A I P S L E T T E R

Written by a cast of $\mathcal{AIPS}$

Edited by

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Happy 40th birthday $\mathcal{AIPS}$ and FITS

The FITS format was devised in a meeting at the VLA site on March 27 and 28, 1979. Don Wells (then of NOAO) and Eric Greisen (still of NRAO) were the primary authors while Barry Clark and other NRAO staff members provided valuable suggestions. The FITS format, enhanced by later extensions, is still in wide spread use in astronomy and is the envy of other scientific fields. Then the FITS format colored the design of the $\mathcal{AIPS}$ internal formats. The $\mathcal{AIPS}$ project was begun officially on July 1, 1979 and has stood the test of time remarkably well.

$\mathcal{AIPS Letter}$ publication

We have discontinued paper copies of the $\mathcal{AIPS Letter}$ other than for libraries and NRAO staff. The $\mathcal{AIPS Letter}$ 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 $\mathcal{AIPS}$ releases on an annual basis. While all architectures can do a full installation from the source files, Linux (32- and 64-bit), and MacIntosh OS/X (Intel) systems may install binary versions of recent releases. Binary versions for Solaris and MacIntosh (PPC) are available for the 31DEC17 release but not for later releases. The last, "frozen" release is called 31DEC18 while 31DEC19 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 $\mathcal{AIPS Letter}$ is intended to advise you of improvements to date in 31DEC19. Having fetched 31DEC19, 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 $\mathcal{AIPS}$ Manager FAQ page on the $\mathcal{AIPS}$ web site.

The MNJ for binary versions of $\mathcal{AIPS}$ 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 $\mathcal{AIPS}$-

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. For local versions, use a copy of the task and its help file in a private disk area instead.

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Improvements of interest in 31DEC19

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 31DEC19 in the last six months. Some of these were in the nature of bug fixes which were applied to 31DEC18 before and after it was frozen. If you are running 31DEC18, 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. There is one new task in 31DEC19 called FGPRT. It prints a matrix of the number of flags applying to each baseline. The counts can be restricted to those applying to selected IFs, channels, times, sources, and the like. There is also one new procedure called VLBAMPHC to calibrate and image data for secondary phase-stopping centers.

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 31DEC18 or, preferably, the latest release.

VLBI

EOPs

The web site at Goddard Space Flight Center long used to provide data on the location of the Earth's pole stopped working late last Fall. Thanks to dedicated GSFC employees, we were able to obtain these data by a back channel to support the VLA and VLBA correlators. We also made these files available on an NRAO (LBO) web page. The standard VLBAEOPS procedure was changed to allow the user to provide the data file instead of automatically downloading it. Finally, in May, a new web site was created to supply the EOP data files and *AIPS* procedures were changed to use it. That web site is

  ftp://cddis.gsfc.nasa.gov/vlbi/gsfc/ancillary/solve_apriori/usno_finals.erp

Using 500-day rather than full data files during this time raised an issue in CLCOR. The code was changed to make sure that the observation date did not precede the valid data in the file.

VLBARUN

VLBARUN is a procedure which invokes many other procedures in the VLBARUN file and in the VLBAUTIL file to load VLBA data to disk and then calibrate and image it. Optionally, VLBARUN creates an html file filled with plots generated during the calibration and imaging. It is easy to skim through this html page looking for issues, or simply confirming that everything went well. Starting with the 2020A observing semester, with proposal deadline Aug 1, 2019, NRAO will offer staff assistance to novice VLBA users with the goal of broadening the user base and reducing the steepness of the learning curve. Therefore, a re-examination of VLBARUN was undertaken.

First, the $\mathcal{POPS}$ language processor was given an increase in memory by a factor of four. This simplified the development of the run files. Then VLBAUTIL was reviewed, but all it required were changes to the typing to make the code and output messages more readable. Then the code of VLBARUN was overhauled. New capabilities were added to allow a-priori flags to be read in at the start from a text file and, before imaging, to run RFLAG on each source individually. Several changes, reported below, were made to RFLAG to enhance its performance in this environment.

