

A I P S L E T T E R

Volume XXXII, Number 1: June 30, 2012

A newsletter for users of the NRAO
Astronomical Image Processing System

Written by a cast of *AIPS*

Edited by

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General developments in *AIPS*

Reduction of EVLA and ALMA data in *AIPS*

This *AIPS Letter* and those from 2010 and 2011 contain numerous improvements to *AIPS* that enable full calibration of EVLA data and most imaging operations as well. The one exception is the wide-band (bandwidth synthesis) deconvolution algorithm (“MSMFS”) being developed in *CASA* by Urvashi Rao Venkata, for which there is no comparable function in *AIPS*. Calibrated *uv* data may be ported 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. It will be announced in the NRAO e-News 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 31DEC11 while 31DEC12 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 31DEC12. Having fetched 31DEC12, 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 31DEC12

We expect to continue publishing the *AIPS Letter* approximately every six months along with the annual releases. Henceforth, this publication will be primarily electronic. There have been several significant changes in 31DEC12 in the last six months. Some of these were in the nature of bug fixes which were applied to 31DEC11 before and after it was frozen. If you are running 31DEC11, be sure that it is up to date to sometime this year (a MNJ after March 8 would be best). New tasks in 31DEC12 include MORIF to break up a data set into a greater number of spectral windows, SNREF to determine which reference antenna would minimize the right minus left phase difference, PRTSY to print statistics of the values in SysPower (SY) tables from the EVLA, FIXAN to correct errors or change the array center in antenna tables, SPCOR to correct an image cube for spectral index and/or primary beam, FIXRL to fix data for mislabeled polarizations in some antennas, and TARS to check the Faraday Rotation Synthesis algorithm (task FARS) with simple user input data. New verbs include NAMEGET to fill in the file naming adverbs completely to aid in writing procedures and IM2HEAD, IM3HEAD, IM4HEAD, IMOHEAD, Q2HEADER, Q3HEADER, Q4HEADER, and QOHEADER to display headers selected by the second, third, and fourth input and the output name adverbs, respectively. New RUN files include OOCAL to enable full self-calibration with the spectral-index and other options of the OOSUB task and LINIMAGE to build a FLATNed spectral cube while separating spectral windows to improve performance in the IMAGR portion.

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. Older versions may use the 31DEC08 display (XAS), but 31DEC08 code may not use older versions of XAS. Magnetic tape logical unit numbers changed with 31DEC04. You are encouraged to use a relatively recent version of *AIPS*, whilst those with EVLA data to reduce should get the latest release.

Mountain lion

Apple has again announced a new revision of OS X, this time called Mountain Lion (10.8). The VAO in Socorro has made a Mac laptop available to us for testing. It was found to install and run the existing MACINT load modules. Several \$SYSUNIX procedures required minor modification since the new version of ps issues a warning message when it is used by a process with a library path set. On lion last year we tried using the latest Intel compiler (12.0.4 dated 20110503) with the x86_64 architecture. That version ran a little bit faster than the 32-bit version, but not enough faster to justify making a new MAC64 "architecture" with a new NRAO computer to support it.

UV-data calibration and handling

Editing

RFLAG has become the standard editing task to remove RFI from most data sets. It has received significant attention in the last six months. The spectral flagging mode was changed to use a sliding median window filter of user-set width. Previously it used, effectively, a full-width window applying to all channels. This caused the disappearance of options to flag full spectra because the rms was too high or too low. An option to expand any flags by \pm FPARM(6) channels replaced them. In the spectral mode, RFLAG automatically

deleted all channels not included in **ICHANSEL**. Now such channels are retained, but the default **ICHANSEL** is now all channels. A number of errors were corrected which caused the task to write many more flags than it should, effectively flagging already flagged data. Other errors had to be corrected for the mode in which **RFLAG** is run to write a new flag table and then immediately plot the consequences of that table on the data set. The problems involved pre-clip flux levels as well as file status.

Following detailed self-calibration, users often delete those data associated with “bad” amplitude and phase solutions. An option **A&P** has been added to **SNFLG** to perform this operation, removing the need for a very repetitive use of task **EDITA**. **TVFLG** and **SPFLG** were corrected to retain and use the source number correctly when flagging a single source extracted from a multi-source data set.

Calibration with models

The task **OOSUB** will subtract a model from, or divide a model into, a *uv*-data set. It has options to apply the model in a frequency-dependent fashion using a model of the primary beam and images of spectral index and curvature. It also has options to omit some of the model Clean components from the computation depending on their position within the primary beam. A new procedure has been written to use **OOSUB** to do self-calibration. The procedure divides the model into the data with **OOSUB** and then invokes **CALIB** to determine the gains. The resulting **SN** table is copied back to the input data set and the temporary, divided data set is deleted (if requested).

A number of detailed aspects of applying models in tasks like **UVSUB** and **CALIB** were also addressed in the last six months. A user may wish to apply some algorithm to the **CC** tables of some of the facets of an image, creating **CC** tables of version numbers greater than one. The software will now allow the use of the highest **CC** table version in each facet if **INVERS** = 0 or to use a specific version number, ignoring those facets lacking that version number, when **INVERS** = *n*. Previously, the software could get confused and either die or change the modeling to use the Cleaned images rather than Clean components. Neither was desirable. When using edited **CC** tables, gridded model would get stuck in the table and only use those components that preceded the first flagged component. Models can now come from small images or ones which are not a power of two on a side. The former require DFT rather than gridded modeling, but a bug kept the code from knowing about image size when it had to make that decision. The latter often perform well with gridded modeling, but the sizes of the grids had to be increased to the next power of two for correct function.

Miscellaneous *uv*-data matters

BPASS no longer supports (*i.e.*, messes up) the **BIF** and **EIF** options.

SETJY now can determine the source velocity at the first data sample and write that into the source table with **OPTYPE='VCAL'**.

VLANT now has a **DOINVERS** option to allow corrections to the **CL** and **AN** tables to be undone. While a new **CL** table produced by **VLANT** can simply be discarded, the changes to the antenna coordinates are made in place so this option is required to undo them. Errors for the EVLA in the sign of the Y correction and the zero point of hour angle were found and fixed.

FRING and **RLDLY** can now solve for delays dividing the IFs into quarters to support the new 3-bit EVLA system.

CLCOR neglected the fact that the GMRT uses the opposite phase sign convention from other telescopes. This was corrected for a number of **OPCODEs**, most importantly the one to apply corrections for changes in antenna and source positions.

