

AIPSL E T T E R

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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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Happy 35th birthday *AIPS*

*AIPS*Letter publication

We have discontinued paper copies of the *AIPS*Letter other than for libraries and NRAO staff. The *AIPS*Letter will be available in PostScript and pdf forms as always from the web site listed above. New issues will be announced in the NRAO eNews mailing and on the bananas list server.

Current and future releases

We have formal *AIPS* releases on an annual basis. While all architectures can do a full installation from the source files, Linux (32- and 64-bit), Solaris, and MacIntosh OS/X (PPC and Intel) systems may install binary versions of recent releases. The last, frozen release is called 31DEC13 while 31DEC14 remains under active development. You may fetch and install a copy of these versions at any time using *anonymous* ftp for source-only copies and *rsync* for binary copies. This *AIPS*Letter is intended to advise you of improvements to date in 31DEC14. Having fetched 31DEC14, you may update your installation whenever you want by running the so-called "Midnight Job" (MNJ) which copies and compiles the code selectively based on the changes and compilations we have done. The MNJ will also update sites that have done a binary installation. There is a guide to the install script and an *AIPS* Manager FAQ page on the *AIPS* web site.

The MNJ 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. Use a copy of the task and its help file in a private disk area instead.

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Improvements of interest in 31DEC14

We expect to continue publishing the *AIPSLetter* approximately every six months, but the publication is now primarily electronic. There have been several significant changes in 31DEC14 in the last six months. Some of these were in the nature of bug fixes which were applied to 31DEC13 before and after it was frozen. If you are running 31DEC13, be sure that it is up to date; pay attention to the patches and run a MNJ any time a patch relevant to you appears. New tasks in 31DEC14 include 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.

Coming attractions include a completely overhauled VLB data-reduction pipeline. Amy Mioduszewski has re-written the RUN file VLBAPIPE, re-naming it VLBARUN, and is now giving it final testing.

31DEC09 contains a significant change in the format of the antenna files, which will cause older releases to do wrong things to data touched by 31DEC09 and later releases. 31DEC08 contains major changes to the display software. You are encouraged to use a relatively recent version of *AIPS*, whilst those with EVLA data to reduce should get release 31DEC13 or, preferably, the latest release.

UV-data

BPWAY is a new task to determine relative weights for spectral channels based on an RFLAG-like rms computation (over time). It can do weight spectra averaged over one scan or over one source at a time.

DBAPP is a new task to append one or more similar uv data sets. It is not as capable as DBCON but can do multiple data sets at once.

CENTR is a new task to change the frequency reference pixel to the actual center channel of each spectrum.

FQCENTER is a new adverb in numerous tasks to change the frequency reference channel to the center of each band ($N_{\text{chan}} + 1$). This requires re-scaling all (u, v, w) values and correcting values in both the FQ and SU tables.

RLDLY was changed to average over all possible reference antennas when REFANT = 0.

PCAL was corrected for an error affecting data sets with axes in non-standard order. It was changed to handle no data found situations with more grace and to make use of previous solutions an option rather than a requirement.

DOPOL applying the orientation-ellipticity mode of PCAL was made to function properly. Unfortunately, the solutions from PCAL are not as good as they should be.

BPASS was corrected to use no spectral index when multiple sources have been averaged together (SOLINT=-1 with multiple sources) but to apply a correction when only one source was averaged.

DOBAND modes 2 and 4 apply the nearest-neighbor bandpass solution to the data. The correction arrays were not initialized correctly at the beginning and after any long breaks in the data.

REWAY was corrected to handle very short scans without dying and to write out data records only when they contain some valid data.

CLIP was given new options to flag parallel-hand polarizations when cross-hand polarizations are clipped and to flag all polarizations when any one polarization is clipped.

