

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 38th 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 and mnj 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 31DEC16 while 31DEC17 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 31DEC17. Having fetched 31DEC17, 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 for binary versions of *AIPS* now uses solely the tool *rsync* as does the initial installation. For locally compiled (“text”) installations, the Unix tool *cvs* running with *anonymous* ftp is used for the MNJ. Linux sites will almost certainly have *cvs* installed; but other sites may have to install it from the web. 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 31DEC17

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 31DEC17 in the last six months. Some of these were in the nature of bug fixes which were applied to 31DEC16 before and after it was frozen. If you are running 31DEC16, 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 31DEC17 include ELFIT to fit polynomials to selected data from tables, SYSOL to calibrate Solar data sets using the SysPower table, DFTIM to make an image of visibility data at a celestial coordinate as a function of time and frequency, AGAUS to fit Gaussian to absorption-line image cubes, ZAMAN to fit Zeeman splitting models to absorption line image cubes, and MODAB to prepare models for the Gaussian fitting tasks. The calibration of polarization, especially of linearly-polarized feeds, is now being addressed.

31DEC14 contains a change to the “standard” random parameters in *uv* data and adds columns to the SN table. Note, however, that the random parameters written to FITS files have not been changed. Older releases of *AIPS* cannot handle the new *internal uv* format and might be confused by the SN table as well. 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. You are encouraged to use a relatively recent version of *AIPS*, whilst those with recent VLA data to reduce should get release 31DEC16 or, preferably, the latest release.

Analysis

The noise in both emission and absorption spectra is approximately constant with frequency. This makes the fitting of emission Gaussians straightforward. However, in absorption, the parameter which is likely to be a sum of Gaussians is the optical depth. The noise in optical depth depends very much on the value of the optical depth and so is a function of frequency. New tasks have been written to fit optical depth Gaussians to absorption spectra in brightness rather than optical depth. The mathematics is just different enough that new tasks are justified. The Gaussian-fitting task AGAUS allows the interactive fitting of optical-depth Gaussians in much the same way as XGAUS is used for emission spectra. The data are displayed in absorption, but when the user provides an initial guess of the Gaussians, the display is briefly converted into optical depth. When all desired pixels of the input image cube have been fit, AGAUS enters an interactive image mode allowing for the fits to be corrected or improved.

Similarly, a new Zeeman splitting task was written to handle the mathematics of absorption spectra. ZAMAN, like ZEMAN, can fit multiple Gaussian components found by AGAUS, or it can do traditional means of fitting the V polarization cube for a Zeeman splitting plus a gain times the I polarization cube. Like the other tasks in this set, the user may edit the results in an imaging stage. Like ZEMAN, however, the fitting is actually linear, so it is normally not possible to make much improvement on the results.

To test these new tasks, another new task called MODAB was written. It can create I and V polarizations cubes in either emission or absorption with rather simple inputs. Tests of the Gaussian-fitting tasks with such model cubes revealed a small, but systematic bias in the answers returned by XGAUS and company. The bias is caused by fitting a Zeeman-widened spectral line rather than the line in the absence of magnetic fields. AIPS Memo 122 was written to describe the new tasks and to illustrate the nature of this small bias.

The new tasks required small changes to the format of XG and ZE tables and minor changes to XGAUS and ZEMAN. The latter now uses the fit baseline in plotting the XGAUS models. The drawing of polygons was altered to function correctly with pixel-replicated (blown-up) images. XG2PL was revised to enable plots of models from all 4 tasks including optical depth spectra as well as the model-fit plus data spectra.

DFTIM is a new task to produce a “waterfall” image from *uv* data of the intensity at a celestial coordinate as a function of frequency and time. It is an extension of the plot task DFTPL and can do averaging in frequency and time.

TVSPC was changed to offer the option of displaying an additional image cube with the frequency plane selected from the spectral display.

UVIMG was changed to allow empty output cells to be zero rather than magic blanks and to use the Hermitian property at all appropriate times. Spectral averaging was changed to allow the averaging of IFs as well as spectral channels.

EVAUV was given all of the data calibration and selection adverbs as well as `CELLSIZE` and `SPECINDX` which are needed when `SMODEL` is used. The DFT modeling code was changed to enable spectral index.

UVMOD was changed to clarify the use of spectral index which is now entirely based on the header frequency.

Holography tasks were changed to pass along and display useful parameters at every stage of the process. The x axis in `HOLOG` was reversed to make the display be from the front of the telescope. Everything was confirmed by experiments with, and then correction, of the surface of one of the VLA antennas.