More technical changes made to VLBARUN include changing the imaging of line data to make a separate image cube for each IF and to plot only a selected number of channels in KNTR. The output plots and html are now written to a dated sub-directory below the directory to which OUTFILE points. The messages from VLBARUN are now printed to a text file which is accessible from the vlbarun.html file. The background color of the gif files was changed from black to a light grey so that they may be displayed outside of the html environment. The plots appear two across in the html file, making comparisons easier and the file shorter. The VLBA tutorial found at https://go.nrao.edu/vlba-tut2 was updated for the revised VLBARUN and the link to the vlbarun.html file was changed to a modern version.

VLBAMPHC

VLBAMPHC is a new procedure to support DiFX's ability to correlate an observation at multiple phase-stopping centers. DiFX writes the calibrator data, which does not use multiple centers, and the zero-offset position of the multiple center source into the "primary" data file. It then writes additional, smaller data files, one for each "secondary" phase stopping center. After the user calibrates the primary data file, by hand or with VLBARUN, VLBAMPHC may be used to copy the highest CL and BP tables from the primary data set to a secondary data set. Applying this calibration, RFLAG may be run. Then the calibration and new flags are applied to the secondary data in SPLIT and the result imaged in either continuum or line modes. RFLAG plots in living color and the message file are available from a vlbamphc.html file.

UV-data

RFLAG

RFLAG was given two new options, both of which are used in the new and revised VLBA procedures. The first, hidden away as FPARM(17), flags all times for a channel if more than FPARM(17) of the times have been flagged. Unlike normal flags written by RFLAG, such flags are restricted to the specified source. The second option, FPARM(18) requests that the clip levels, usually set in NOISE and SCUTOFF, be instead computed and used on a baseline basis. This requires a new attached table, called NS, which like the adverbs is computed in the DOPLOT > 0 pass of RFLAG and then applied in the DOPLOT < 0 pass. The computation of the table and its application can be done in one pass if DOPLOT > 0 and DOFLAG > 0. The usual plots and adverbs, averaged over baselines, are still output as well (but not used) even when FPARM(18) is invoked.

A subtle bug was found in the code which could in some cases make very non-subtle results (NaNs and infinities in NOISE and SCUTOFF). The bug also caused a large number of useless flags to be written. Masking portions of the summing arrays when a baseline has no data in a time interval solved the issue. Applying the pre-clip parameter FPARM(13) is also a good idea. The help file recommends it now and the VLBA procedures use it.

Miscellaneous

FGPRT is a new task to count flags by baseline applying to user specified ranges of IF, channels, sources, times, etc. A matrix display is produced.

Planets are now supported wherever a coordinate is required so long as a proper PO table is available to describe the time-varying coordinates.

Linear polarization required a reversal of the sign of the parallactic rotation formulae when converting linear polarization data to Stokes. We believe we finally have the sign correct.

FRING was changed for EVLA data to have the default for DPARM(9) be to not compute rates. EVLA users can overlook this important option and then be very puzzled by the wild swings in the phases.

TYSMO has a new option DOSCALE to normalize the values in each scan for the median-window filter clipping. That clipping was changed to be applied both before and after the median window operation. Psum was flagged mysteriously due to testing on Psys, when no such test was requested. Corrected to flag only when requested.

The SY table format was changed some time ago to add a solar data indicator. Several tasks, especially TYSMO when flagging the SY table, were corrected to handle the new format properly.

SPLIT was given a ROTMEAS option to apply a rotation measure correction to the cross-hand polarization data written. The value used is added to the output file's header keywords. This option will allow averaging of spectral channels in the cross hands.

BDF2AIPS has a new option DOSTOKES to select the desired data when the desired configuration contains data with different numbers of Stokes.

SETJY has a new option SRCALIAS to give source name aliases so that a user's name for a source does not have to match the official name(s) of the source in 'CALC'. SRCALIAS(i) must be an official name for the SOURCES(i).

BPWAY was given the NORMALIZ option to avoid the rms spectrum normalization if desired. It was corrected to write the correct *uvw*'s when BIF > 1.

BPASS has additional normalization options (BPASSPRM(10)) to use the median rather than the mean.

VBCAL was corrected to write out valid data. The default values for the *x*PARM adverbs were corrected and the help file improved.

IM2CC was given the IMSIZE option to allow the output image to be bigger than the minimum size. The image size controls the accuracy of gridded modeling and larger is much better.