- SPLAT** was changed to “tidy up” the calibration table as well as the source table. Otherwise, the CL table could contain sources no longer in the SU table. The output frequency, when averaging spectral windows with $BIF > 1$, was corrected. The task was also changed to defend itself from bad input values when doing spectral averaging.
- UVFND** was given the DOSCALE option to normalize the amplitudes by the fluxes in the source table, including optionally the spectral index. Channel averaging was corrected.
- CLCAL** was corrected for a bug which caused re-referencing of phases to fail and for a bug in time smoothing affecting very short scans.
- SETJY** was corrected for bugs in the velocity computations in OPTYPE = ' ' and 'SPEC' modes.
- SNP2D** was tested to calibrate wide-band phase using a single spectral line. Converting input SN table phases into both a delay and an IF-dependent phase appears to provide an excellent adjustment after the standard calibrations have been applied.
- SPECR** was given the option to use simple interpolation methods rather than the FFT method, but the FFT is still recommended in most cases.
- RLCAL** was corrected to do time averaging properly, to stop dividing Q and U models by the I polarization flux, and to pay attention to all adverbs before dividing by a model.
- TI2HA** and HA2TI were given the REFANT option to control the antenna to which the hour angle refers. Previously it was the lower numbered antenna in each pair which made for confusion in sort order.
- FITLD** was changed to save the data file when an error occurs in reading “trailing” records in the FITS file. Problems finding the desired records in the MC and IM table were also fixed.
- APCAL** was given the option of looping over all subarrays. It was changed to handle flagged table records without getting upset, to understand that subarray 0 means all, and to handle duplicate records in GC tables properly.
- PCCOR** was changed to handle magic blank values in the input tables properly.
- SNSMO** was corrected in numerous ways to handle rates properly in Hz at the correct IF frequency, rather than handling them rather casually in the basic units (sec/sec).

Display

A new task HUINT has been written. Its goal is to do the same display as the TVHUEINT verb, but then to save the image as displayed in rather arbitrary units and, optionally, to save an image of the hue-intensity step wedge as well. The results may then be plotted in tasks such as KNTR with the full flexibility allowed by LWPLA and its PostScript output. The task TVHUI attempts to write out the image with real image units, suitably scaled, and is caught up in the now obsolete need to replicate true color in a non-true color environment. The results from the new task appear more pleasing than those from this older one. Until now, if one wanted to capture a TVHUEINT display, one had to use a screen capture tool (such as import) and could not modify anything about the plot afterwards.

- BLSUM** now offers the option of weighting the spectral sums with the values of the blotch image. This should be good for recombination lines with total intensity as the blotch. The task also now offers the option of making real plot files instead of printer plots.
- SNPLT** now offers the option of plotting amplitude gains as $1/g(t)^2$ called POWR and $-20 \log(g)$ as PODB to display the antenna-based power. Several aspects of rate plotting were changed to use correct frequencies in scaling from sec/sec to mHz.
- POSSM** was given improved labeling for parallel- versus cross-hand and auto- versus cross-correlations.

- VPLOT** now allows all x -axis types when plotting amplitude and phase in the same plot.
- PRTAB** was changed to use enough digits when an exponential format had to be used in a floating-format display. It also now handles extra long character strings appropriately.
- LISTR** was corrected to use **FACTOR** properly in phase, elevation, and parallactic angle displays. Additional information on **FACTOR** was added to the help file — it can be confusing. Some display overflows were previously not shown as such.
- CURVALUE** was given adverbs to control which graphics plane is used for its display and which memory plane is used for the image data to be displayed.
- Slice** labeling was corrected for a variety of issues including special code for when the slice is along an axis and code to encourage the use of the full display area.
- Coordinate** labeling was adjusted to be more flexible in dealing with the new, all-sky types of coordinates.

Imaging

IMAGR was given several new options. If **OBOXFILE** is set simply to an environment variable, *e.g.*, **MYAREA:**, then an output box file named in a unique way will be written to that directory. Adverb **LTYPE** specifies the type of labeling to be added to any image display on the TV. These displays can also plot “stars” which are specified by up to 100 **S** cards in the **BOXFILE**. More important, perhaps, was the addition of the concept of “UNClean” boxes, namely rectangular or circular areas within which no Clean components are allowed (at least in the facet for which the UNClean box has been specified). This concept has been used profitably in the **OBIT** package to add special facets with bright sources carefully centered upon a pixel. Users may use the concept this way, but its introduction to *AIPS* was required for the time-dependent imaging procedures described next. UNClean boxes are supported interactively in the image display if at least one was specified in the input **BOXFILE**.