UV-data

Solar observations

The VLA is (finally) getting around to commissioning Solar observations following the upgrade. Such observations require the insertion of pads to reduce the signal levels by 20 db and the use of correspondingly stronger noise diodes to measure the system gain. The on-line system has been modified to write a `CalDevice` table containing both normal `Tcal` values and Solar `Tcals`. The `OBIT` program used by `BDF2AIPS` was modified by Bill Cotton (distribution level 567) to read all `Tcals`, writing them into a new format of `CD` table containing two more columns for `SOLCAL1` and `SOLCAL2`. This version of `OBIT` also writes a new column in the `SY` (`SysPower`) table called `CAL TYPE` to say whether the Solar or regular `Tcals` apply to the values in that row.

AIPS was revised on June 15, 2017 to read the new table formats, supplying suitable default values if the new columns are not present. Then all tasks that use the `SY` table were modified to use the new `Tcal` array and calibration type. These tasks include `EDITA`, `LISTR`, `TYAPL`, `TYCOP`, `TYSMO`, `SNPLT`, and several others. Finally, a new task `SYSOL` was written. For non-Solar data, it is simply a version of `TYAPL`. But not all antennas have Solar `Tcals` at all frequencies. So like the old VLA task `SOLCL`, `SYSOL` determines the average gain and weight factors at each time for those antennas that have Solar `Tcals` and applies the average to those antennas that do not. The presence of the `CAL TYPE` parameter saves `SYSOL` and all the other tasks from the old problem of telling a Solar visibility from a non-Solar one.

New flux scale

Rick Perley and Brian Butler have released a new calibration scale for all standard calibration sources and quite a number of other sources as well. The new scale was introduced into *AIPS* on March 31, 2017. The new scale is thought to be valid from 50 MHz to 50 GHz for the standard sources while some of the other sources have a more restricted frequency range. `SETJY` implements this new scale by default and will compare it to the previous default scale (Scaife-Heald for low frequencies, Perley-Butler 2013 for ≥ 1 GHz). The standard sources are 3C48, 3C123, 3C138, 3C147, 3C196, 3C286, and 3C295. Extra sources which will be computed, but which may not be good calibrator sources are (one name each) J0444-2809, PictorA, 3C144 (Taurus A, Crab Nebula), 3C218 (Hydra A), 3C274 (Virgo A), 3C348 (Hercules A), 3C353, 3C380, 3C405 (Cygnus A), 3C444, 3C461 (Cassiopeia A). The 3C name is the only one used in `SETJY` for those extra sources with a 3C name — the parenthetical remarks are here for clarity only. Most of the sources in the extra list have limits on the frequency range over which the function is valid, `SETJY` will tell you if the frequencies are out of range.

Values for the standard calibrators were also changed in `BPASS`, `CPASS`, `BLCHN`, and `PCAL` where corrections for spectral index may be made. Other tasks which make spectral index corrections depend on the values being set in the `SU` table by `SETJY`. These tasks include `CLIP`, `UVFND`, `FTFLG`, `SPFLG`, and `UVPLT`.

- PCLOD** was changed to handle multiple concatenated files with multiple sets of header cards and to round out the scan boundaries to avoid just missing samples.
- PCFIT** was changed to allow time averaging under control of SOLINT. This should allow even more accurate solutions for delay and phase.
- DBCON** was corrected for a bad error; it re-scaled the *uvw* values by the ratio of the header frequencies of the two data sets. The *uvw* values are correct for the two frequencies and should not be altered except for shifts in the reference pixel. The handling of the two antenna files was improved in case the second data set had an antenna not in the first.
- VBGLU** was changed to write out all versions of input tables which it finds. Previously, it would only write one version. Of course, it is up to the user to make sure that such gluing is meaningful.
- SOUSP** was changed to use REFREQ to select the reference frequency for the spectral fit and displays.
- REWAY** now prints out statistical information to assist in finding reasonable ranges of weights and to locate odd baselines, IFs, and/or Stokes.
- ELFIT** is a new task to fit polynomials to table data as a function of elevation, zenith angle, hour angle, parallactic angle, and azimuth.
- CLCAL** was changed to refuse to re-reference SN tables initially written by RLDLY. That task is designed to write the same delay and phase into every left-hand polarization; re-referencing changes that delay and phase to zero.
- FITLD** was changed so that ANTNAME is not entirely ignored when concatenating outputs and to have the special value VLITE produce the list V0 to V27. The number parser was changed to die on bad values only for structurally significant keywords.