OOSUB was corrected in its division mode for an error that zeroed channels too early. Other corrections were made to zero only the current channels and Stokes when computing a 'MODL'. The DFT routine and lower-level Q routines were changed to keep better track of whether a normal or a 'MODL' computation was being done. The decision on DFT versus GRID mode was also improved.

Display and imaging

IMAGR was given NEXT FIELD and LAST FIELD options in the TV menu to make examining a large number of fields easier. The STOP FLD and ALLOW FLD options now appear with all values of OVERLAP.

FILIT was corrected to enable the menu after loading an image, rather than simply loading the images to the display in an infinite loop. The roam function was also corrected.

RESCALE was given a DOCC option to apply the re-scale factor to any CC files as well as the image.

Plots from several basic tasks labeled brightnesses as "flux". This was corrected to "brightness."

General

The memory for the *POPS* language processor was increased by a factor of 4. POPSGN and the SAVE and GET pseudo-verbs were improved to handle such changes in a manner that will be mostly transparent to the user.

QCREATE was changed so that the default is to create disk files quickly. Many users are unaware of this adverb to GO and suffer needless delays in their processing. It may still be set negative to force a new file to be filled with zeros thereby insuring that the disk space is available when needed.

CookBook   updates were made for the labeling of figures plus changes described here and new tasks from last year `TVIEW` and `SNBLP`.

MOVE   was given a new `OPCODE = 'COPD'` to copy a catalog entry, allowing duplicate names, and then delete the input file.

Patch Distribution for `31DEC18`

Important bug fixes and selected improvements in `31DEC18` 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 `31DEC19` are found, they are simply corrected since `31DEC19` 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 `31DEC18`, meaning that a MNJ run on `31DEC18` after the patch will fetch the corrected code and/or binaries rather than failing. Also, installations of `31DEC18` after the patch date will contain the corrected code. The `31DEC18` release has had a number of patches:

1. `VBCAL` did not write the output data set. *2019-01-18*

2. `TYCOP` and other tasks had the old number of columns for the SY table. *2019-02-13*

3. Model computation had problems when computing multiple CC models. *2019-03-05*

4. Conversion of linear polarization to Stokes had a wrong sign. *2019-03-05*

5. `TYSMO` applied clipping and flags inconsistently. *2019-03-05*

6. `FILIT` had an infinite loop displaying the image facets and did not handle the roam function properly *2019-03-28*

7. `KNTR` and other tasks truncated one of the "brightness" strings *2019-04-03*

8. `OOSUB` did not do channel dependent division correctly. *2019-04-10*

9. `SPIXR` did not handle sub-images with an `FQ` axis correctly. *2019-05-03*

10. `RFLAG` did not handle missing data correctly, making too many flags. *2019-06-14*

11. `KNTR` computed the number of planes to plot poorly *2019-06-14*

12. `BPWAY, RLCOR` did not change uvw for `BIF` greater than one.*2019-06-14*

13. `TAPLT` tested for no data backwards and so did not do good plots. *2019-06-21*

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*. So far in 2019 more than 263 IP addresses have downloaded the frozen form of `31DEC18`, while more than 396 IP addresses have downloaded `31DEC19`. The binary version was accessed for installation or MNJs by 253 sites for `31DEC18` and 352 sites for `31DEC19`. A total of 671 different IP addresses have appeared in one of our transaction log files. The numbers for `31DEC19` are essentially the same as last year while the total and `31DEC18` numbers are slightly lower than last year at this time.
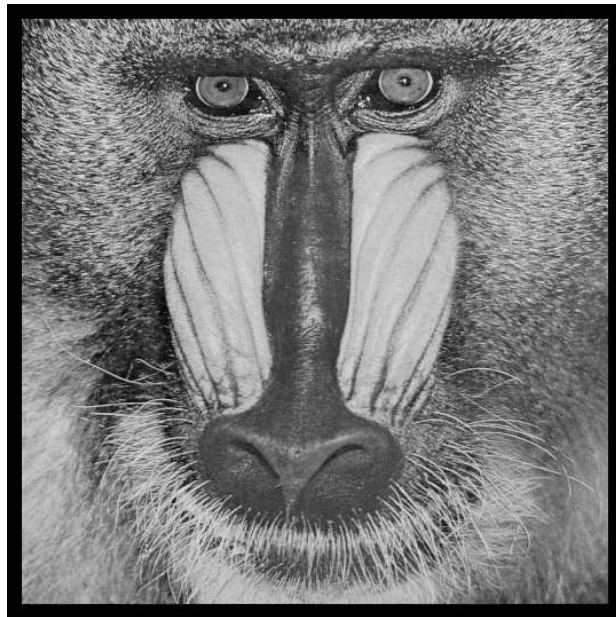
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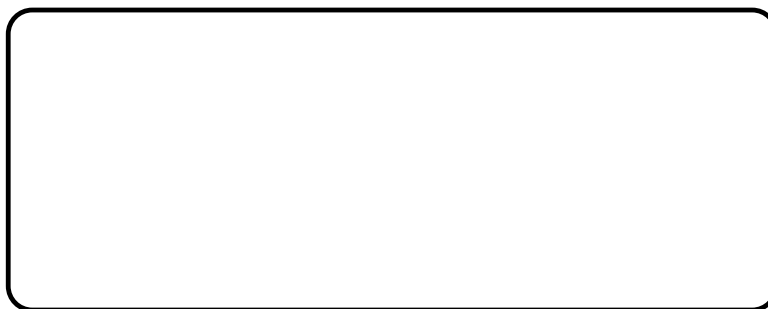
A I P S L E T T E R