A general help file and a **RUN** file, both called **TDEPEND**, have been written to suggest a sequence to image a source which varies during the course of a synthesis observation. In general, the assumption is that one has a variable source (*i.e.*, a star) in the midst of a larger field containing other sources which do not vary. Each time interval is imaged with a number of facets including a special facet just for the star and an UNClean box around the star in any other facet in which it occurs. **UVSUB** is then used to remove the star from the uv data of the time interval and all intervals of star-free data are concatenated. The combined data are then used to image the full field including self-cal and editing as needed. The process may then be iterated to make better images of the star in each interval, a uv file more free of the star, and then further imaging of the full field. Eventually, the final calibration and flag tables may be applied to the star-only data in intervals and time-dependent images made. **TDEPEND** has not been used “in anger” as yet, so your editor is very interested in any experiences you may have with this.

Image analysis

XGAUS, RMFIT, ZEMAN, modeling

The analysis of image cubes in polarization, spectral line, and Zeeman splitting received considerable attention in the last six months. There is a new *AIPS* Memo number 118 to describe the use of the presently available tasks. The abstract for this Memo appears later in this *AIPS Letter*. A new image modeling task **MODSP** was written. It can add models to existing image cubes (**I** and **V** or **RR** and **LL**) or create new ones. Each model object is a spectral line with specified frequency and spatial structure and separate **RR** and **LL** fluxes.

The three cube fitting tasks received several improvements in common. All three will now display, in the “edit” phase, small images expanded by pixel replication. This means that **TVZOOM**, which affects the menus as well as the image, is far less necessary. All three tasks now offer the option of using TV menus in the fitting stages, rather than communicating extensively in the terminal window. All three also use the adverb

RMSLIMIT to specify when a fit has failed, changing the task from automatic fitting back into interactive modes.

XGAUS and RMFIT now indicate a component which is not to be fit by an X off the left side of the spectrum plot. They both are prepared to fit larger menus and titles when there are a large number of components and/or the character size is increased (via CHARMULT). They both offer a DO FIT menu option after the user has entered a guess by the HAND option, treating the user's guess not as the answer but just an initial guess to be refined if possible. XGAUS even allows the user to specify that certain parameters are to be held fixed during the fit that immediately follows the HAND entry.

XGAUS was corrected to require that the *average* of three consecutive spectral points be above the cutoff for fitting. This is what is expected by ZEMAN and it is important that both tasks do the same thing. XGAUS was given another scheme to make its initial guesses which turns out to be successful in many cases. It also had bugs preventing the writing out of the residual image. The plot of the initial guess in ZEMAN was changed to be at the data points, rather than on a fine and regular grid. The latter made the plot look like a step function for no good reason.

RMFIT was changed to fit for a rotation measure "thickness" using any one of three models for the thickness (slab, Gaussian, exponential). Such thickness accounts for much of the loss of polarization brightness at low frequencies. MODIM was changed to be able to model such thicknesses.

Other analysis changes

FARS did not do the convolution by the restoring function properly, making the answers from Cleaning incorrect. This was fixed while simplifying the code for legibility and performance.

IMFIT, **JMFIT**, and **MAXFIT** again had trouble with negatives. The tasks ran into problems fitting baselines in regions less than zero and failed to report all the values they found. MAXFIT was given the adverb DOINVERS to allow it to fit a maximum or a minimum and was corrected to do these in regions of negative brightness.

DSKEW had a bug affecting the correction of images with any apparent rotation, especially those with a large rotation angle.

AIPS Memo 117 was changed to describe the meaning of the (x, y) coordinates in the Clean Components file correctly.

General

TGET file has changed format to include the adverb names and their types and lengths. This allows TGET and VGET to remark on changes in the INPUTS since the corresponding TPUT (or G0) and VPUT and to avoid messing up adverb values following the changes. The old format TGET files will still be used if the task or verb is not found in the new format file. TGINDEX will list the contents of both format files, listing only the most recent occurrence of each task.

DISKU was changed to have the DOALL adverb control the smallest size catalog entry to be listed in detail and the format of that listing was made much more useful. This enables users to find their largest data files when it becomes time to clear some disk space.

CookBook was brought up to date in April and later converted to use Palatino fonts rather than Computer Modern fonts. This *AIPSLetter* also uses these more elegant fonts. Appendix L on reducing EVLA low frequency data was contributed by Minnie Mao.

On-line help information in interactive tasks involving menus is provided by special help files, *e.g.*, HLPXGAUS. The parsing of these files was changed to allow certain string substitutions for increased clarity, namely "<n>" has the current value of n substituted.

Maximum image size was increased to 131072 to match the maximum number of spectral channels. FFTs of this size are then supported, but will be expensive. Square arrays of this size are too large for Fortran compilers by a factor of more than 32.