Imaging

There are users who wish to do calibration in *AIPS* who have source models (with or without spectral index) in the form of large images. The task IM2CC was written some time ago to break the model image into suitable facets with Clean Component files containing all pixels above some specified level. Procedures called OOFRING and IMFRING were written as part of the OOCAL RUN file. The latter executes IM2CC, followed by OOFRING, and finally followed by a clean-up step. OOFRING uses OOSUB to divide the calibrator data by the model including spectral index and then to run FRING on the divided data set, finally copying the resulting SN table to the input *uv* file.

- IMAGR** was revised to offer an inverse taper option in which data at the center of the *uv* plane are down-weighted. This may be of some use with arrays that are heavily concentrated toward their center. The loading of images to the TV display was changed to use the full range of image intensities only whenever the displayed facet changes.
- SPIXR** was changed to use REFREQ to select the reference frequency for the output brightness and curvature images.
- SETFC** was changed to work either with or without an output BOXFILE.
- SUBIM** was given the additional OPCODE = 'SUM' used when writing only every XINC'th and YINC'th pixel to write the sum of the image pixels in each XINC by YINC area.
- CCRES** was corrected to honor blanked pixels properly.
- SQASH** was corrected to handle non-zero values of BLC and TRC.

Display

UVPLT was changed to prepare the plot in array in memory before loading it to the TV display or plot file. For large data sets, in which many input visibilities are displayed at the same plot pixel, this is a great improvement in performance. The labeling is done the old-fashioned way which means that the user can still edit the output of LWPLA fairly easily. The plot can still be done the old way entirely under control of BPARM(10). The binning option was changed to use double precision to avoid loss of accuracy.

PCNTR was given the option DOFRAC to control whether the polarization lines are proportional to the total or fractional polarization.

IRING was changed to allow logarithmic scales on the y axis and to allow up to 10240 rings.

POSSM was corrected to allow correlation functions to be labeled in seconds.

General

The *CookBook* was updated to include the new VLA Solar calibration, the new and updated Gaussian-fitting tasks, DFTIM, changes to REWAY, PCNTR, and RMSD, the new image option in TVSPC, and the new calibration source flux scale. Task NANS was altered to search for NaNs (Not-a-Number bad values) in image files as well as *uv* files. *AIPS*' start-up scripts and low-level disk access routines were changed to allow up to 71 disks while running *AIPS* rather than "just" 35.

Recent *AIPS* Memoranda

All *AIPS* Memoranda are available from the *AIPS* home page. *AIPS* Memo 120 describing the new *AIPS* task TVSPC was revised. *AIPS* Memo 118, "Modeling Spectral Cubes in *AIPS*", received minor revisions in February and new *AIPS* Memo 122 describing AGAUS and ZAMAN appeared. *AIPS* Memo 117, "*AIPS* FITS File Format," was revised in June to describe the changed formats of the CalDevice (CD) and SysPower (SY) tables.

120 revised **Exploring Image Cubes in *AIPS***

Eric W. Greisen, NRAO

December 27, 2016

AIPS has recently acquired powerful tasks to fit models to the spectral axis of image cubes. These tasks are easier to run if the user is already familiar with the general structure of the data cube. A new task TVSPC has been written to assist in acquiring this familiarity. This task provides an exploration tool within the *AIPS* environment, rather than requiring users to export their cubes to one or more of the many excellent visualization tools now available. In the 31DEC17 version an additional data cube may be displayed one plane at a time.

122 revised **Modeling Absorption-line Cubes in *AIPS***

Eric W. Greisen, NRAO

March 7, 2017

AIPS does Gaussian fitting of spectral lines with recently-overhauled task XGAUS and can fit V polarization image cubes for Zeeman-splitting with the relatively new task ZEMAN. Both of these tasks are designed for emission spectra in which the noise is not a function of spectral channel. In absorption, however, the noise in optical depth becomes high when the optical depth is high. Therefore, new tasks AGAUS and ZAMAN have been written to provide similar functions but with mathematics suitable for absorption lines. This memo describes the new tasks in some detail and includes a description of a new, simplified modeling task MODAB which may also be useful. That task has shown that the results of these four tasks are biased by the presence of the Zeeman splitting and need modest correction if they are meant to describe the actual pre-splitting line widths and magnetic field.

