AIPSLETTER

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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*

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General developments in *AIPS*

Reduction of VLA and ALMA data in *AIPS*

This *AIPSLetter* and those beginning in 2010 document numerous improvements to *AIPS* that enable full calibration of data from the Karl G. Jansky VLA and most imaging operations as well. The one exception is the wide-band (bandwidth synthesis) deconvolution algorithm ("MSMFS") being developed in CASA by Urvashi Rao Venkata, for which there is no comparable function in *AIPS*. Calibrated uv data may be exported from *AIPS* in "UVFITS" format for use in that program. ALMA data may also be reduced in *AIPS*, although the package is not fully qualified to calibrate data from linearly-polarized feeds. See Appendix E of the *AIPS* Cookbook, available via the *AIPS* web site, for details.

AIPSLetter publication

We have discontinued paper copies of the *AIPSLetter* other than for libraries and NRAO staff. The *AIPSLetter* will be available in PostScript and pdf forms as always from the web site listed above and will be shipped with all distributions of *AIPS*. It will be announced on the bananas and mnj list servers and, usually, in the NRAO e-News mailing.

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 *or have system managers that forbid the use of* `rsync` or `cvs`, you will need to do a source-level installation. The current release is called `31DEC14` 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 2015 to convert your copy of `31DEC14` into the frozen version. However, when patches to `31DEC14` are announced in 2015, 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 `31DEC15`, 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 `31DEC15`, you may update your installation whenever you want by running the MNJ. This uses `cvs`, `rsync`, and/or transaction files to copy all changed text files and then to copy the binary files or to 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 31DEC15 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 124-Mbyte `31DEC15.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. Use a new name for the task or put a copy of the task and its help file in a private disk area instead.

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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 used in the MNJ 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 verified. 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 `$HOME/.AIPSRC` file may be left in place, but it will need to be edited. The lines giving the `DOWNLOADED` and `UNPACKED` parameters should be cleared and the `CCOMOPT` line should be changed to point to the current release rather than the previous one. If you have made a special version of `do_daily.`*host*, you should preserve it under a new name and restore it after the install. If you have an odd set of AIPS versions, the `$AIPS_ROOT/AIPSPATH.*SH` files may need to be edited after the install to set the desired versions.

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. Note that the only version which we patch for major errors is 31DEC14; even 31DEC13 is no longer changed.

Preview of coming attractions

The 31DEC15 release already contains a few changes that we decided were a bit risky or not needed in 31DEC14. The low-level Clean-component modeling routines were changed to allow an I polarization model to be divided into the cross-hand polarization data as well as the parallel-hand data. UVSUB offers this option with OPCODE='DIV4' and the option is, so far, not available in any other task. Interactive image histogram equalization. to replace the non-functional tasks TVHXF and TVHLD (which requireD an IIS Model 70), has appeared in 31DEC15 using the TVHLD name.

Improvements of interest to users in 31DEC14

We expect to continue publishing the *AIPSLetter* every six months along with the annual releases. There are a few new tasks and verbs released in the last six months. New task ACSCL allows VLBI amplitude adjustment after bandpass calibration and TVSAD allows interaction with the model fitting done by the "search and destroy" task SAD. New verb IMFITSET provides similar TV interaction to prepare the adverbs for the IMFIT and JMFIT Gaussian-fitting tasks. New verb GETDATE returns a date string in one of several user-selected formats. A new data-reduction pipeline procedure called VLBARUN, located in a RUN file of the same name, was also released by Amy Mioduszewski.

In the first six months of 31DEC14 the new tasks were BPWAY to determine spectral channel-dependent uv data weights, DBAPP to append multiple uv data sets at once, CENTR to change the frequency reference pixel to the center of the spectrum, HUINT to adjust hue-intensity images interactively and then save the result as image files, and MODSP to compute model images of spectral lines. A set of RUN files, under the general name TDEPEND, was created to assist with imaging a time-dependent source. The cube model-fitting tasks XGAUS, RMFIT, and ZEMAN were given significant attention and a new *AIPS* Memo was written to document their usage.

Normally, bugs which appear in an *AIPS* TST version and then are 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 31DEC14 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* documentation web page (http://www.aips.nrao.edu/aipsdoc.html). Please do not hesitate to contact us via the NRAO help desk (https://help.nrao.edu) or via e-mail daip@nrao.edu with any questions or suspicions that there are problems.