Patch Distribution for 31DEC13

Important bug fixes and selected improvements in 31DEC13 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 sub-directories below this. As bugs in 31DEC14 are found, they are simply corrected since 31DEC14 remains under development. Corrections and additions are made with a midnight job rather than with manual patches. Since we now have many binary installations, the patch system has changed. We now actually patch the master version of 31DEC13, which means that a MNJ run on 31DEC13 after the patch will fetch the corrected code and/or binaries rather than failing. Also, installations of 31DEC13 after the patch date will contain the corrected code.

The 31DEC13 release has had a number of important patches:

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. DOOSR0 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. DOOSR0 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 tables when 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. *2014-02-31*
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 were 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 only 2 baselines occurred in an interval. *2014-06-27*

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.

118 Modeling Spectral Cubes in AIPS

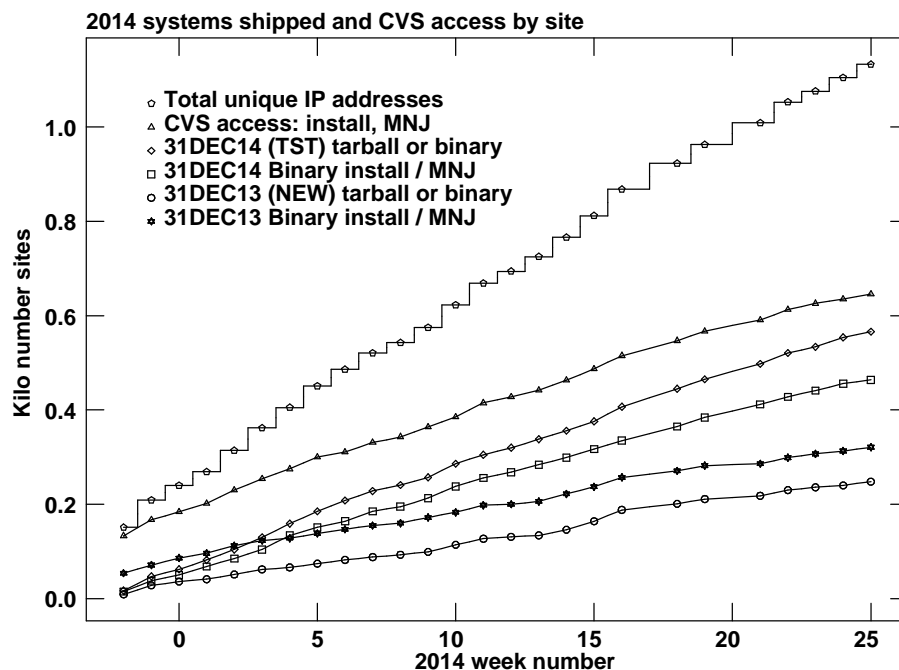
Eric W. Greisen, NRAO

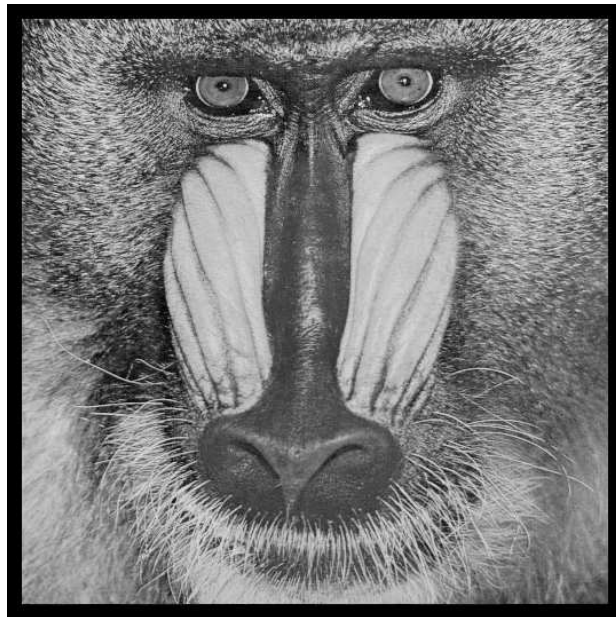
June 19, 2014

AIPS has done Gaussian fitting along the x -axis of image cubes with task XGAUS since the 1980s. That task has recently been overhauled to be much easier to use and much more capable. In like fashion, new tasks ZEMAN and RMFIT have been developed. The former fits the standard leakage and scaling terms for Stokes V cubes, including a new option to do this for each of the Gaussians found by XGAUS. The latter fits polarization models to Stokes Q and U cubes, using the output of Faraday Rotation Measure Synthesis (AIPS task FARS) to assist with initial guesses. The models can contain multiple components each with a polarization flux, angle, rotation measure, and rotation measure "thickness." The present memo will describe the functions of these tasks in some detail with numerous graphical examples. This memo also discusses a number of tasks which make visibility and image model files.