A newsletter for users of the NRAO
$\mathcal{A}$stronomical $\mathcal{I}$mage $\mathcal{P}$rocessing $\mathcal{S}$ystem

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General developments in $\mathcal{AIPS}$

Reduction of VLB, VLA and ALMA data in $\mathcal{AIPS}$

$\mathcal{AIPS}$ 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 $\mathcal{AIPS}$ 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 $\mathcal{AIPS}$. Calibrated uv data may be exported from $\mathcal{AIPS}$ in "UVFITS" format for use in that program. ALMA data may also be reduced in $\mathcal{AIPS}$, although the package is not fully qualified to calibrate data from linearly-polarized feeds. Chapter 4 of the $\mathcal{AIPS}$ Cookbook, available via the $\mathcal{AIPS}$ web site, was revised to describe the new calibration operations.

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Current and future releases

We have formal $\mathcal{AIPS}$ 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 no longer binary versions available for Solaris and Mac PPC chip architectures. If you develop $\mathcal{AIPS}$ 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 31DEC19 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 2020 to convert your copy of 31DEC19 into the frozen version. However, when patches to 31DEC19 are announced in 2020, you may apply them with the MNJ. This $\mathcal{AIPSLetter}$ is intended to advise you of corrections and improvements in this release.

We have begun a new version, called 31DEC20, which is now under development by the $\mathcal{AIPS}$ Group.

You may fetch and install a complete copy of this version at any time. Having fetched 31DEC20, 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 31DEC20 *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 171-Mbyte `31DEC20.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 31DEC19; even 31DEC18 will no longer be changed.

Improvements of interest to users in 31DEC19

In the latter half of 2019, new tasks appeared including UVADD to compare two very similar *uv* data sets, SYVSN to compare SysPower values to solution phases, XYMOD to apply a linear polarization point source model to a *uv* data set, PPAPP to apply a PP table from RLDIF to a second data set, BLPLT to plot BL tables from BLCAL, BPFLG to flag *uv* data for high or low values in the bandpass table, and TADIF to compare selected columns from tables. In the first half of 2019 only one new task, FGPRT appeared. It prints a matrix of the number of flags applying to each baseline.

Normally, bugs which appear in an *AIPS* TST version and then are fixed in that same version before its release get little or no discussion in the *AIPSLetter*. Since a rather large number of sites now install the TST version of *AIPS* during its development, this is somewhat of an oversight. We urge you to run the

"Midnight Job" at least once after 31DEC19 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 $\mathcal{AIPS}$ 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

The VLB data reduction pipeline continued to get attention in the reporting period. Bugs affecting the saving of adverb values, inserting the date string into full path names, and finding the correct version of plot files were corrected. The option to run CLIP before, or instead of, RFLAG was added to both VLBARUN and VLBAMPHC. The option to run TYSMO was added to VLBARUN to replace bad system temperatures with nearby good ones. The option to run UVFLG to flag low elevation observations was also added. VLBAMPHC was changed to copy flag table version 1 from the master file, avoiding the repetition of the UVFLG options. Both scripts run INPUTS at the beginning so that the message file contains the user's parameters. The old pipeline script VLBAPIPE was removed to avoid user confusion.

