AIPSLETTER

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A newsletter for users of the NRAO
Astronomical Image Processing System

Written by a cast of *AIPS*

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General developments in *AIPS*

Reduction of EVLA and ALMA data in *AIPS*

This *AIPSLetter* and those beginning in 2010 documents numerous improvements to *AIPS* that enable full calibration of Jansky VLA data 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 `31DEC13` 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 2013 to convert your copy of `31DEC13` into the frozen version. However, when patches to `31DEC13` 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 `31DEC14`, 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 `31DEC14`, 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 `31DEC14` *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 115-Mbyte `31DEC14.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 `31DEC13`; even `31DEC12` is no longer changed.

Preview of coming attractions

The `31DEC14` release already contains a few changes that we decided were a bit risky or not needed in `31DEC13`. `APCAL` will now loop over subarray. The format of the `TGET/TPUT` file was changed to incorporate the names, sizes, and types of the adverbs present in the file. Subsequent `TGET`s will change the values of these adverbs and report any differences between the `TGET` file and the current `INPUTS` file. This will prevent adverb values from being messed up by a `TGET` when there are new adverbs in the `INPUTS` file. `RLDLY` has the option to average solutions over all possible reference antennas rather than depending on just one. A new appendix to the *CookBook* has been completed. It is a simplified guide to EVLA P-band data reduction in *AIPS*. The EVLA and VLBA data reduction pipeline procedures have been brought up to date. After some more testing, they will be released in `31DEC14`. `BLSUM` will soon have the ability to make real plot files in addition to, or instead of, its printer plots.

Improvements of interest to users in 31DEC13

We expect to continue publishing the *AIPSLetter* every six months along with the annual releases. There are several new tasks released in the last six months. New tasks in the last six months include BPWGT to use the bandpass table to estimate channel-dependent weights, HA2TI to convert data sets with hour angle as the "time" into true times, SNP2D to convert a single-channel phase calibration into a delay suitable for wide bandwidths, ALVAR to estimate the Allen variance of visibility phases, REIFS to convert a data set into multiple IFs allowing the new IFs to include data from more than one input IF, BDAPL to apply a BD table found by BLCHN to another data set, ZEMAN to fit Zeeman splitting models to image cubes with interactivity, and SPMOD to add spectral-line models to a *uv*-data set. See below for more details.

In the first six months of 31DEC13 the new tasks were RMFIT to fit polarization models to Q/U cubes interactively, DSKEW to remove coordinate skew from input (usually optical) images, FTFLG to edit *uv* data interactively in a frequency-time display with all baselines averaged, CLVLB to apply calibration to correct VLBI data for phase-stopping positions away from the pointing position, VLAMP to determine system temperature calibration for the phased VLA in VLBI observations, and PCVEL to include planetary velocities when correcting *uv* data spectra to be centered on a line at the source. The interactive Gaussian-fitting task XGAUS was overhauled to become a much more usable tool to fit large spectral cubes. The handling of more global coordinate types was expanded and brought up to more modern standards to handle images, primarily optical, now being brought into *AIPS*. A fifth name group (IN5NAME, *et al.*) was added with new verbs GET5NAME, M5CAT, U5CAT, IM5HEAD, and Q5HEADER to support it.

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 31DEC13 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 e-mail daip@nrao.edu with any questions or suspicions that there are problems.

UV data

Primary calibration source spectra

Task SETJY is provided with the best possible fluxes and spectral shapes available. These parameters are provided by Rick Perley and Bryan Butler. In 2013, SETJY was given time-dependent fluxes for 3C48, 3C138, and 3C147, low frequency fluxes from Anna Scaife and George Heald, and spectra for the stable sources 3C123, 3C196, and 3C295. SETJY was also given a new option VANT to compute the velocity of each source at its first scan, like VCAL but with respect to a specified antenna rather than the center of the Earth. Bugs affecting the velocity computation were fixed.

Tasks BPASS and CPASS need to know source spectral index in order to correct the bandpass functions to a spectral index of zero. Both tasks were given knowledge of all spectral energy distributions known to SETJY. BPASS was corrected to allow separate spectral indexes for each calibration source and to fit the fluxes in the SU table for any calibration source not in the list of known sources. BPASS was also corrected for an error in separating closely-spaced scans.

BPWGT is a new task to set the weights of data based on the values in the bandpass table. Various functions of the bandpass values are allowed.

HA2TI is a new task to convert hour angles back to legitimate times in a data set which had been through TI2HA. This allows data from multiple days to be run through STUFFR and then converted back for use by tasks that require real times (such as UVFIX, CASA).

SNP2D is a new task to convert the phase calibration found in one IF at one channel (*e.g.*, at a maser line at the phase center) into a delay suitable for application to a wide bandwidth.

