and the component modeling offered by IMAGR and OOSUB. It affects the implementation of spectral index in a wide variety of other tasks to be discussed below.

Other "analysis" topics include a change to TRANS which was found to be able to get into very unfortunate disk access issues while row swapping. It will now take large amounts of dynamic memory and attempt to avoid these issues. The recording of actual Clean beam size as a function of channel begun near the start of this release cycle meant that image files have more than just Clean Component (CC) tables attached. Clean Gaussian (CG) and frequency (FQ) tables may also be present. A large number of tasks were modified to copy these tables from the input to the output, omitting the CCs in around half of the cases.

UV data

EVLA data acquisition

EVLA data are recorded using two types of formats, the ASDM or science data model which contains a variety of xml files describing the data set and the BDF or binary data format containing the visibilities. These are available from the archive but need to be translated in order to be useful in CASA or in *AIPS*. One route to *AIPS* involves first a translation into CASA measurement sets followed by a translation into *uv* FITS format which is then read by UVLOD or FITLD. A new route has become available through a software package called obit written by Bill Cotton. If you have the data in ASDM/BDF form on your computer and obit is installed, you may run a procedure outside of AIPS called BDF2AIPS which will perform the translation directly into *AIPS* files in your *AIPS* data area. This has two major advantages. It avoids several data copy/translation steps and so is significantly faster. More importantly however, it also produces several *AIPS* extension files not currently available through CASA. Index (NX), calibration (CL) including opacities and gains, flag (FG), calDevice (CD) $T_{\rm cal}$ values, and sysPower (SY) tables are among these tables. obit is currently the only route to get the SY data which will be significant in proper calibration of EVLA data. Observers not in Socorro should be able — eventually — to get *uv* FITS files from the archive produced either by the CASA or the obit route.

EVLA gain calibration

The EVLA "WIDAR" correlator is a very linear device over a wide range of input power. Therefore, the correlator will deliver cross-power spectra without internal normalization by the autocorrelation "self" powers. To determine the system temperatures and correct for changes in system gain, it is necessary to switch a noise tube on and off and to record the total power when it is on and when it is off. In the case of the EVLA, the recorded parameters are $P_{sum} = G(P_{on} + P_{off})$ and $P_{dif} = G(P_{on} - P_{off})$, where G is the gain following the synchronous detector. These data are recorded as a function of IF, polarization, and time for each antenna in the SY table written by the obit program BDFIn invoked from the script BDF2AIPS. The system temperature is given by $T_{cal} \times P_{sum}/P_{dif}$ which may be used to determine data weights and the square root of the product of P_{dif}/T_{cal} for the two antennas may be used to correct cross-power into visibilities.

The SY tables have become available in the past six months and a variety of tools have been extended to manipulate, edit, and apply them. SNPLT may be used to plot all possible combinations of the SY table parameters. EDITA may be used to edit *uv* data based on the contents of the SY table, while SNEDT may be used to edit the contents of the SY table itself. TYSMO may be used to clip, median-window filter, and smooth the SY table. The flag (FG) table is now applied to the SY table by all three of these tasks as they first read it in. Finally, TYAPL may be used to scale the data visibilities by the appropriate gains determined from the SY and CD tables and to scale the weights by the system temperatures. Due to a number of problems such as incorrect P_{dif} from a couple of antennas, this calibration has yet to become the standard. But it will soon be the best way to calibrate EVLA data.

Task REWAY is a relatively new task designed to determine data weights by examination of the rms in the data. During the last six months, it was given new methods to find the rms using medians. It was also changed to use the weights in the incoming data and attempt to determine output weights as a scale change from the incoming weights. There is some question whether this works as one would like. A header keyword (CROSSPOW) is now written by REWAY and TYAPL to allow later calibration routines to apply the gains to the weights as well as the visibilities. If CROSSPOW is not true, EVLA data weights are not changed by any gain application.

Spectral polarization calibration

AIPS has traditionally assumed that instrumental polarization was at worst a function of IF and stored the parameters of that calibration in the antenna (`AN`) table. With the very wide bandwidth of the EVLA, the polarizers cannot be as pure (so far) as they were with the VLA. Therefore, it was necessary to change `PCAL` to offer the option of making its solutions as a function of spectral channel with a smoothing option offered to improve signal to noise. This caused a lot of changes including a major bug fix: the task no longer insists on fitting a source model when using an input model. This will allow solutions from a single scan when the source polarization is known (such as 0). Source spectral index becomes significant when doing the spectral mode solution and adverbs were added to guide the task.