Patch Distribution for 31DEC16

Important bug fixes and selected improvements in 31DEC16 can be downloaded via the MNJ or from 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 31DEC17 are found, they are simply corrected since 31DEC17 remains under development. Corrections and additions are made with a midnight job rather than with manual patches. Because of the many binary installations, we now actually patch the master version of 31DEC16, meaning that a MNJ run on 31DEC16 after the patch will fetch the corrected code and/or binaries rather than failing. Also, installations of 31DEC16 after the patch date will contain the corrected code. The 31DEC16 release has had a number of important patches:

1. POSSM would not label correlation functions in seconds. 2017-01-04
2. ATLOD would not open disk files properly. 2017-01-06
3. CCRES did not honor blanked pixels. 2017-01-12
4. DFTPL did not use the correct frequencies when $BIF > 1$. 2017-01-31
5. DBCON scaled uvw wrongly when combining data sets of different frequencies. 2017-02-24
6. DFTPL did not address data correctly when the input had more than one Stokes. 2017-02-28
7. BPASS did not normalize linear polarization bandpasses correctly for normalization type 1. 2017-03-08
8. Automatic spectral index finding from the SU table had problems when one or more IFs had no flux value. 2017-03-21
9. UVMOD did not handle frequencies correctly with spectral index. 2017-03-21
10. SPIXR did not label the output images with the frequency for which they were determined (1 GHz). 2017-03-31
11. PCAL miscomputed the flux at 1 GHz for known sources at low frequency. 2017-06-06
12. SQASH mishandled non-default values of BLC and TRC. 2017-06-21
13. UVLSF copied tables twice to the output continuum data set. 2017-06-30

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 2017, there have been a total of 375 IP addresses so far that have accessed the NRAO cvs master. Each of these has at least installed *AIPS*. During 2017 more than 265 IP addresses have downloaded the frozen form of 31DEC16, while more than 433 IP addresses have downloaded 31DEC17. The binary version was accessed for installation or MNJs by 258 sites in 31DEC16 and 377 sites in 31DEC17. A total of 768 different IP addresses have appeared in one of our transaction log files. These numbers are lower than last year, which was lower than the year before.

From the archives

Banana daiquiri

1. Combine in an electric blender: 2 ounce **light rum**, 0.5 ounce **banana liqueur**, 0.5 ounce **lime juice**, 1/2 small **banana** peeled and coarsely chopped, and 1/2 cup crushed **ice**.
2. Blend at high speed until smooth.
3. Pour into large saucer champagne (or similar) glass. Serves one.

Banana storage

Bananas ripen after harvesting. They do it best at room temperature. Because of this there are three stages to banana storage.

1. **On the counter:** When you buy a bunch of bananas that are not exactly at the ripeness you want, you can keep them at room temperature until they are just right for you. Be sure to keep them out of any plastic bags or containers.
2. **In the refrigerator:** If there are any bananas left, and they are at the ripeness you like, you can put them in the refrigerator. The peel will get dusty brown and speckled, but the fruit inside will stay clear and fresh and at that stage of ripeness for 3 to 6 days.
3. **In the freezer:** If you want to keep your bananas even longer, you can freeze them. Mash the bananas with a little lemon juice, put them in an air tight freezer container and freeze. Once they're defrosted, you'll go bananas baking bread, muffins and a world of other banana yummys. Or, you can freeze a whole banana on a Popsicle stick. When it is frozen, dip it in chocolate sauce, maybe even roll it in nuts, then wrap it in aluminum foil and put it back in the freezer. Talk about a scrumptious snack.