FITLD had the order of the adverbs revised to clarify which of the many adverbs apply only to VLBI IDI-format data sets and which are more general.

FIXRL is a new task to rearrange data on the polarization axis when some antennas have been connected incorrectly (swapping R and L usually).

INDXR now has a frequency-dependent VLA gains file which it applies to the CL file in a frequency-dependent manner.

ELINT now displays the rms of the fit on plots. Adverbs **QUAL** and **CALCODE** were added to help separate out the desired calibration sources. Problems reading over-the-top tables and large source tables were corrected and the task was forced to ignore flagged solutions.

SNREF is a new task to examine the statistics of the right minus left phases in an **SN** table as a function of the choice of reference antenna. It should help to select the antenna having the most stable R-L and hence providing the best polarization calibration.

MORIF is new task which can divide a data set into a larger number of spectral windows (IFs) which may help deal with spectral index issues at very low frequency and may help performance in data sets with a large number of spectral channels (see **LINIMAGE** below).

PRTSY is a new task to print the extrema and statistics of the EVLA SysPower (**SY**) table as a function of antenna and IF. It should help provide parameters for use in **TYSMO** and other tasks.

FIXAN is a new and dangerous task that re-writes the coordinates of antenna tables. It has **OPTYPES** to switch between Earth-centric and site-centric systems correctly and to correct an apparent site-centric system computed by simply differencing Earth-centric coordinates. This last is wrong since site-centric systems must have the antenna (X, Y) based at the local longitude.

Imaging

AIPS imaging task **IMAGR** received only a little attention in the last six months. The biggest change was to a double-precision pseudo array processor; see below. This will result in more accurate images, especially near the corners where round-off error was magnified by the large correction for the Fourier transform of the gridding function. The uniform weighting routine was also worked on to insure that all summing variables are double precision floats or integers. Large EVLA bandwidth synthesis data sets were overflowing the counters in uniform weighting. An option was added to average spectral channels as the data are read in the on-the-fly, baseline-length dependent time averaging done in writing the work file. This will reduce the size of the work file and, in many cases, will not compromise the accuracy of the images.

When **IMAGR** is used to make a spectral-line cube, the calibration routines are started up several times per channel both for the input data which uses a flag table and for the work file which does not. These calibration start-up routines used to comment on the use of the flag table on every twentieth call. This led to confusion since it would say sometimes “using flag version n ” and other times “using no flag table.” The low level routines were changed so that flag table use is reported once after each change of the file being read unless that file is a scratch or work file for which **FLAGVER** was never set. For cubes, this means that the flag file usage is mentioned at the start of each channel. If the flag table version changes, as in **RFLAG**, then that change is also reported.

Tasks **SCMAP** and **SCIMG** loop over self-calibration and imaging (and even data editing) within a single task. They were improved by adding **BOXFILE** to define Clean boxes, **IM2PARM** to allow auto-boxing, and a parameter to allow negative components to be used in the model and restart of the Clean. Flag tables were ignored for input data which were not compressed, while they were used for compressed data. This oversight was corrected.

A new **RUN** file and procedure called **LINIMAGE** was written to help speed the creation of spectral image cubes. It loops over spectral window (IF) copying the IF to a scratch file and then invokes **IMAGR** on that rather smaller file. This is much faster than extracting each channel one at a time from the full file. After **IMAGR**, the facets are **FLATNed**. When all IFs have been imaged, the headers are examined and either **MCUBE** or **FQUBE** is run to put all the IFs back together. A data set with a very large number of spectral channels may be run through **MORIF** to prepare it for **LINIMAGE**.

Display

LISTR was changed to do system temperature and gain as determined from a SysPower table in the 'GAIN' listing. Adverb **XINC** was added to the 'LIST' and 'GAIN' listings as well as an adverb to change all times to local sidereal time rather than IAT.

POSSM was changed to read the BP table to find a list of times present in the file to allow it to use SOLINT properly when plotting BP tables.

IM2HEAD is a new verb to display the header like **IMHEAD**, but for the file pointed to by the adverbs **IN2NAME**, **IN2CLASS**, **IN2SEQ**, and **IN2DISK**. **IM3HEAD**, **IM4HEAD**, and **IMOHEAD** are the same but for the third and fourth input name and the output name adverbs.

Q2HEADER is a new verb to display the header like **QHEADER**, but for the file pointed to by the adverbs **IN2NAME**, **IN2CLASS**, **IN2SEQ**, and **IN2DISK**. **Q3HEADER**, **Q4HEADER**, and **QOHEADER** are the same but for the third and fourth input name and the output name adverbs.

Slice plots along a FQID axis can usually be plotted on a linear frequency axis by placing the plot points appropriately. **ISPEC** and **RSPEC** were changed to do this. Alternatively, the slice can be interpolated to regular frequencies as it is computed. **SLICE**, **ISPEC**, **RSPEC**, and **BLSUM** were changed to do this. The slice file format had to be changed slightly to provide the necessary information for subsequent plotting.

IMEAN was given a DOPRINT option to control printing and particularly to write a compact format listing the window, minimum, maximum, mean, rms, and flux. Using this option, looping over a plane at a time with **BLC** and **TRC**, would give a useful text file for a spectral cube.

CCNTR was changed to allow limits on the flux of plotted components, to allow plot symbols to scale with component flux, and to ignore flagged rows in the CC table rather than dying.

TV code was changed to remember if the TV has been opened or not. Previously, failing plot tasks could hang waiting for plot finishing on a TV display that was never going to respond.

Image and uv analysis

Faraday rotation synthesis

AIPS' Faraday rotation synthesis package has continued to be tested by committed users and corrected by the AIPS group. The main **FARS** task was changed to convert from real/imaginary to amplitude/phase correctly, which was a particular problem when residual images were output. The Clean code was changed to do no iterations at some pixels due to the value of **FLUX** and to output zero in those cases. An option to shift the phases to the original λ^2 set was added. The handling of **APARM(4)** was clarified and its display in the history file corrected. The **DOFARS** procedure was changed to use more appropriate default output classes.

A new task, named **TARS**, was created to test the algorithms used by **FARS**. It is nearly identical to **FARS** but takes its input data from a text file which may be prepared more easily by people wishing to test this new algorithm.