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 some systems assign the same computer 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. In 2014, there have been a total of 646 IP addresses so far that have accessed the NRAO cvs master. Each of these has at least installed AIPS and 257 appear to have run the MNJ on 31DEC14 at least occasionally. During 2014 more than 248 IP addresses have downloaded the frozen form of 31DEC13, while more than 566 IP addresses have downloaded 31DEC14. The binary version was accessed for installation or MNJs by 321 sites in 31DEC13 and 464 sites in 31DEC14. A total of 1105 different IP addresses have appeared in one of our transaction log files. Some of these numbers are a bit higher than those of 2013 at a comparable date, while the cvs number is curiously low.

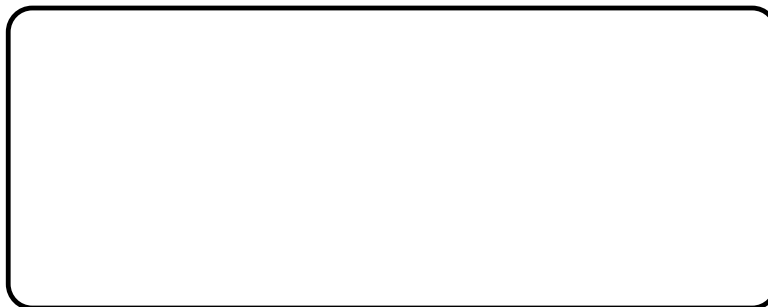




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General developments in *AIPS*

Reduction of VLA and ALMA data in *AIPS*

This *AIPS*Letter 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.

*AIPS*Letter publication

We have discontinued paper copies of the *AIPS*Letter other than for libraries and NRAO staff. The *AIPS*Letter 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 *AIPS*Letter 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 `TVHFX` 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 *AIPS Letter* 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 BPPWAY 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 AIPS Letter. 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 HTML, 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 $T_{\text{sys}}(\text{IF}, t)$ 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. PRYSY 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 `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

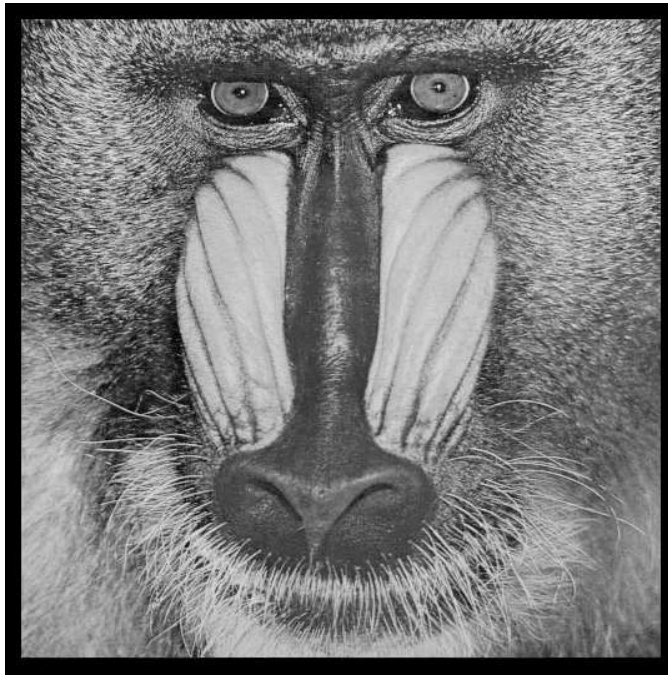
1. BPASS failed to apply a spectral index correction when SOLINT=-1 even when there was only one calibration source. 2014-01-14
2. LISTR failed to read source information while printing "gains". 2014-01-14
3. DOOSRO run file had a typo in its first line. 2014-01-27
4. UVFND in averaging channels used 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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