SPLIT and SPLAT ran into trouble when a source was found to have no data. The error messages have been improved and history card counters reset. SPLAT copies only those flag tables with a version greater than the one being applied (when making a multi-source output file.)

UVFND now offers the NCHAV option so that tests are performed on a channel average rather than a noisier single-channel value.

LISTR can now list P_{sum} and P_{dif} from SY tables with OPTYPE 'GAIN'.

ALVAR is a new task to compute the Allen variance of complex visibilities in several ways. It prints the answers as a function of baseline and IF which may be used to evaluate the performance of the telescope.

TYAPL was changed to give "skipped" antennas (due to bad values in the SY table and the CUTOFF adverb) values equal to the average of those antennas which were not skipped. While not perfect, this will put the data weights on a similar basis.

RFLAG was given two more options to flag whole baselines in any spectral window that has fluxes exceeding the new parameters (FPARM(15) and FPARM(16)).

REIFS is a new task to divide a data set into multiple IFs. The new IFs can include data from more than one input IF which allows the task to retain IF-dependent values from the input tables.

SPFLG was given double-precision counters to avoid overflows, was changed to handle missing sources in the source table, and was fixed to label sub-images correctly. DPARM(4) = 2 is a new option to divide not only by the source flux (as a function of IF) but also to determine a spectral index and use it to determine the flux to be divided into each channel.

UVPLT was given the DOSCALE option to divide the plotted fluxes by those in the source table, including optionally a spectral index also found from the source table values. Thus the plot is of normalized flux.

CLIP was given the DOSCALE option to divide the tested fluxes by those in the source table, including optionally a spectral index also found from the source table values. Thus the clipping is based on normalized flux and so might apply to multiple sources.

BLCHN was changed to correct the answers for the calibration source spectral index. The "known" sources have spectral indexes available, unknown sources will find the spectral index from the source table, or the user may specify a spectral index (and curvature). The correction may be turned off if desired.

BDAPL is a new task to apply a BD table found by BLCHN to another data set (*i.e.*, not the one input to BLCHN.

USUBA was changed to write subarray value 0 into those tables for which the new subarray values are not readily determined. Only tables with subarray, source, time, *and* antenna columns will get the newly determined subarray numbers. All tasks should understand that subarray 0 means all subarrays.

Imaging

SUBIM was given a ZINC option to allow selecting every n^{th} plane. The option to determine the average, minimum, or maximum over the XINC $\times$ YINC $\times$ ZINC voxel was retained. Errors in the old implementation of this option were corrected.

TRANS messed things up badly when swapping rows with a row reversal. The task usually died from writing off the end of the file. The matter has been fixed.

IMAGR was corrected to compute the average included frequency correctly. Previously it assumed that the frequencies were in a monotonic and regular sequence.

TVMOVIE can be replicated in an animated gif for use in talks. Information about how to do this was added to the help file.

Analysis

Interactive analysis of spectral cubes

The previous *AIPSLetter* reported on the overhaul of `XGAUS` to make a truly useful, interactive task to fit Gaussians to spectral-line cubes. It also reported the creation of a task to fit rotation measures to cubes of Stokes Q and U. Tests of `RMFIT` show that it correctly resolves RM components which are totally blended in Faraday rotation measure synthesis methods. These tasks received considerable effort over the last six months as well. The most notable changes are to allow `XGAUS` to fit up to 8 Gaussians at every pixel, to allow both tasks cubes up to 8192 pixels on the x axis, and, optionally, to fit spectral index in `RMFIT`. Both tasks were changed to display the image step wedge more clearly (including a line drawn around the image), to handle the setting of blotch regions with more forgiveness for user error, to display and manage images larger than the TV display, to display the fit results and errors more completely, to try additional methods for finding the next initial guess, to solve for the fit even when a parameter or component is not fit, and to allow restarts on smaller regions interior to the region used initially. `RMFIT` was changed to function without a total-intensity input image, to allow the user to set the Q and U display ranges, and to record more things in the `RM` table including the rms of the fit evaluated with and without weighting. `XGAUS` was changed to drop a number of adverbs that are no longer useful in the overhauled task.

A new task, based on `XGAUS` has now been written. It is called `ZEMAN` and solves at each spectrum the equation $V(c) = AI(c) + 0.5BdI(c)/dc$ where $V(c)$ is the Stokes V cube at channel c and $I(c)$ is the total intensity spectrum. The task also offers the option of using the `XG` table produced by `XGAUS` and solving $V(c) = AI(c) + 0.5\sum[B_i dG_i(c)/dc]$, where G_i is the i'th Gaussian component. `ZEMAN` has much of the same structure as `XGAUS` and `RMFIT` although the fit is linear and not as difficult as the Gaussian and rotation measure ones. In the end, `ZEMAN` will produce images of A and B or B_i. The Gaussian model for `ZEMAN` has been found correct answers in data of poor spatial resolution (in which 2 lines overlap spatially) when compared to the same region observed earlier with good spatial resolution.