As `PCAL` finishes, it writes its solutions in a polarization D-term (`PD`) table and, if it has fit for a source model, the calibrator polarization (`CP`) table. Later tasks, with `DOPOL = 1`, will use the `PD` table if it is present and the antenna table D-terms if it is not. Adverb `PDVER` controls which `PD` table is used.

`RLDIF` was then revised to determine the right minus left phase difference as a function of spectral channel. It applies these corrections to the `BP`, `PD`, and `CP` tables for spectral solutions and to the `CL`, `AN`, and `SU` tables for continuum mode solutions. Note that `CLCOR` is no longer required although one may defer the `CL` correction if one wishes to be cautious and use `CLCOR` later. Although this should be sufficient, it has been found that an addition execution of `PCAL` after `RLDIF` results in better solutions. We will look for the bug causing this problem, if it is indeed a bug, but have not done so yet.

EVLA-driven changes

CALIB was changed to offer a number of gain normalization options. Previously, the average gain was found over all antennas, IFs, and polarizations. Alternatives, that normalize differently by polarization and/or IF are now offered.

SOUSP is a new task to determine spectral index parameters by fitting the fluxes after `GETJY` in the source table.

BPASS acquired more spectral-index adverbs to allow curvature as well as simple spectral index. Furthermore, it knows the correct values for the standard sources 3C48, 3C138, 3C147, and 3C286.

SETJY now has adverbs `SPECINDX` and `SPECURVE` to supplement `ZEROSP` with spectral index information.

TRUEP is a new task to determine the true instrumental polarization from data taken with the horns in their normal position and with the horns on one antenna rotated by 90 degrees. This is primarily for Rick Perley.

UVLOD and `FITLD` will now rename sources if needed to keep two sources with the same name, `QUAL`, and `CALCODE` from appearing in the output.

NOIFS is a new task that converts a multi-IF spectral data set into a single IF data set with many more channels per IF. Overlapped channels are averaged.

SPLIT and `SPLAT` got rather confused when sources in the source table had the same name and qualifier. Added testing on the `CALCODE` to insure proper separation. Also added code to watch for the output name ending up with duplicates since it can only use the first 12 characters of the source name and did not previously use the qualifier or the `CALCODE`.

VBGLU now handles `SY`, `CD`, `PD` and `CP` tables correctly; they all have IF-dependent columns.

FRING and `RLDLY` now have the option to combine IFs 1 through $N_{IF}/2$ in one solution and IFs $N_{IF}/2+1$ through N_{IF} in a second solution. The EVLA AC and BD basebands (real IFs), separate in this fashion in the *AIPS* "IFs" which are really sub-bands (spectral windows). All AC IFs should have the same delay and all BD IFs should have a different delay.

Other changes

Delay correction used a method which could result in lobe ambiguities for very large delays or bandwidths. A simpler and more accurate method has been implemented.

REAMP was changed to use a large adverb array (PBSIZE) to allow up to 64 subarrays or 64 IFs to be scaled separately under control of OPTYPE.

CLIP and FLGIT now have options to flag $\pm n$ channels surrounding an obviously offending spectral channel.

DOPOL application was corrected to include all spectral channels needed for the spectral smoothing called for by SMOOTH.

UVAVG was changed to offer a number of options to control the times of the averaging intervals and the times reported in the output.

STOKES value 'QU' was not previously supported but will now be allowed by the calibration routines and supported in POSSM.

Display

UVPRT was changed to avoid reading the data set to determine scaling parameters with control of those parameters given to the user in adverb DPARM. Self-scaling may be requested but it is slow on large data sets.

POSSM and BPLOT were changed to display spectra of instrumental or source polarization (the PD and CP tables, respectively). APARM(1) = 0 now gets vector averaging in POSSM.

SNPLT was changed to display all of the parameters of the EVLA SysPower (SY) table.

TVHELIX is a new interactive TV pseudo-coloring verb that implements a scheme due to Dave Green (MRAO). The color and intensity changes in a helical fashion intended to make perceived brightness be monotonically increasing.

FGPLT was overhauled to plot flags on an antenna rather than baseline basis when possible and to work for any number of antennas and IFs.

TVFLG and SPFLG were changed to offer the option of plotting axis labels for both visibility and intensity wedge data. TVFLG has a new option to do the next spectral channel, then next IF, and finally next polarization.

General and system matters

FITS reading tasks were made more forgiving about unexpected format details. In particular, logical variables have appeared in quotes, EQUINOX has about a dozen representations, and multi-dimensional arrays may appear outside the understood *uv*-table usage.

CookBook was updated including a new Appendix (E) specifically addressed to EVLA users.