The output of **FARS** may be compromised if the input Q and U polarization cubes are affected by frequency-dependent amplitude changes due to the source spectral index and to the primary beam of the interferometer. The new task **SPCOR** was written to correct the Q and U cubes for these effects. One may use **SPIXR** on a I cube to determine images of spectral index that may be appropriate to the Q and U images. The I spectral index image output of **MSMFS** in **CASA** may also be used.

AFARS is the task which reads the **FARS** output images to find the position on the rotation measure axis of the maximum amplitude and then write images of the rotation measure and of the amplitude or phase at that position. It was corrected to account properly for **BLC**, to avoid the parabolic fit estimation when it did not have all required values due to blanking and edge effects, to use the header coordinates properly rather than guesses which could be wrong, and to output the blanking value when the input rotation measure row was all blank or zero. The help file was improved to clarify which files are required as inputs.

UV-plane model fitting

The monster task **OMFIT**, written by Ketan Desai many years ago, received some much overdue attention. The task contains some very high quality mathematical routines which implement a wide variety of source model types and a joint model-fit and self-calibration. It is a bit difficult to use, but once convergent models are found, it can be very useful. A few rather simple corrections were required to get it to work at all. The input model is read by a **KEYIN**-based routine which had to be corrected to handle parameters longer than 8 characters. The task was corrected so that it would work on single-source input files. Michael Bietenholz provided suggested code changes to add a **WEIGHTIT** parameter adjusting the data weights, to normalize phase-only self-cals correctly, to display “real” chi-squared values, and to include a spherical shell model type. Commentaries on how to use **OMFIT** were also provided by Michael for inclusion in the explain file.

The other *uv*-plane model fitting task **UVFIT** also received some attention. It was changed to allow up to 60 components in the model. All of the code in the task now supports this parametric upper limit after the last of the hard-coded 4’s were rooted out. The computation of phase now uses the proper geometric routines which are slower but very much more accurate for components well separated from the phase center. The input text file describing the model may now include a comment string which is included in the output summary text file.

Other analysis changes

COMB was corrected to adjust the units of each of the input images so that units of Jy/beam become units of Jy per the same beam. Previously two images in Jy per different beam were added, subtracted, divided, etc. producing outputs which may have had more to do with the differences in beam than in source.

DTSIM is a *uv*-data simulation task which was corrected to use right-handed antenna geometries, to use correct and current-best antenna locations for known antennas (VLBA and EVLA), to use sensible and many more user-controlled defaults, to create an NX table, and to write the data in the standard axis order. The help file was overhauled to tell the truth about things including whole areas previously omitted. A useful example replaced an overly simple one. This task may actually be useful.

SAD now uses a robust determination of the rms to inform the histogram fit of the rms, producing a much more reliable estimate of the overall uncertainty.

General

Double-precision pseudo array processor

When a four-byte integer is used to count, it will overflow after $2^{31} - 1$ or 2147483647. When a four-byte, IEEE-format real variable is used to sum 1.0’s, it will stop increasing after 16777216. With the EVLA, bandwidth synthesis easily exceeds the latter limit and can exceed the former. *AIPS*’ pseudo-array processor (“AP”) code is a software emulation of the old hardware array processors we used to own. It isolates computationally intensive operations in a modest collection of “Q” routines based on a shared data space. This structure allowed us to change the entire pseudo-AP from single-precision to double-precision real and integer for the shared data and, with some editing, to complete the change so that all variables inside the AP are extra precision. Variables received from and sent to the non-Q calling routines are normally still single-precision, although new routines **QDGET** and **QDPUT** were written to allow full-precision data transfers.

This has a number of consequences. The most important is that the number of words available in the pseudo-AP memory is halved, or the memory in bytes required is doubled if the number of words is kept constant. This required some changes in the verb **SETMAXAP**. Tests a couple of years ago suggested that performance of a double-precision AP was about 10% worse than a single-precision version, presumably due to memory cache issues as much as anything. The computed results, however, are more accurate even when double-precision was not needed to avoid overflow. Convolution functions and their Fourier transforms are computed in the AP code and so will be much more accurate in gridding *uv* data and then correcting in the image plane for that gridding.

Other general-interest changes

Lustre is a high-performance file system used at NRAO and elsewhere. Such systems do not keep information about file sizes with the files themselves and so can mis-inform *AIPS* about the file size. Low-level routines were changed to pause and try again twice before dying when it appears that a task wants to read or write beyond the end of file.

Source table format was updated to include columns for the observed (or pointing) right ascension and declination. The current RA and Dec columns are used for the phase stopping position, which may be quite different.

Frequency table format was changed to include a column for BANDCODE, an 8-character string meant to identify which receiver was used for each IF for each frequency identifier.

ZEXIT.C is a new routine to allow a non-zero exit code to be returned to the calling procedure. It is useful in stand-alone programs, especially the *AIPS* pre-processor program PP. It replaces the non-standard Fortran system routine EXIT.

NAMEGET is a new verb which may be useful in writing procedures. It uses the first image name parameters (INNAME, *et al.*) to find the image or data set that an *AIPS* task would find with those name parameters and to fill in the remaining ones so that there are no defaulted or wild-carded ones.

Patch Distribution for 31DEC11

Important bug fixes and selected improvements in 31DEC11 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 31DEC12 are found, they are simply corrected since 31DEC12 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 31DEC11, which means that a MNJ run on 31DEC11 after the patch will fetch the corrected code and/or binaries rather than failing. Also, installations of 31DEC11 after the patch date will contain the corrected code.

The 31DEC11 release has had a number of important patches:

1. Imaging code had problems with large gridded modeling. *2012-01-16*
2. UVFIT had many areas dimensioned for the old limit of 4 components, rather than the new limit of 20. *2012-01-16*
3. FARS did not shift residuals back to the original λ^2 correctly and did not add residuals into amplitude/phase outputs correctly. *2012-01-16*
4. AFARS did not handle BLC correctly, producing wrong rotation measure images. It also stated incorrect information in the history. *2012-01-16*
5. SQASH had an error in history writing that led to aborts. *2012-01-16*
6. FITAB omitted an essential keyword for compressed UV data. *2012-01-16*
7. CLCOR ignored the fact that the GMRT uses an opposite phase convention. *2012-01-16*
8. VLANT did not correct EVLA data properly. *2012-03-01*
9. SCMAP and SCIMG did not apply the flag table to the data entering the self-cal step *2012-03-07*

Recent *AIPS* and related Memoranda

All *AIPS* Memoranda are available from the *AIPS* home page. There is one new memoranda in the last six months.