DTSUM   was changed to apply the full suite of calibration adverbs to the data as they are read. The flagging state of each scan is particularly relevant.

APCAL   was corrected to close the FQ table when an error occurs and to respond to error conditions more completely.

UV data

SNCOR   was changed to copy the input SN table rather than changing (damaging) it in place. VLBAUTIL was changed to leave SNVER zero so that all uses of SNCOR get the highest version number.

BPASS   was corrected to use the proper list of standard sources when finding the spectral index. NaNs (not-a-number) are not likely to appear in the BP solutions — but they have — prompting a routine to check for them.

BPEDT   menu handling when there is only one time needed correcting.

UVADD   is a new task to add, subtract, multiply, or divide two very similar uv data sets.

SYVSN   is a new task to compare SysPower values to solution table phases to measure the correlation of the two. This might be a poor-man's water vapor radiometer.

XYMOD   is a new task to compute a linear polarization point source model and then to subtract it from, divide it into, or replace a uv data set.

PRTAN   now offers the option of making a plot (file or TV) of the antenna locations.

UVFLG   was corrected in the loop over subarray when flagging for shadowing. It used antenna data for the highest subarray for all subarrays. It also did way too much disk I/O.

TIORD   was given the option to use direct disk access rather than going through the calibration routines. The latter were found to skip data out of time order with no comment. The calibration package was changed to issue a message about data being lost.

UVCOP   was given the option to avoid scaling the u, v, w parameters for a change in reference frequency. This scaling is wrong for holography data.

RLDIF   and XYDIF were changed to write a PP table giving the correction phases when in spectral mode. The ability to plot such tables was added to POSSM.

PPAPP   is a new task to apply the PP table to additional data sets.

TYAPL was given the option to specify antennas which have bad SY table values but would otherwise pass the CUTOFF test. They are given the average of the corrections for the good antennas.

BLPLT is a new task to plot BL table values produced by BLCAL. It makes a BPLOT-like plot with IF on the horizontal axis and all baselines to the selected antenna on the vertical axis.

BPFLG is a new task to flag visibility data for bad values in a bandpass table. It does the FLAG ABOVE and FLAG BELOW operations of BPEDT without all the plotting and interactive overhead.

Imaging and Display

IMAGR, SCIMG and SCMAP were changed to correct the residual image whenever the user has specified the Clean beam dimensions. The residual image is convolved (when possible) to the resolution specified and the brightness units ("per beam") corrected. Bugs in the self-cal tasks preventing the interactive editing phase were corrected.

TVWEDGE and HUEWEDGE were changed to allow the user to point to the left or right of the image to select a vertical wedge rather than a horizontal one.

TVLABEL was given the CBPLOT option to add a Clean-beam plot to the label. It was also added to tasks PLAYR, TVSPC, and TVIEW..

TVIEW was changed to plot a spectrum in the upper left corner when there is no "reference" image to be displayed there.

UVPLT, WIPER, VPLOT, and ANBPL were corrected to retain proper source information even when selecting only one source from a multi-source data set.

General

The gfortran compiler versions 4.x, 7.x, and 8.x have been noted over the years to fail with the pseudo-array processor code when employing dynamic memory with the base memory in a Fortran COMMON. Versions 5.x and 6.x did work with this coding. To allow users to compile *AIPS* without worrying about versions of gfortran, a major re-organization of the pseudo-AP code was undertaken. In this re-write, the base memory is in the main routine of each AP task. Its name is then passed down to all subroutines, including the "AP" Q routines, in call sequences. The memory is still allocated dynamically by a call to QINIT and the resulting offset is passed through the COMMON. Remarkably, this works with all versions of gfortran and versions 6 and 7 were found to produce identical results (including run time) in the Y2K large test.

Apple Mac OS/X is rolling out a new version 10.15 that, famously, will not run 32-bit load modules. Fearing that our old Intel compiler was producing same, we switched our MACINT version to use gfortran version 6.3. Since then, we have had access to a brand new laptop running 10.15. It was found that the gfortran version runs nicely. Surprisingly, we also found that an old 31DEC17 version ran perfectly well also. Thus, despite information to the contrary, all binary versions of *AIPS* should work on the new Mac OS.