UV data: VLBI

VLBARUN

The new RUN file VLBARUN contains a "pipeline" procedure which uses the VLBA calibration procedures (from VLBAUTIL) and some logic to calibrate and image VLBA data. Unlike the old VLBAPIPE, VLBARUN attempts to make intelligent decisions on defaults, so it can be run fairly automatically, if the names of the sources are known. If desired, VLBARUN will produce diagnostic plot files and write them to disk creating an HTML file to ease examination of these files. Images will be produced, but no self-cal is done, so the images should be considered diagnostic in nature. VLBARUN differs from VLBAPIPE in that all references to magnetic tape are gone, many of the input adverbs have intelligent default values, ionospheric and EPO corrections have been added, plots are generated optionally and even converted to HTLM, auto-boxing is used in IMAGR, and an e-mail may be generated informing you when the pipeline has finished.

Flux-density calibration

Several projects have reported errors in flux densities measured with the VLBA, using the latest hardware and software of the VLBA, compared to those measured with other instruments. R. Craig Walker has investigated this problem and has reported his findings in VLBA Scientific Memo #37. The reported errors are as high as 25-30 % and have not been fully understood. A number of *AIPS* tasks were modified and a new one written to assist in this investigation. Craig is now recommending a revised calibration process, doing in sequence (1) ACCOR to give unity autocorrelation, (2) PCCOR or FRING to remove residual delay offsets, (3) BPASS with power-based normalization, (4) ACSCL to re-normalize autocorrelations after applying the bandpass, and (5) APCAL to apply the T_{sys} and gains with opacity corrections and correction of unwarranted fluctuations in the T_{sys} values. We are evaluating possible changes to VLBARUN to account for these suggestions, but have made no changes as yet. The changes to *AIPS* made in this effort include

ACSCL is a new task similar to ACCOR but containing many of the calibration adverbs. It is intended to re-normalize the data by the autocorrelations in case the bandpass normalization is not quite right.

ACCOR was changed to apply the flag table to the autocorrelation data before averaging.

BPASS was given two normalization options based on the bandpass squared (power) rather than the bandpass itself (which is a voltage gain).

APCAL was revised to use more appropriate spillover corrections depending on frequency and to continue to find corrections even if the TV plotting is turned off. It was given the option to reduce the variation of the apparent T_{sys} over "IF" using the average over time of the ratio of T_{sys}(IF,t) to the average over IF of T_{sys}.

CLCOR was given the `'POGN'` option to enter gains in power rather than voltage units.

ANTAB was changed to refuse to function on multi-subarray data sets. One must run `ANTAB` before `USUBA`.

UV data: other

VLA SysPower tables

Calibration using the SysPower tables produced by the VLA received attention on several fronts. The post-detection gains are the only calibration values useful for wide-band (3-bit) observations at present. Traditionally, they have been held more or less constant during an observation, but for a variety of reasons, that is likely to change. Therefore, the clip, smooth, and flag operations of `TYSMO` were extended to the gains. Bugs in the flagging of all `SY` data were corrected. `SNEDT` can now edit the post-detection gains and `EDITA` can edit uv data using the gains.

The SysPower table may be used to estimate antenna efficiencies as a function of frequency, at least with respect to some one frequency which is thought to be "known." Then, the gains found by `CALIB` may be used to correct the T_{cal} values assumed at the telescope. To prepare for this, `TYAPL` was given the ability to read an $AIPSIONS/VLA_EFFICIENCIES file, but, in its absence, the task continues to use the efficiency estimates built into the task. `PRTSY` will be used in this effort. It was changed to give more control over what is printed, to offer a new display of scan averages (using median), to do median averages over source, to divide one source by another, and to write a new efficiencies file based on an old one plus the measured ratios between two sources.

Editing and miscellaneous

FTFLG was given numerous corrections, previously made in `SPFLG` to handle source numbers, labeling, flagged table rows, counting large data sets, and providing run-time help.

TVFLG, `SPFLG`, and `FTFLG` were given the option to flag a range of IFs. Additionally, if the data will not fit on the TV screen at the current averaging interval, these tasks now divide the data into "pieces," display one of those pieces, and offer the options to load the previous or next piece. Bugs in labeling sub-images and in handling the data when the next TV load has no valid data were also corrected.

UVFLG used too large a time increment and so could miss a data sample when flagging for shadowing or elevation.

PCAL was corrected to use a weighted average over the data paying proper attention to flagging. Full spectral-index correction capability was added including the `DOSCALE` adverb.

Linear polarization was enabled/corrected in numerous tasks, which did not handle Stokes values of -5 to -8 properly. This allows VLA P-band data to be processed simply. *AIPS* does not calibrate linear polarizations properly, but P-band is almost always unpolarized.

CAPLT and `CLPLT` were corrected to plot relatively correct error bars.

Spectral index corrections were enhanced to allow fitting for, and using, spectral curvature in `SPFLG`. `FTFLG`. `UVPLT`, `CLIP`, `UVFND`, `BPASS`, `CPASS`, and `BLCHN`.