117 *AIPS* FITS File Format

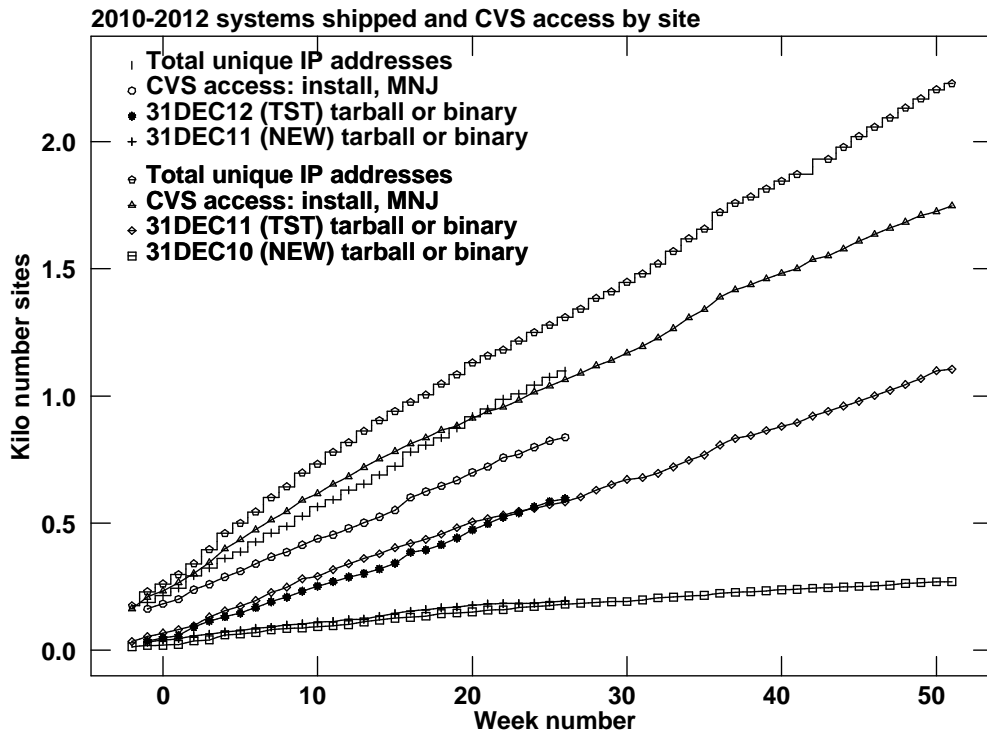
Eric W. Greisen, NRAO

June 28 2012 (latest revision)

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. An Appendix providing a serious introduction to the subject of FITS format is also provided.

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 2012, there have been a total of 837 IP addresses so far that have accessed the NRAO cvs master. Each of these has at least installed *AIPS* and 281 appear to have run the MNJ on 31DEC12 at least occasionally. During 2012 more than 194 IP addresses have downloaded the frozen form of 31DEC11, while more than 596 IP addresses have downloaded 31DEC12. The binary version was accessed for installation or MNJs by 303 sites in 31DEC11 and 600 sites in 31DEC12. All of these numbers are significantly lower than those of 2010 at a comparable date. The attached figure shows the a comparison of the numbers from all of 2011 and from 2012 for the first half of the year. From bottom to top the numbers plotted are the cumulative unique IP address to download the NEW version, to download the TST version, to access the cvs web site, and the total unique addresses. It is strange that the downloads in 2012 are if anything slightly ahead of 2011, while the cvs access and hence the total numbers in 2012 are way behind those in 2011. It makes one suspect an as yet unidentified change in the way the cvs numbers are counted.

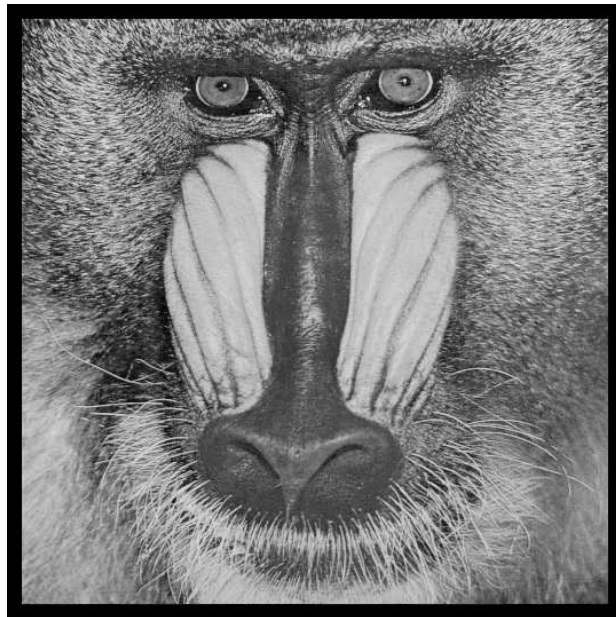


A personal note

The rumor that your editor is about to retire is not true. While I am certainly old enough, I am having too much fun and believe that I am still too useful to retire any time soon. *ATPS* will continue to be supported for the foreseeable future.

Warning

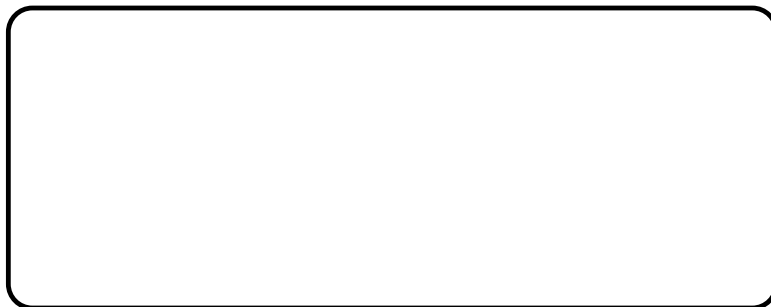
Recent *uv* FITS files written by **CASA** and containing ALMA data have had significant errors in the contents of the antenna and frequency tables and the frequency information in the main header. The antenna error will primarily affect the use of **UVFIX** to recompute projected baselines. The frequency error will certainly affect plotted spectra (reversed axis labeling) and will have a small effect on computed images. These errors are known to be in release 3.4.0; FITS files written by earlier releases should be checked closely. **CASA**'s **exportuvfits** program is now being worked upon and these issues are expected to be missing from the next release. These errors do not appear to arise with EVLA data as written, via **CASA**, from the archive.



