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

Written by a cast of *AIPS*

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Happy 38th birthday *AIPS*

AIPSLetter publication

We have discontinued paper copies of the *AIPSLetter* other than for libraries and NRAO staff. The *AIPSLetter* will be available in PostScript and pdf forms as always from the web site listed above. 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 *AIPSLetter* 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.

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 likley 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 DOFRACT 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 yummies. 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.

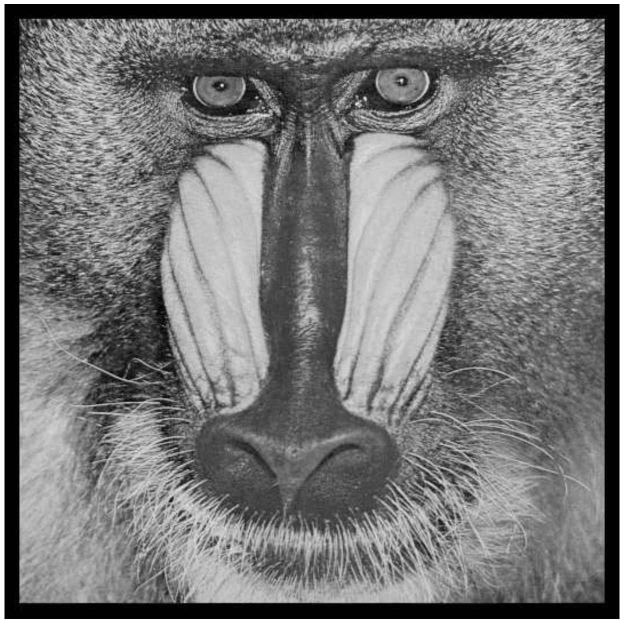
Banana-chocolate tea bread

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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