CookBook was updated on July 11, October 15, and November 25. The ABOUT lists and tab completion and APROPOS files were also updated at the same time.

TADIF is a new task which does a not very smart comparison of selected columns of two tables. It may be used to determine what might be different between them when PRTAB is too overwhelming.

Compilation requires a -c most places but not in the Makefile used to compile XAS. The compile procedures FC and AIPSCC were revised along with several FDEFAULTS.SH and CCOPTS.SH to correct this installation issue.

$\mathcal{AIPS}$ **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 $\mathcal{AIPS}$ 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 $\mathcal{AIPS}$. In 2019, a total of 406 different IP addresses downloaded the frozen form of 31DEC18 and 754 IP addresses downloaded 31DEC19 in tarball or binary form. Fully 435 IP addresses accessed the NRAO cvs master. Each of these has at least installed some version of $\mathcal{AIPS}$, 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 1155. The table below shows these numbers as a function of year since we began recording them. The plot of numbers versus time shows that 2019 exceeded 2018 by a bit, especially in the last half of the year.

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
2018	31DEC18	31DEC17	684	368	603	343	461	1099
2019	31DEC19	31DEC18	754	406	686	388	435	1155

2017-2019 systems shipped and CVS access by site
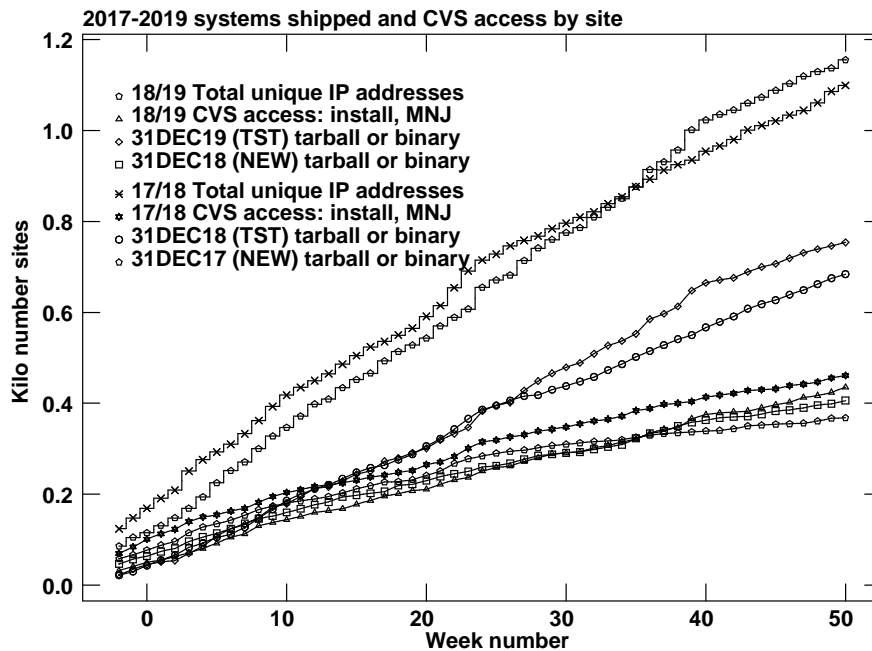
Recent $\mathcal{AIPS}$ Memoranda

All $\mathcal{AIPS}$ Memoranda are available from the $\mathcal{AIPS}$ home page. $\mathcal{AIPS}$ Memo 117 was revised to describe PP, XG, RM, and ZE tables, Memo 120 was revised to show CBPLOT, and Memo 124 was revised to show CBPLOT and plotting of the current spectrum (in the absence of a reference image).

117 $\mathcal{AIPS}$ **FITS File Format**
Eric W. Greisen, NRAO
October 14, 2019 revision
$\mathcal{AIPS}$ 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 in still required. This memo is an attempt to meet that perception. $\mathcal{AIPS}$ 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.

120 **Exploring Image Cubes in** $\mathcal{AIPS}$
Eric W. Greisen, NRAO
October 18, 2019 revision
$\mathcal{AIPS}$ 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 $\mathcal{AIPS}$ 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.