June 30, 2012



AIPSLETTER
National Radio Astronomy Observatory
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A I P S L E T T E R

Volume XXXII, Number 2: December 31, 2012

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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*, you will need to do a source-level installation. The current release is called 31DEC12 and is now “frozen.” If you took a development copy of this version at some earlier date, you should use the “Midnight Job” (MNJ) to bring it up to date. You need to run a MNJ only once in 2013 to convert your copy of 31DEC12 into the frozen version. However, when patches to 31DEC12 are announced, 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 31DEC13, 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 31DEC13, 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 31DEC13 *AIPS* over the Internet (via *anonymous* ftp). Both versions require you to copy the installation procedure `install.pl` via `ftp`; the source-only version also requires you to ftp the 115-Mbyte 31DEC13.`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 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 31DEC12; even 31DEC11 is no longer changed.

Preview of coming attractions

The 31DEC13 release already contains a few changes that we decided were a bit risky or not needed in 31DEC12. `SNPLT` was changed to allow the plotting of multiple parameters from the same extension table (such as `Psum`, `Pdif`, and `Psys` from the `SY` table). `SETJY` was changed to avoid setting `CALCODE` and the velocity parameters on `OPTYPEs` intended for other purposes. It will soon have a complete set of spectral parameters as a function of epoch for the primary calibration sources. `RFLAG` offers the option of finding and then using separate amplitude scaling factors for each IF, baseline, and source. This will help when the RFI is so bad that the recommended pre-calibration is not feasible. `TVFLG` and `SPFLG` were changed to display the status line in the same graphics plane as the axis labeling (to enable later displays) and to offer the option of plotting the data as far to the right as possible, reducing overlap with the menu.

Improvements of interest to users in 31DEC12

We expect to continue publishing the *AIPSLetter* every six months along with the annual releases. There are a few new tasks released in the last six months. New tasks in the last six months include **BSCAN** to find the “best” scan on a calibration source to use for fringe finding and the like, **GCPLT** to plot gain versus elevation from the input text files used by **INDXR**, **CC2IM** to make images from Clean Component files, **MODIM** to construct model image cubes including polarization, spectral index, and rotation measure, **QUXTR** to extract text files from Q/U cubes for input to **TARS** (Faraday rotation measure synthesis test task), and **TARPL** to plot the output of **TARS**. New verbs include **CHARMULT** to instruct the TV display (**XAS**) to use larger character sizes, **CODECIMAL** to switch coordinates between decimal and sexagesimal forms, **GETVERS** and **QGETVERS** to return the maximum version number of a specified extension file type, and **M2CAT**, **M3CAT**, **M4CAT**, **MOCAT**, **U2CAT**, **U3CAT**, **U4CAT**, and **UOCAT** to do quick catalog listings of images or *uv* files for **IN2DISK**, **IN3DISK**, **IN4DISK**, and **OUTDISK**, respectively.

In the first six months of 31DEC12 the new tasks were **MORIF** to break up a data set into a greater number of spectral windows, **SNREF** to determine which reference antenna would minimize the right minus left phase difference, **PRTSY** to print statistics of the values in SysPower (**SY**) tables from the EVLA, **FIXAN** to correct errors or change the array center in antenna tables, **SPCOR** to correct an image cube for spectral index and/or primary beam, **FIXRL** to fix data for mislabeled polarizations in some antennas, and **TARS** to check the Faraday Rotation Synthesis algorithm (task **FARS**) with simple user input data. New verbs include **NAMEGET** to fill in the file naming adverbs completely to aid in writing procedures and **IM2HEAD**, **IM3HEAD**, **IM4HEAD**, **IMOHEAD**, **Q2HEADER**, **Q3HEADER**, **Q4HEADER**, and **QOHEADER** to display headers selected by the second, third, and fourth input and the output name adverbs, respectively. New **RUN** files include **OOCAL** to enable full self-calibration with the spectral-index and other options of the **OOSUB** task and **LINIMAGE** to build a **FLATNed** spectral cube while separating spectral windows to improve performance in the **IMAGR** portion.

Normally, bugs which are created in an *AIPS* TST version and then fixed in that same version before its release get little or no discussion in the *AIPSLetter*. Since a rather large number of sites now install the TST version of *AIPS* during its development, this is somewhat of an oversight. We urge you to run the “Midnight Job” at least once after 31DEC12 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* web page under documentation. Please do not hesitate to e-mail daip@nrao.edu with any questions or suspicions that there are problems.

UV data

FRING was given the **DOAPPLY** adverb to control whether single-source data sets would be copied, correcting for the calibration parameters found. The writing of the output files now includes automatic generation of an **NX** table. An option to break the input IFs into *N* groups (of equal size) was added, replacing the limit that *N* = 1, 2, or 4. Handling of the case *N* = 1 with multi-band delays was corrected. Adverbs **BIF** and **EIF** were added but only for the case *N* > 0 and *N* ≠ *N_{if}*.

LISTR was given the option in **DPARM(10)** to control the data scaling in **LIST**, **GAIN**, and **MATX** modes.

Flag application is now limited to no more than 60000 flags applying to a single time in most tasks and 600000 in **UVCOP** and **TYAPL**.

TYAPL was given the option to apply the post-detection gain from the **SY** table rather than the gains determined from *P_{dif}*. EVLA 3-bit data benefit from this, while the *P_{dif}* values are found to have non-linear scaling issues.

UVCOP copies tables for a time range beginning a little before that used for the *uv* data and ending a little after so that enough table values will be available for any interpolation. User control over the size of “little” was added. The copying of **PD** tables (spectral polarization calibration) was corrected.

RFLAG was changed to handle **FG** table versions more carefully to achieve the apparent user-requested pattern. Since this task uses the **flag** table to read the data multiple times, but also can write it at the same time, great care is required.