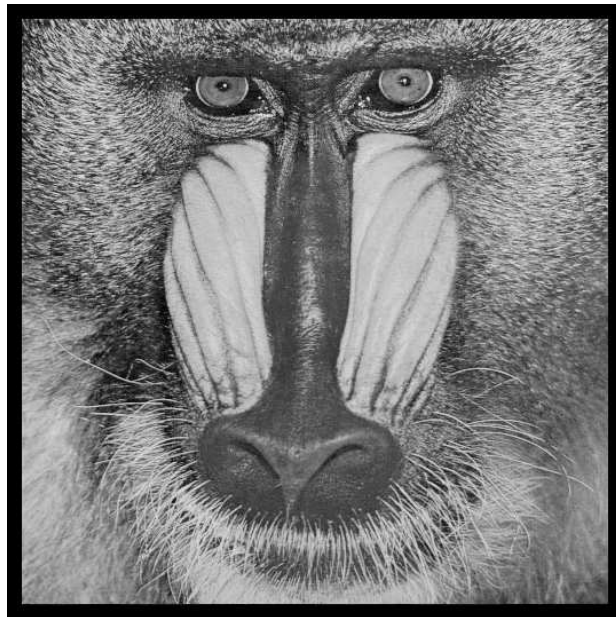
Banana-chocolate tea bread

1. Cream 1/2 cup softened **butter**, gradually add 1 cup **sugar**, beating until light and fluffy. Add 2 **eggs**, one at a time, beating well after each addition.
2. Combine 1 1/2 cups all-purpose **flour**, 2 tablespoons **cocoa**, 1 teaspoon **baking soda**, 1 teaspoon **salt**, and 1/2 teaspoon cinnamon; sift together.
3. Stir flour mixture into egg mixture, blending well.
4. Add 1 teaspoon **vanilla extract**; stir in 1 cup mashed **banana**, 1/2 cup **sour cream**, 1/2 cup chopped **walnuts**, and 1/3 cup miniature **semi-sweet chocolate chips**.
5. Spoon batter into two greased and floured 7-1/2 x 3 x 2-inch loaf pans. Bake at 350° F for 55 minutes or until a wooden pick inserted in center comes out clean. Cool in pans 10 minutes, remove from pans and cool completely on a wire rack.

Thanks to Tim D. Culey, Baton Rouge, La. (tsculey@bigfoot.com).

Golden mousse

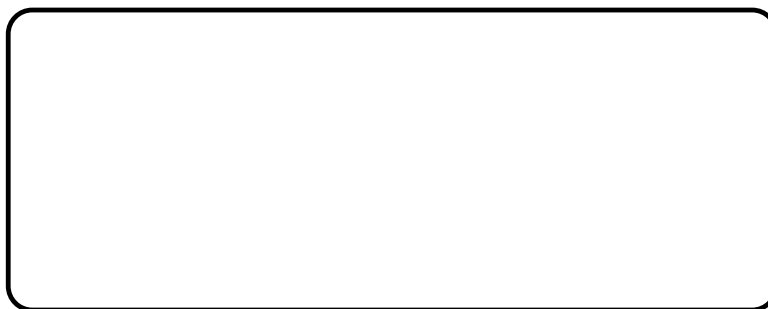
1. Combine 1 cup mashed ripe **bananas**, 2 tablespoons **orange juice**, 1/4 cup shredded **coconut**, 3 tablespoons **brown sugar**, a few grains **salt**, and 1/8 teaspoon grated **orange rind**.
2. Whip until stiff 1 cup **heavy cream**.
3. Fold whipped cream into fruit mixture and turn into freezing tray. Freeze rapidly without stirring until firm.



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General developments in *AIPS*

Reduction of VLB, VLA and ALMA data in *AIPS*

AIPS continues to be the main software system for the reduction of VLBI data from the VLBA and other telescopes. Since 2010, there have been 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 (Intel chips only), and Linux (32- and 64-bit) systems, but all architectures can do a full installation from the source files. There are also binary versions available for 31DEC17 for Solaris and Mac PPC chip architectures. 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 31DEC17 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 2018 to convert your copy of 31DEC17 into the frozen version. However, when patches to 31DEC17 are announced in 2018, 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 31DEC18, 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 31DEC18, 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 31DEC18 *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 135-Mbyte 31DEC18.tar.gz compressed tar file. Binary installations use only *rsync*, while locally compiled versions also use *cvs*. 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. 31DEC15 and later versions contain improvements to the code which should make local compilation more reliable. If using the binary installation, a full new installation must also be done with *rsync*. 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. The file `$SYSLOCAL/UPDCONFIG` also needs to be edited to correct your e-mail address(es).

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. 31DEC15 contains a change in the headers of *uv* data sets which will not be understood by previous versions. Note that the only version which we will patch for major errors is 31DEC17; even 31DEC16 will no longer be changed.

Improvements of interest to users in 31DEC17

In the latter half of 2017, new tasks appeared including *FGSPW* to flag whole spectral windows on a scan, baseline, and polarization basis when the scalar average amplitudes are excessive. New tasks for handling large pulse-cal tables include *PCAVG* to average pulse-cal tables over time, *PCRMS* to flag a pulse-cal table automatically based on various statistics, and *PCHIS* to plot histograms generated by *PCRMS*. The calibration of linearly-polarized feeds has been partially addressed although there is much room for improvement. New tasks in the first half of 2017 include *ELFIT* to fit polynomials to selected data from tables, *SYSOL* to calibrate Solar data sets using the *SysPower* table, *DFTIM* to make an image of visibility data at a celestial coordinate as a function of time and frequency, *AGAUS* to fit Gaussians to absorption-line image cubes, *ZAMAN* to fit Zeeman splitting models to absorption line image cubes, and *MODAB* to prepare models for the Gaussian fitting tasks.