124 **Further Exploration of Image Cubes in** $\mathcal{AIPS}$
Eric W. Greisen, NRAO
October 18, 2019 revision
$\mathcal{AIPS}$ has powerful tasks to fit models to the spectral axis of image cubes. Tasks like XGAUS and RMFIT are easier to run if the user is already familiar with the general structure of the data cube. Task TVSPC was written to explore data cubes with emphasis on plots of spectra. Now a new task TVIEW has been written to explore data cubes with displays of position-velocity transpositions of the data cube. This task provides an additional exploration tool within the $\mathcal{AIPS}$ environment, rather than requiring users to export their cubes to one or more of the many excellent visualization tools now available. TVIEW offers the option of rotating the image in the celestial axes so that the position-velocity curves may be viewed along axes pertinent to the source, *e.g.*, the major axis.

Patch Distribution for `31DEC18`

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, `31DEC18` was patched during 2019 and `31DEC19` will be patched as needed during 2020. 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 $\mathcal{AIPS}$ web page or by *anonymous* `ftp` to the NRAO server `ftp.aoc.nrao.edu`. Documentation about patches to a release is placed on this site at `pub/software/aips/`*release-name* and the code is placed in suitable sub-directories below this. Patches to older releases are kept here as well, but they will require local compilation.

The `31DEC18` 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 2019. They are

1. `VBCAL` did not write the output data set. *2019-01-18*

2. `TYCOP` and other tasks had the old number of columns for the SY table. *2019-02-13*

3. Model computation had problems when computing multiple `CC` models. *2019-03-05*

4. Conversion of linear polarization to Stokes had a wrong sign. *2019-03-05*

5. `TYSMO` applied clipping and flags inconsistently. *2019-03-05*

6. `FILIT` had an infinite loop displaying the image facets and did not handle the roam function properly. *2019-03-28*

7. `KNTR` and other tasks truncated one of the "brightness" strings. *2019-04-03*

8. `OOSUB` did not do channel dependent division correctly. *2019-04-10*

9. `SPIXR` did not handle sub-images with an `FQ` axis correctly. *2019-05-03*

10. `RFLAG` did not handle missing data correctly, making too many flags. *2019-06-14*

11. `KNTR` computed the number of planes to plot poorly. *2019-06-14*

12. `BPWAY, RLCOR` did not change uvw for `BIF` greater than one. *2019-06-14*

13. `TAPLT` tested for no data backwards and so did not do good plots. *2019-06-21*

14. `BPASS` messed up some of the standard source spectral indices. *2019-07-12*

15. `CLIP` messed up reporting its results for linear and other non-standard polarization data. *2019-07-26*

16. `UVFLG` did not use the correct antenna data when looping over subarrays for shadowing. *2019-08-22*

17. `BPWAY` did not close the table IO when looping over scans. *2019-09-30*

18. `TYSMO` could ignore some flags when applying an `FG` table to the `TY`/`SY` data. *2019-11-18*
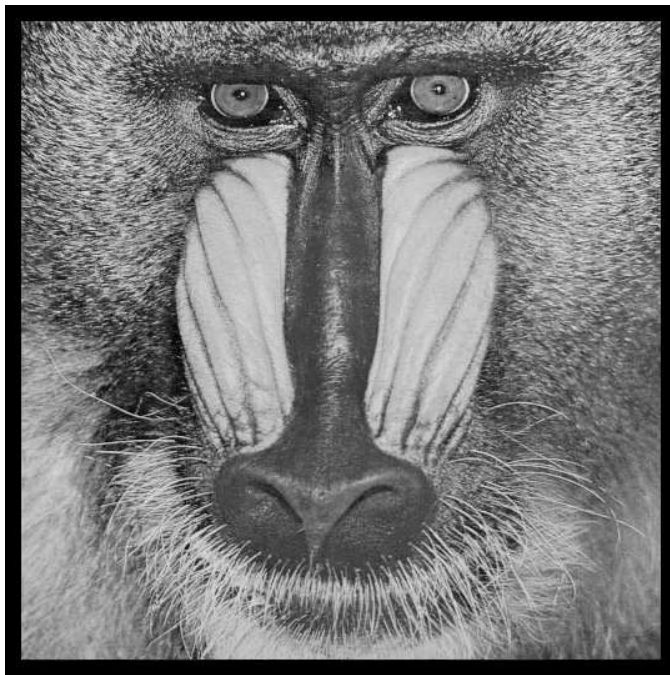
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