- CLCOR** was changed to re-compute the apparent coordinates before using them in source and antenna position corrections. **FITLD** was changed to re-compute the apparent coordinates in all cases, not just those in which they were very obviously wrong.
- Ka-band** models for the primary flux calibration sources were released.
- EVAUV** was changed to plot the real versus imaginary values of the data-model and data/model-1 files as logarithmic contours in 2-dimensional images. Adverbs to control these plots (size of images, range of values, smoothing) were added. The option of saving the data-model and data/model *uv* data sets was also added.
- UVFIX** was made fault tolerant when it fails to find a particular source, time, and antenna in the **CL** table or **F0** table. It used to turn off all time-dependent frequency shifts in case of error, but now reports the error and keeps trying.
- ATL0D** was corrected to handle files larger than 2 Giga-bytes.
- CLCOP** was given an **AVER** option to average values from a list of IFs and then replace the values of another list of IFs with the average. This should help deal with IFs adversely affected by RFI, line emission, and the like.
- SETJY** was corrected for errors in **OPTYPE** 'VCAL' in computing LSR and radio-convention velocities. The transfer of velocity at one pixel to that at the reference pixel in the optical convention was replaced by the more accurate, fully non-linear formula. Perley-Butler fluxes for 2013 were added for 3C286 and 3C295 (only) and the reporting of the “previous” values was improved.
- TVFLG** and **SPFLG** had addressing problems after the **MAXCHA** increase which could cause the master grid to be damaged on **CLIP INTERACTIVE**, while **LIST FLAGS** needed modernizing to report them correctly and **NEXT IF/ST** assumed 2 Stokes without checking which made for addressing problems.
- BSCAN** is a new task which checks the data in each scan of a user-specified calibrator source to see if any have all antennas and, if so, which has the most data. It returns time ranges of the recommended scans. This should be most useful in pipelines searching for fringe finder scans and the like.
- GAINS** for the EVLA antennas as functions of elevation are given in a text file determined by Perley and Butler. The file was corrected and currently only has one set of values for each band although it retains the ability to be more finely divided in frequency.
- Baseline** dependent calibration may be determined with **BLCAL** and then applied through adverb **BLVER**. The calibration routines failed to initialize its use properly which caused confusion in tasks like **IMAGR** that read different *uv* files through the calibration routines.
- Edit** class methods used in **EDITA**, **EDITR**, **SNEDT** and others were changed the make the **SWITCH ALL IF** operation have 3 possibilities: 1 IF, a range of IFs, and all IFs. The second one is new and appropriate for EVLA data in some cases.
- KEYIN** is a routine used to parse free-format inputs for tasks including **PCL0D**, **SETAN**, **USUBA**, **M3TAR**, **DTSIM**, **ANCAL**, **FETCH**, **ANTAB**, **VLBIN**, **UVFLG**, and **MK3IN**. Its handling of character strings owes more to Fortran 2 than 77 and required a variety of fixes to handle strings of varying lengths.

Imaging

Compared to some years, **IMAGR** has received only modest attention. It was changed to compute the actual average frequency found in the data used to make a bandwidth-synthesis image and to put that frequency in the header. Editing can cause this to be somewhat different from the nominal frequency. The findings of this computation are reported to the user. Errors in frequency-dependent imaging were found: the value of **FQTOL** could get lost causing the task to do way too much work and too low a value for the number of channels could get used, causing the model to be damaged. When **IMAGR** was told to include all subarrays but also given other adverb values (such as time range) that caused there to be no data in one or more of the subarrays, the task would die. It was corrected to handle the “no data” return with grace, dying only if all subarrays lack data. Subtle errors affecting multi-facet imaging with **ONEBEAM** true and cases in which baseline-dependent calibration is to be applied were also corrected.

Faraday rotation analysis

The subject of Faraday rotation measure synthesis is receiving a great deal of attention these days. *AIPS* task **FARS** performs this analysis and was corrected to subtract the contribution of the last Clean component from the residuals before they are used for output or for restoration of the components. The output file naming adverbs were simplified and the header coordinates corrected to drop the incorrect **STOKES** axis. Task **AFARS** examines the image cubes from **FARS** to extract images of the rotation measure at the peak amplitude and the amplitude and phase or real and imaginary at that peak (along the RM axis). The methods of determining that maximum were changed, with the new default being an exact cubic fit, and with obviously wrong answers trapped and corrected. **AFARS** now writes out all 3 images with a simplified control of the output names and with corrected header coordinates.

To study the methods used in **FARS**, another task **TARS** was written. It computes a single rotation measure spectrum, taking its data from an input text file which can include model components and a spectrum of Q and U values and writing an output text file. It had the same error as **FARS** in handling the last Clean component. **TARS** was changed to use the sum of the Q/U spectrum and any model. Previously, it ignored the Q/U values if there was a model and used the spectrum only for its list of frequencies. An experimental method of doing a complex Clean was added. This pattern match scheme is rather slow and so will not be added to **FARS** unless it is found to be worth the wait. the width of the real part of the RM transfer function (dirty beam really) is now used as the default restoring beam width. **TARS** may now write repeatedly to the same output text file, allowing comparison of RM spectra made with different input parameters.

To assist in these studies, three new tasks were also written. **MODIM** will construct model I, Q, and U cubes. Each model component has I, Q, U fluxes at 1 GHz plus a spectral index and rotation measure as well as the usual position, width, and type parameters. Up to 9999 components may be read from a text file and, optionally, added to pre-existing images. New task **QUXTR** reads Q and U cubes to extract a spectrum in the form expected by **TARS**. Finally, new task **TARPL** plots the RM spectrum from one or more **TARS** output spectra contained in a single text file.

Other analysis

SLICE was given the option to avoid interpolation when the slice is directly along the *X* or *Y* axis. It already did that along the *Z* axis. It now allows non-integer end points when interpolating. All slice plots and **SLFIT** now detect the old format slice files and handle them correctly. The format was changed quite some time ago without properly insuring backward compatibility.

CODECIMAL is a new verb to switch between decimal coordinate (**X**, **Y**) and sexagesimal coordinate (**COORDINA**) representations.

IMVAL was changed to let the user choose between returning the value at the nearest integer pixel and doing a cubic fit to determine the value.

MAXFIT was changed to return the shift necessary to move the peak found to the nearest integer pixel.

CC2IM is a new task to convert point and Gaussian components in Clean Component extension files into images without any convolution. Some software expects model images rather than **CC** files.

FITLD and **IMLOD** now trap the modern coordinate description used for East-West interferometers and change it into the description recognized by *AIPS* (**-NCP**).

Display

SNPLT was given the option to color the plot based on source number. This is very helpful when examining calibration tables.

IMEAN now uses **BLC**, **TRC**, and **DOINVERS** when it does the initial robust estimate of the rms prior to the fitting. **DOMODEL** was added to control the plotting of the fit Gaussian. The **TRIANGLE** adverb was added to output the flux level exceeded by only *i* percent of the pixels. This may be used in scripts to select intensity ranges, contour levels, and the like.