UVHOL was given print control adverbs to avoid the cost of determining print scaling by reading the data set.

Analysis: spatial gaussian fitting

When Gaussian-fitting tasks JMFIT, IMFIT, and SAD attempt to deconvolve the Clean beam from the fit beam, they first do the deconvolution at the formal solution. Then they try the deconvolution with the 27 different combinations of solutions at plus and minus one and zero times the uncertainty in each of the width parameters. The report shows the formal deconvolution and the extrema in the deconvolved major axis, minor axis, and position angle. Values of zero in the deconvolved widths indicate that the deconvolution fails in that parameter (*i.e.*, the fit Gaussian is effectively smaller than the Clean beam). These tasks were changed to test plus or minus adverb EFACTOR times the uncertainty, with a default of 1.3. The tasks have a set of criteria on which to decide whether the object is probably unresolved, probably resolved, or somewhere in between. The factor of 1.3 was found to make those tests more reliable. See the EXPLAIN files of these tasks for a detailed breakdown of the criteria used to make this judgment. The determination of the image rms in IMFIT was corrected; previously it would fail and the (quite reasonable) initial guess was always used. MFPRT displays the contents of the model-fit table produced by these tasks. Its computation of the velocity was corrected.

JMFIT and IMFIT depend on reasonably good initial guesses for the height, position, and widths of the Gaussians to be fit. A new verb, MFITSET was written to assist in getting these right. It uses the TV to set the image name parameters, the fitting window (BLC, TRC), the number of Gaussians (NGAUSS), and the Gaussian parameters (GMAX, GPOS, GWIDTH) and can draw ellipses on a graphics plane marking your selections as you make them.

SAD attempts to make a catalog of sources in an image by finding "islands" of emission above user-selected threshold(s), guessing the Gaussian needed to fit each island, and then attempting the fit. It uses a variety of criteria on the fit to decide if it is reasonable and, if the fit appears to be good, it subtracts the Gaussian from the residual image and adds it to the catalog. Islands that fail these tests are passed unchanged into the output residual image, leaving problem areas to be dealt with later by the user. TVSAD is a new version of SAD which attempts to avoid leaving so many problem islands for later. It displays each island on the TV and allows the user to modify the initial guess before attempting the fit. It shows the result and allows the user to loop back to try again or to accept the solutions found. The interactivity can be turned off until a "failed" island is found, after which the interactivity is turned back on. *AIPS* Memo 119 discusses this task in detail, describing each TV screen and menu.

Plotting and general matters

LTYPE adverb was given more values which will allow the user a measure of control over the metric scaling of plot labels.

SNPLT was changed to use a consistent metric scaling on each page of output. It was given options PDGN and PSGN to plot Pdif and Psum divided by the post-detection gains.

VPLOT, ANBPL, CLPLT and CAPLT were corrected to remember and use the user's fixed scale for all plots. Previously, the scale expanded outward as the tasks progressed.

POSSM was corrected to plot correlation functions for all polarizations in the data, not just the first.

PRTAB was changed to make a better set of defaults for the adverbs controlling which array values are printed from each line of the table.

GETDATE is a new verb to return a date string called THEDATE in a variety of formats.

INPUTS was provided with the adverb DOPRINT so that the user may choose to avoid the page-full stopping points. This should be particularly useful in procedures that are invoked interactively.

CookBook was updated to match the changes over the last year.

Recent AIPS Memoranda

All AIPS Memoranda are available from the AIPS home page. AIPS Memo 117 describing AIPS' usage of the FITS format was modified slightly in the first part of 2014.

119 **TVSAD: interactive search and destroy**
Eric W. Greisen, NRAO
December 11, 2014
TVSAD is a new task in AIPS, which first appeared in November 2014. It is an interactive version of the automatic source finding task, SAD (or "search-and-destroy") which has been in AIPS for a long time. SAD finds a list of Gaussian components and writes a residual image with the components removed. However, any components for which the fit appears bad are left in the image. TVSAD is an attempt to allow the user to avoid these left-behind components.