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 31DEC17 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.

VLBI matters

Pulse-cal tables

The DiFX correlator is now capable of providing pulse-cal tones at every MHz. These complex data are written into text files archived in full at the correlator site and may be written in the FITS-IDI output files. Since these data have very high signal-to-noise ratio, they should be used wherever possible to assist with calibration. During the past 6 months, PCLOD was changed to get the start date from the data once rather than from the pulse-cal input and to offer the option of keeping or ignoring data outside of *uv*-data scans. PCFLG was changed to handle large input tables, to manage the sort order carefully to avoid excessive sorting, to handle only times in the specified time range, and to display times including day number correctly even when there are no values in the current display. PCAVG is a new task to average pulse-cal tables over time. PCFIT was given a new option to suppress excessive jumps in delay and the sign of the value written to the SN table was switched. PCPLT was changed to honor XYRATIO and ANTENNAS and to do horizontal axis labeling for any number of panels. PCRMS is a new task intended to auto-edit pulse-cal tables. This task looks for individual channels that stick out too much from their neighbors and for times where spectral windows deviate excessively from the average and rms of that spectral window, polarization, and antenna. PCRMS does a surprisingly good job, but, if you want to examine the data, PCRMS has the option of writing a text file containing the IF-average amplitude and its rms for every time in the table. The new task PCHIS can read this file and plot histograms and statistics. The format of the file is rather general, so PCHIS may well have other uses. The SN table written by PCFIT has been shown to correct many, but not all, delay jumps found in real data sets.

Miscellaneous

VLBAUTIL was changed to update the URL for the EOP file.

VLBARUN was changed to avoid some BLEW TEMP C failures.

ANTAB occasioned a change to allow 2560-character input lines in *AIPS*' version of KEYIN and a more extensive explanation of allowed input formats.

APCAL was given very much larger buffers to handle data sets with numerous spectral windows.

KRING was changed to write zeros rather than magic blanks for multi-band delay and dispersion when a polarization is flagged. The calibration routines flagged all polarizations on the magic blanks.

USUBA was changed to allow more sources and entries up to the limits imposed by compilers.

UV data: Miscellaneous

Low-level routines in the calibration package were changed to allow correct conversion of linear polarization data into full Stokes. This requires more widespread maintenance of the current parallactic angle. PCAL still cannot handle a linear-polarization model but works well on unpolarized calibrators at P-band. The correction for the X-Y phase difference is not available at this time, so full calibration of linear polarization still does not work in *AIPS*.

FGSPW is a new task designed to find and flag spectral windows that have been over-run by RFI. It does a scalar-amplitude average of all spectral channels in each scan and, for those baselines, polarizations, and spectral windows that exceed a user-set cutoff, flags the data in that scan. It is a fast way to start the editing of RFI-riddled data, before using SPFLG or RFLAG.

SY table format changed and required some tasks to handle the tables differently and TYAPL to change its internal version of the SY-table flagging routine.

Antenna file opening and reformatting required changes to avoid leaving open files on errors, to specify enough keywords for data sets with 30 or more spectral windows, and to handle CASA's decision to honor only a portion of the new format.

WIPER was corrected to position displays properly on zoomed images.

TVFLG and similar tasks were corrected to handle time labels correctly including day number and to switch to fully blanked displays when no data are found for the selected image. Label information became incorrect when the old, valid data remained on the display. They were also changed to support STOKES = 'IQU' and 'IQUV'.

UVMOD was changed to allow comment lines and negative flux components in the input text file.

UVHOL was corrected to handle unwanted data at the end of a print group and to allow a choice of whether the parallactic angle correction is applied or not on DOPOL > 0.

HOLOG was changed to allow the option to compute the images from user-supplied parameters rather than the data and to simulate the effect of reference pointing. It was changed to allow the specification of the frequency used to control the sampling and to request real and imaginary images rather than amplitude and phase.

Analysis: Miscellaneous

RMFIT was corrected to handle blotch drawing on pixel-replicated images when switching solutions between components and the units of the Q0 and U0 output images were corrected. The option to display total polarization and polarization angle instead of Q and U was added. Fitting is done in Q and U always. The initial guess algorithm was substantially improved.