- POSSM** was changed to avoid plot labels below panels that are not the bottom of a column of panels. Overlaps were occurring in LWPLA outputs. Labeling of IF numbers and polarization was improved. The flux scaling (milli, kilo, *et al.* will now be fixed on each plot page, being set by the first panel. Previously, when panels were separately scaled, the prefix portion was ambiguous.
- GREYS** was corrected to handle 3-color images correctly and was given additional options controlling the transfer function type and intensity ranges separately in each color. KNTR and PCNTR were also corrected to implement DOCOLOR correctly.
- TVHUI** was changed to allow transfer functions in the hue image and to allow the output of an image of a two-dimensional, hue-intensity step wedge.
- LWPLA** was changed to guess the size of characters in a string (some are narrow) and adjust the string positioning accordingly. Plot tasks will now use upper and lower case lettering where appropriate. Plots now can have ticks separated by as little as 1 micro unit (previously 10 micro units was the lower limit).
- PRTAB** was changed to use F format by default for printing real and double precision values. It tries to represent both the smallest and largest values present.
- GCPLT** is a new task to plot the gain curve text files used by INDXR and BDF2AIPS.
- TAPLT** was given more adverbs to limit which rows are selected for inclusion in the plot.
- EXTLIST** was brought up to date systematically for all plot tasks already supported and support for CCNTR, SERCH, EVAUV, DELZN, ELINT, FGPLT, GAL, SNIFS, SOUSP, and WETHR was added. These tasks were modified to insure that defaults were filled in before the plot files are created. Verb PLGET was also updated to support these tasks.
- CHARMULT** is a new verb to instruct the XAS TV display to use the standard character font scaled by a specified integer. Very large TV displays will choose the default scaling but may need user direction.

General and system matters

- MAXCHA** is the maximum number of spectral channels which *AIPS* can handle. It was increased from 65536 to 132096 (a factor of 2 plus 1024). An overflow in the calibration application at 65536 was corrected.
- TAB** characters in input text files are invisible to users and catastrophic to incautious software. All software was changed to check input text for TABs and change them to an equal number of blanks.
- CookBook** was updated generally including Appendix E specifically addressed to EVLA users. The control files that enable TAB completion, ABOUT, and APROPOS were also updated.
- U2CAT**, **U3CAT**, **U4CAT**, and **UOCAT** are new verbs like UCAT except that the disk examined is controlled by the IN2DISK, IN3DISK, IN4DISK, and OUTDISK adverbs, respectively.
- M2CAT**, **M3CAT**, **M4CAT**, and **MOCAT** are new verbs like MCAT except that the disk examined is controlled by the IN2DISK, IN3DISK, IN4DISK, and OUTDISK adverbs, respectively.
- GETVERS** is a new verb to return the maximum version number of the extension file type specified with messages; QGETVERS does the same, but quietly. The output is stored in the MAXVERS adverb.

Patch Distribution for 31DEC11

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, 31DEC11 was patched during 2012 and 31DEC12 will be patched as needed during 2013. 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.

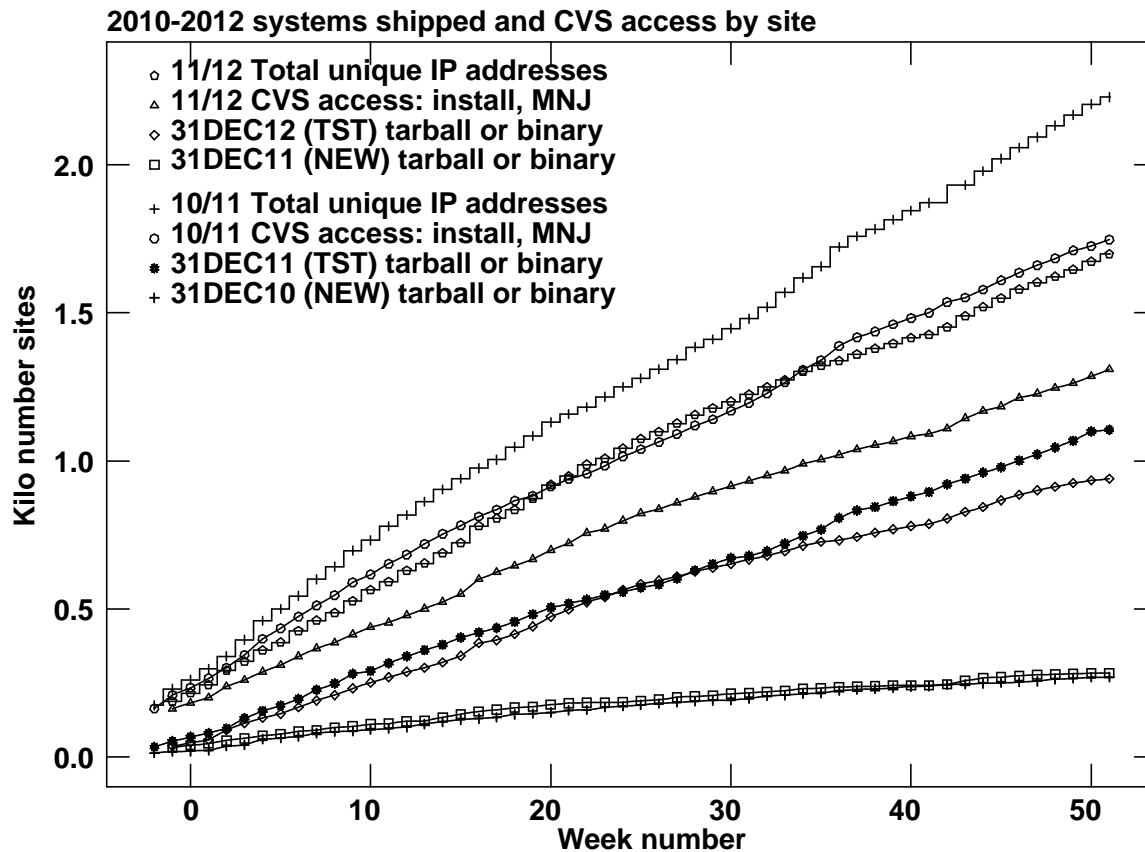
The 31DEC11 release is no longer available for installation and will no longer receive patches even for egregious errors. It had a number of important patches during 2012. They are