Other analysis

SPMOD is a new task that adds a model to an existing uv-data set. The model is of spectral lines of specified spatial type, position, and extent and frequency position and Gaussian width. Up to 9999 components may be specified.

SAD, `IMFIT`, and `JMFIT` were corrected to return positive error bars even when the component peak flux is negative.

SLFIT was changed to scale with the slice minimum and maximum rather than those of the image as a whole. Changed to use double precision to deal with extreme images.

FARS was corrected to use buffers large enough for the images in allowed.

General and system matters

RUN files may now contain `RUN` commands, up to a nesting level of 20. The "verb" `COMPRESS` uses `RUN` and so counts as one of the 20.

install.pl was changed to drop the dependence on certain Perl "packages" which are not always available.

Unix sockets have predictable names which are used by *AIPS* but this now fails on Mac systems. The start-up procedures were changed to skip the test on the display name on Macs. This does interfere with the option to have one computer display on multiple computers, but Macs are not usually used in that way.

Tables may have flagged rows, since this option is directly available to the user. All table routines should return flagged rows to the calling routine with a negative error code to indicate the flagging. Numerous table routines that did other things were corrected. Calling routines should deal with flagged rows appropriately (skip them usually).

Patch Distribution for 31DEC12

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, 31DEC12 was patched during 2013 and 31DEC13 will be patched as needed during 2014. 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.

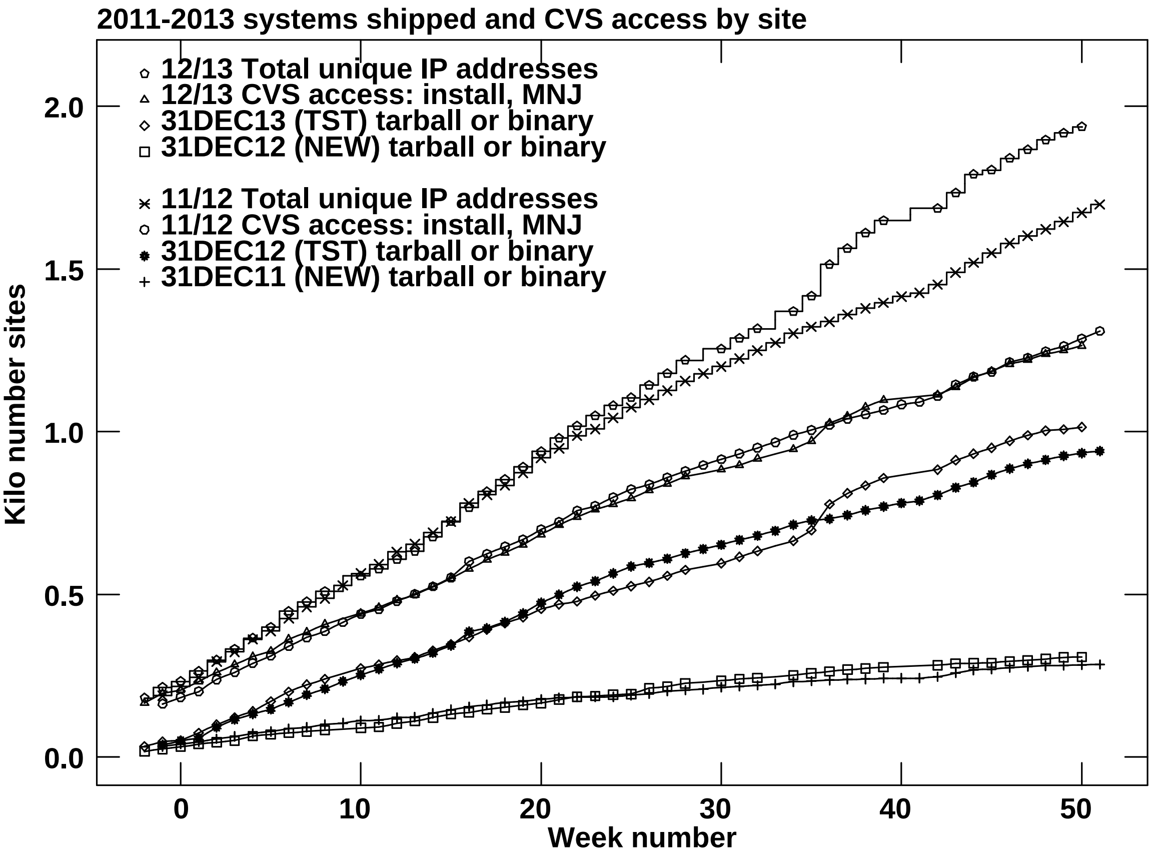
The 31DEC12 release is no longer available for installation and will no longer receive patches even for egregious errors. It had a number of important patches during 2012. They are