FARS was changed to write the one-dimensional RMTF (RM beam) as slice files, one each for real, imaginary, amplitude, and phase.

FQUBE was changed to use the FQ planes in the current image and not to complain about FQ values in the table which are not present in the image. This allows SUBIM to be used on an FQ axis with the result being fed back into FQUBE.

TVSPC acquired the options to label the images and to do a CURVALUE display for any of the up to four displayed images and plots.

Imaging and Display: Miscellaneous

IMAGR added OVRSWTCH, FGAUSS, and IMAGRPRM(11) to the supported TELL adverbs. Multi-scale Clean requires OVERLAP ≥ 2 , so the code was changed to force this.

RSPEC was changed to use BLC and TRC in the normal way with DOINVER controlling whether the statistics are done inside or outside the window.

WETHR was corrected to use the correct table-file format and to decide whether the TIME column is double precision correctly. An option to connect the plotted points was added.

PCNTR was changed to allow, with a warning, the drawing of polarization vectors on images lacking a proper celestial coordinate pair of axes.

General

Major difficulties arose over the last year or so with the LNX64 binary version of *AIPS*. Beginning with Fedora 25, tasks started to produce NaNs (“not-a-number”) in seemingly random but repeatable places in the output. IMAGR was particularly affected, but other tasks were as well. Gradually other operating systems, more modern than those used at NRAO, began to see the same problem. Thinking that the very old version of the Intel compiler which we were using might be at fault, we installed the latest Intel compiler (version 18.0.0, dated 20170811). All continued to work well on NRAO computers, but the new version failed on those computers on which the old version had failed. The new failures occurred at even earlier points than the NaNs. Therefore, the binary version of *AIPS* for LNX64 is now computed with gfortran and gcc version 6.3. This seems to work more or less everywhere. During the test on the latest Intel compiler, *AIPS* code was corrected for “over-stated” EQUIVALENCE statements and incorrect *Ew.d* format codes.

ABORTASK was given the NUMTELL adverb to allow aborting tasks running under other POPS numbers.

WAITTASK was given the NUMTELL adverb to allow waiting on tasks running under other POPS numbers.

RUN was corrected to avoid using magic text-file logical unit numbers so that verbs executed under nested RUNs would have normal access to those LUNs.

CookBook was updated for changes noted above.

Recent *AIPS* Memoranda

All *AIPS* Memoranda are available from the *AIPS* home page. *AIPS* Memo 117 was modified to describe the added columns in the SY and CD tables for Solar data. Memo 120 was modified for new options in TVSPC. Memo 118 was modified for new options in RMFIT. *AIPS* Memo 123 was written to describe the usage of the new, large pulse-cal tables in VLBI.

117 *AIPS* FITS File Format

Eric W. Greisen, NRAO

June 19, 2017 (revised)

AIPS has been writing images and *uv* data in FITS-format files for a very long time. While these files have been used widely in the community, there is a perception that a detailed document is still required. This memo is an attempt to meet that perception. *AIPS* FITS files for *uv* are conventions layered upon the standard FITS format to assist in the interchange of data recorded by interferometric telescopes, particularly by radio telescopes such as the EVLA and VLBA.

118 Modeling Spectral Cubes in *AIPS*

Eric W. Greisen, NRAO

November 20, 2017 (revised)

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. A revision of this memo discusses changes made for the 31DEC15 release and two new tasks to plot spectra with model fits and a number of tasks which make visibility and image model files. The November 2017 revision includes new display options in RMFIT.

120 Exploring Image Cubes in *AIPS*

Eric W. Greisen, NRAO

July 22, 2017 (revised)

AIPS has recently acquired powerful tasks to fit models to the spectral axis of image cubes. These tasks are easier to run if the user is already familiar with the general structure of the data cube. A new task TVSPC has been written to assist in acquiring this familiarity. This task provides an exploration tool within the *AIPS* environment, rather than requiring users to export their cubes to one or more of the many excellent visualization tools now available. In the 31DEC17 version an additional data cube may be displayed one plane at a time.

123 New Pulse-cal Capabilities for VLBI in *AIPS*

Eric W. Greisen, NRAO

October 30, 2017

The DiFX correlator has acquired the capability of measuring and recording large numbers of pulse-cal tones, typically at intervals of 1 MHz through each spectral window. These pulse-cal tones have very high signal-to-noise, but show a roll-off at the edges of each spectral window and usually have one or more single channels which have amplitude and residual phase differing significantly from the average for the spectral window. *AIPS* has acquired the ability to deal with these data including new tasks to display and edit them and to derive calibration from them.