1. Imaging code had problems with large gridded modeling. *2012-01-16*
2. UVFIT had many areas dimensioned for the old limit of 4 components, rather than the new limit of 20. *2012-01-16*
3. FARS did not shift residuals back to the original λ^2 correctly and did not add residuals into amplitude/phase outputs correctly. *2012-01-16*
4. AFARS did not handle BLC correctly, producing wrong rotation measure images. It also stated incorrect information in the history. *2012-01-16*
5. SQASH had an error in history writing that led to aborts. *2012-01-16*
6. FITAB omitted an essential keyword for compressed UV data. *2012-01-16*
7. CLCOR ignored the fact that the GMRT uses an opposite phase convention. *2012-01-16*
8. VLANT did not correct EVLA data properly. *2012-03-01*
9. SCMAP and SCIMG did not apply the flag table to the data entering the self-cal step *2012-03-07*
10. Mac OS/X version Mountain Lion changed `ps` to issue an error message when there is a library path; procedures needed defenses against this. *2012-11-19*

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 2012, a total of 284 different IP addresses downloaded the frozen form of 31DEC11 and 940 IP addresses downloaded 31DEC12 in tarball or binary form. Fully 1309 IP addresses accessed the NRAO cvs master. Each of these has at least installed some version of *AIPS* and 422 appear to have run the MNJ at least occasionally. The total number of unique IP addresses in these three lists was 1698. The table below shows these numbers as a function of year since we began recording them. The attached figure shows the cumulative number of unique sites, cvs access sites, and tar-ball/binary download sites known to us as a function of week in 2012. The numbers for 2011 are also plotted and show a drop in the shipping of TST. The cvs access numbers have dropped in a way that suggests some change in the manner of counting in addition to the decrease in the numbers for the TST version.

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



Recent *AIPS* and related Memoranda

All *AIPS* Memoranda are available from the *AIPS* home page. *AIPS* Memo 117 describing *AIPS*' usage of the FITS format was modified slightly on several occasions in 2012. In addition, there are two new EVLA memorandum from the *AIPS* group in the last six months. Obtain them via

<http://www.aoc.nrao.edu/evla/memolist.shtml>

162 Comparison of E and D configuration sensitivity when D configuration is tapered

L. Kogan & F. Owen, NRAO

July 6, 2012

The latest design of the new most compact E-configuration of VLA has been finished. So the array dimensions are approximately 3 times less than the existed most compact VLA configuration: D. Therefore the sensitivity of E-configuration to the brightness temperature of an expanded source might be expected to be 9 times better in comparison with D configuration. However using tapering with D-configuration data can diminish this advantage. In this memo, we estimate the actual possible advantage of E configuration when tapering is used with the D configuration data.

164 Some comments on the W-projection algorithm

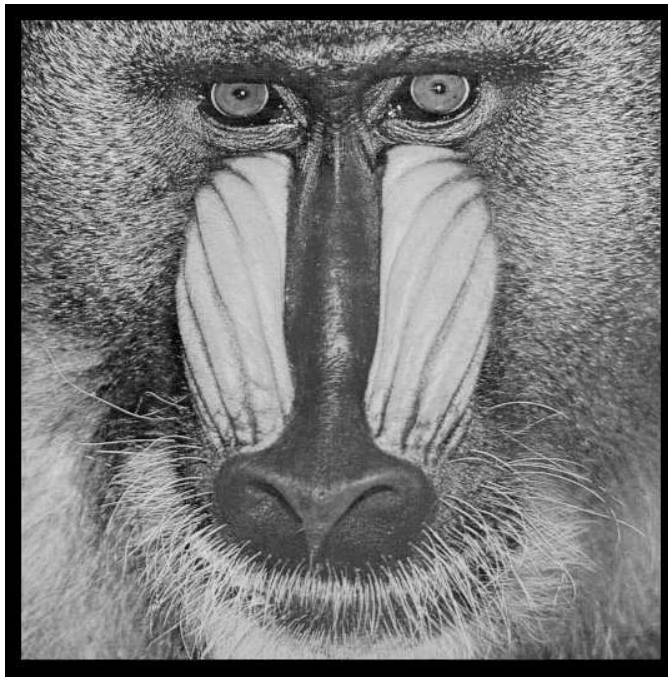
Leonid Kogan, NRAO (ret.)

October 8 2012

The algorithm W-projection implemented in CASA has been successfully tested using some data. But still the restrictions of this algorithm are not clear. In this memo we point out to the possible problems at the case of poor UV coverage for some W layers. We have evaluated analytically the convolution function which is used at the W-projection algorithm to project (recalculate) the measured visibilities (corrupted by the W term) to the visibilities corresponded to the ideal observations ($W=0$). The found analytical equation for the convolution function allows to find a simple expression for its width for arbitrary field of view and W. The width is much wider in some cases than the upper limit (70x70 pixels) cited and therefore the computation time may not be as small as cited. We suggest multiplication by $\exp(j\pi W l^2)$ at the image plane (instead of the convolution at the UV plane). Such a way to correct the W-term may give the gain in the computation time.

Personal note

Leonia Kogan has retired from NRAO and the *AIPS* group although he still pays attention to our progress and will help us if needed with programs for which he was responsible; note the EVLA Memo cited above. Leonia worked for NRAO for nearly 20 years, most of that assisting the *AIPS* project. His first **CHANGE.DOC** entry was May 21, 1993. He is a mathematician by training and temperament and solved many of our most difficult, mathematically-based issues. Most recently he worked on **FARS**, implementing NRAO's first Faraday Rotation Synthesis algorithm. But he is also well known for **UVFIX** which computes u, v, w from antenna locations and time with much trusted accuracy and for several correction functions in **CLCOR**, most notably that for the position of the Earth's pole. He is widely known for his work on array configurations, represented in *AIPS* by tasks **CONF** (array optimization) and **UVCON** (array simulation). VLBI data calibration received a lot of his attention through tasks such as **FRMAP**, **PCCOR**, **PCLD**, **ACCOR**, **COHER**, **DELZN**, and **ATMCA** as well as work on handling orbiting antennæ. He developed **UVRFI** to excise RFI from EVLA data and did substantial work on tasks **VPLT**, **SPLAT**, **FGPLT**, **ELINT**, and **RMSD**. Leonia's name appears on very many entries in **CHANGE.DOC** encompassing a much wider range of matters than the list given above would suggest and reflecting his ready willingness to help wherever he was needed. Leonia will be missed and we wish him the very best in his future endeavors.



December 31, 2012



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