Patch Distribution for 31DEC13

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, 31DEC13 was patched during 2014 and 31DEC14 will be patched as needed during 2015. 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 31DEC13 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 2014. They are

1. BPASS failed to apply a spectral index correction when SOLINT=-1 even when there was only one calibration source. *2014-01-14*
2. LISTR failed to read source information while printing "gains". *2014-01-14*
3. DOOSRO run file had a typo in its first line. *2014-01-27*
4. UVFND in averaging channels used the real part as both the real and imaginary parts. *2014-02-07*
5. DOBAND modes 2 and 4 had an initialization problem. *2014-02-09*
6. DOOSRO had a POPS language error. *2014-02-10*
7. KNTR and PCNTR had minor issues which blocked display of true-color images. *2014-02-11*
8. PCCOR did not handle blanked values from the PC table cable-cal measurements. *2014-02-11*
9. FITLD had trouble finding the correct records for MC and IM tables. *2014-03-11*
10. DSKEW did bad things when the input image had a non-zero value of rotation. *2014-03-17*
11. CLCAL failed to re-reference the SN table as requested. *2014-03-19*
12. SNP2D needed clarification of BCHAN and BIF and to write reference channel phases as well as delays. *2014-03-27*
13. TIORD had a bad format. *2014-03-31*
14. XGAUS and RMFIT called the function routine incorrectly numerous times, mostly with remarkably benign results. *2014-04-02*
15. PRTAB could abort when string data was very long. *2014-04-02*

16. LISTR did not show the correct scaling for angles in the GAIN listing. *2014-04-11*

17. TVFLG and SPFLG interpreted flagged rows in the flag command table as a serious error in a couple of places. *2014-05-29*

18. DTSUM omitted the highest numbered antenna from its matrix list if it did not have autocorrelation records. *2014-06-13*

19. CALIB in phase-only solutions could return amplitude gains other than 1.0 when 2 baselines occurred in an interval. *2014-06-27*

20. PCAL did not take data flagging into account when averaging data over time. *2014-08-08*

21. TYSMO did not apply flagging correctly except if all flags applied to all Stokes. *2014-08-21*

22. BPASS did not allocate quite enough dynamic memory causing bad messages when it closed. *2014-09-12*

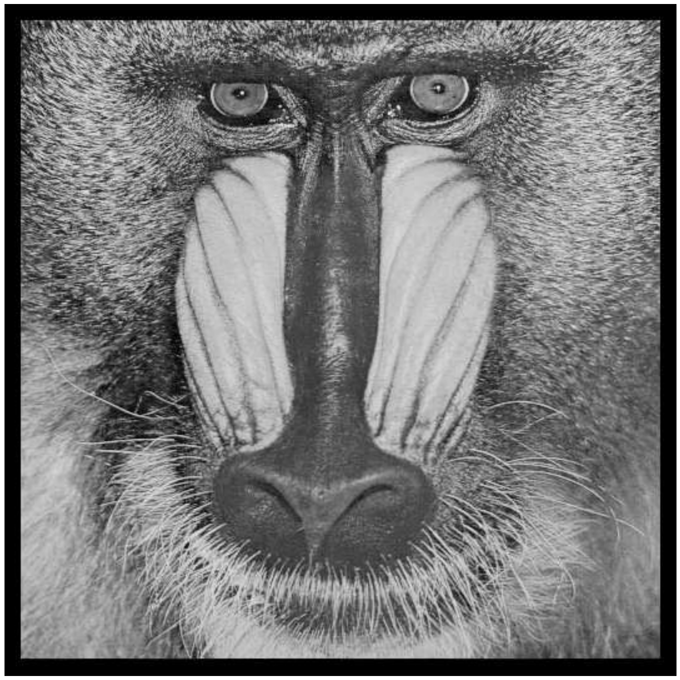
23. SPFLG, TVFLG, and FTFLG made a mess of the header in memory when trying to load a fully flagged plane making many operations other than a good TV load fail. *2014-09-12*

24. FITLD had trouble finding widely spaced records in the MC table. *2014-09-30*

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 2014, a total of 333 different IP addresses downloaded the frozen form of 31DEC13 and 1045 IP addresses downloaded 31DEC14 in tarball or binary form. Fully 1023 IP addresses accessed the NRAO cvs master. Each of these has at least installed some version of *AIPS* and 376 appear to have run the MNJ at least occasionally. The total number of unique IP addresses in these three lists was 1843. The table below shows these numbers as a function of year since we began recording them.

year	TST name	NEW name	TST	NEW	TST binary	NEW binary	cvs	Total unique
2004	31DEC04	31DEC03	808	196			797	1276
2005	31DEC05	31DEC04	832	246	299	48	982	1460
2006	31DEC06	31DEC05	806	191	402	94	1050	1398
2007	31DEC07	31DEC06	965	277	669	161	1385	1811
2008	31DEC08	31DEC07	1058	246	986	303	1667	2107
2009	31DEC09	31DEC08	1228	307	1082	478	1855	2399
2010	31DEC10	31DEC09	1228	307	1203	477	1914	2416
2011	31DEC11	31DEC10	1105	270	1064	424	1747	2228
2012	31DEC12	31DEC11	940	284	1028	396	1309	1698
2013	31DEC13	31DEC12	1014	307	990	443	1264	1937
2014	31DEC14	31DEC13	1045	333	848	431	1023	1843



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