Y2K was changed to avoid difficulties with exact agreement between the master and a test image, to examine all four HUGE Clean images, and to report all check results. The master data sets were recomputed using the Linux 64-bit Intel compiler tasks.

REBYTE was found to have forgotten about compressed *uv* data sets and so to have swapped the real and imaginary parts of each visibility. REBYTE was fixed to handle compressed data sets and new task SWAPR was written to correct affected output data sets.

AIPS startup procedures now check for a $HOME/.dadevs.always file which defines data areas to be included regardless of the current host name.

MEDIAN is a subroutine that finds the median of a list of numbers by much faster methods than a full sort of the list. It has replaced the old method wherever possible.

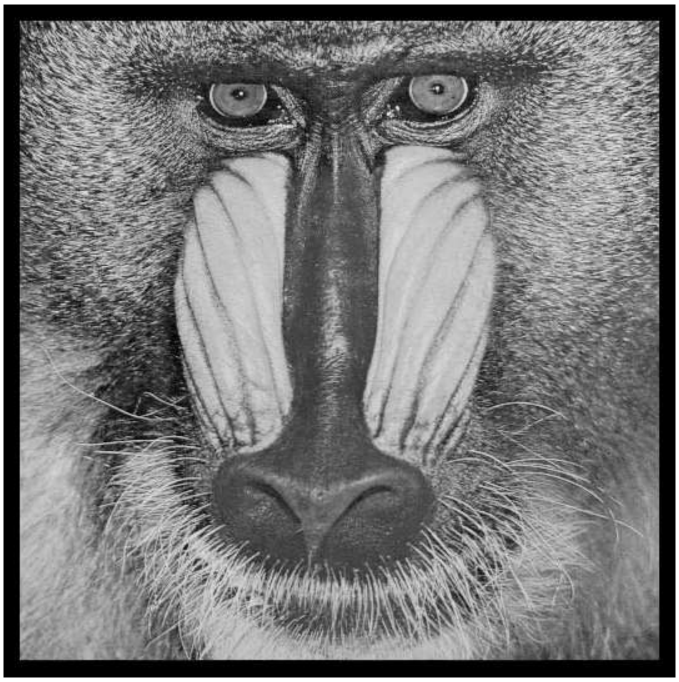
INQSTR is a subroutine to read a string input by the user. It now checks the length of the string actually input by the user against the limit imposed by the calling routine and complains when the user has typed too much.

Patch Distribution for `31DEC09`

Because of the extensive use of binary installations, we now patch the master copy of the most recently frozen version. Older versions are not corrected even for egregious errors. Thus, `31DEC09` was patched during 2010 and `31DEC10` will be patched as needed during 2011. Your copy of them may be corrected simply by running a Midnight Job. Information about patches and the code may be found using links from the main *AIPS* web page or by *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 sub-directories below this. Patches to older releases are kept here as well, but they will require local compilation.

The `31DEC09` release is no longer available for installation and will no longer receive patches even for egregious errors. It had a number of important patches during 2010. They are

1. `IMEAN` and `IMSTAT` must count pixels in double precision for large cubes. *2010-02-05*
2. `DOBAND` must not use edge channels to scale weights for EVLA. *2010-01-18*
3. `FITLD` messed up the polarization type code in the antenna file for FITS IDI files. *2010-01-25*
4. Amplitudes were corrected for delay corrections which should be done only if channel averaging is done post correlation. *2010-02-11*
5. `APCAL` read every other row of the weather table and could go off the end. *2010-02-11*
6. `CVEL` could go into an infinite loop and would not shift scans after the first for single-source files having an index (`NX`) table *2010-03-01*
7. `UVFLG` failed to flag shadowed antennas correctly *2010-03-05 and 2010-06-23*
8. `FITLD` issued alarming but harmless messages about reference date with EVN FITS-IDI data files. *2010-03-05*
9. `UVCON` did not produce correct models from images *2010-03-17*
10. `SPLIT` and `SPLAT` corrected the alternate reference pixel for `BCHAN` twice *2010-03-17*
11. `CVEL` shifted VLBA antennas wrongly, using the antenna location rather than the center of the Earth *2010-04-05*
12. `INDXR` when making a new `CL` table 1 for VLA data made mistakes likely to affect P, KA, and Q bands *2010-04-08*
13. `BPASS` aborted when trying to shift VLBA bandpasses *2010-04-21*
14. `DBCON` excited errors in the `AN` file reformatting *2010-07-09*
15. `UVCOP` and others failed to copy `BP` table records that were only partially blanked *2010-07-09*



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National Radio Astronomy Observatory
Post Office Box O
Socorro, NM 87801-0387
USA