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 2017, a total of 408 different IP addresses downloaded the frozen form of 31DEC16 and 874 IP addresses downloaded 31DEC17 in tarball or binary form. Fully 644 IP addresses accessed the NRAO cvs master. Each of these has at least installed some version of *AIPS*, but with the change to the MNJ we are unable even to guess how many sites have run the MNJ. The total number of unique IP addresses in these three lists was 1383. The table below shows these numbers as a function of year since we began recording them. The usual plot of numbers versus time, which we omit, shows that 2016 and 2017 were very similar.

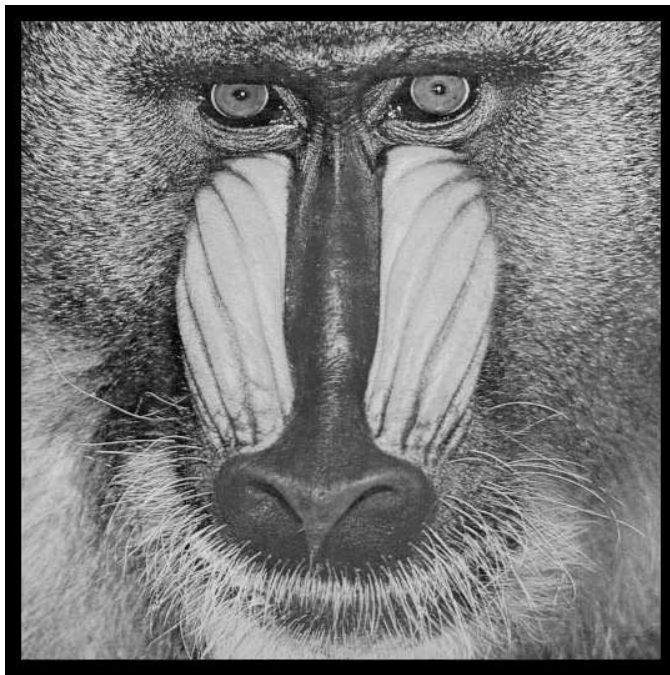
year	TST name	NEW name	TST	NEW	TST binary	NEW binary	cvs	Total unique
2004	31DEC04	31DEC03	808	196			797	1276
2005	31DEC05	31DEC04	832	246	299	48	982	1460
2006	31DEC06	31DEC05	806	191	402	94	1050	1398
2007	31DEC07	31DEC06	965	277	669	161	1385	1811
2008	31DEC08	31DEC07	1058	246	986	303	1667	2107
2009	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
2015	31DEC15	31DEC14	1104	309	1001	350	1070	1817
2016	31DEC16	31DEC15	878	222	788	372	761	1330
2017	31DEC17	31DEC16	874	408	768	386	644	1383

Patch Distribution for 31DEC16

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, 31DEC16 was patched during 2017 and 31DEC17 will be patched as needed during 2018. 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 *ATPS* 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 31DEC16 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 2017. They are

1. POSSM would not label correlation functions in seconds 2017-01-04.
2. ATLOD would not open disk files properly. 2017-01-06.
3. CCRES did not honor blanked pixels. 2017-01-12.
4. DFTPL did not use the correct frequencies when $BIF > 1$. 2017-01-31.
5. DBCON scaled uvw wrongly when combining data sets of different frequencies. 2017-02-24.
6. DFTPL did not address data correctly when the input had more than one Stokes. 2017-02-28.
7. BPASS did not normalize linear polarization bandpasses correctly for normalization type 1. 2017-03-08.
8. Automatic spectral index determination from the SU table had problems when one or more IFs had no flux value. 2017-03-21.
9. UVMOD did not handle frequencies correctly with spectral index 2017-03-21.
10. SPIXR did not label the output images with the frequency for which they were determined (1 GHz). 2017-03-31.
11. PCAL miscomputed the flux at 1 GHz for known sources at low frequency 2017-06-06.
12. SQASH mishandled BLC, TRC 2017-06-21.
13. UVLSF copied tables twice to the output continuum data set. 2017-06-30.
14. SCMAP and SCIMG messed up the self-cal step when the number of IFs was not the same as the number of polarizations. 2017-07-03.
15. PCAL left a file open when an IF had no data in spectral mode, causing failure on the next IF. 2017-07-11.



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