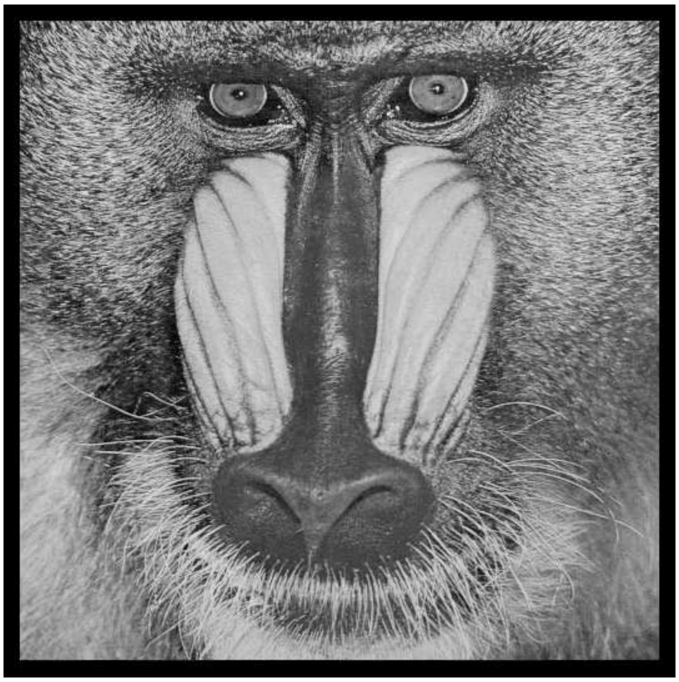
1. Bandpass calibration was not applied to enough channels to support frequency smoothing afterward. *2013-01-16*
2. Tick increments were computed with an erroneous round-off parameter leading some tick marks to be plotted at offset values. *2013-01-29*
3. POSSM had a variety of irritating bugs. *2013-02-05*
4. FITLD turned off DIGICOR corrections when the array name was not VLBA. *2013-02-05*
5. FITLD, after correction 4, failed if it could not make a CQ table. *2013-02-18*
6. CL2HF aborted because of an internal name conflict. *2013-02-19*
7. PRTAB had a format issue with large F formats (NDIG ≤ 0). *2013-03-01*
8. COMB did not do POLC correctly when using constant noise values. *2013-04-04*
9. AFARS had a header bug causing it to try to write too much. *2013-04-05*
10. FITLD could get the EQUINOX wrong in the SU table with FITS-IDI input. *2013-04-11*
11. COMB messed up scaling when combining two images with one of them not JY/BEAM. *2013-05-03*
12. FITLD had a bad warning message, causing aborts on some machines. *2013-05-21*
13. BPASS rounded times outward for each scan by too much. *2013-06-17*
14. SETJY used Perley 2010 coefficients but reported Perley 2013 coefficients. *2013-06-26*
15. IMAGR computed the actual average frequency wrongly. *2013-07-03*
16. IMFIT and JMFIT could return negative error bars when the object was negative. *2013-07-07*
17. TRANS messed up when reversing the order of an axis it was also swapping. *2013-07-17*
18. PRTAB had formatting issues with large tables with many blanked values. *2013-07-25*
19. SU table access was incorrect in some routines including widely used ones. *2013-07-29*
20. SPFLG had a gridding counter which could overflow with modern data sets. *2013-08-16*
21. PRTAB had formatting issues with required E formats in F-format modes. *2013-08-23*
22. SETJY and CVEL were affected by a bad variable in setting the Doppler velocity and the former omitted the system velocity when setting source velocities. *2013-10-21*
23. ISPEC on an image with an FQID axis could fail. *2013-10-24*

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 2013, a total of 307 different IP addresses downloaded the frozen form of `31DEC12` and 1013 IP addresses downloaded `31DEC13` in tarball or binary form. Fully 1264 IP addresses accessed the NRAO cvs master. Each of these has at least installed some version of *AIPS* and 365 appear to have run the MNJ at least occasionally. The total number of unique IP addresses in these three lists was 1937. The table below shows these numbers as a function of year since we began recording them. The attached figure shows the cumulative number of unique sites, cvs access sites, and download sites known to us as a function of week in 2013. The numbers for 2012 are also plotted and show an increase in 2013 in all numbers except those for `cvs`, perhaps due in part to a VLBI workshop which used *AIPS*.

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





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