AIPSLETTER

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A newsletter for users of the NRAO
Astronomical Image Processing System

Written by a cast of *AIPS*

Edited by
Eric W. Greisen
National Radio Astronomy Observatory
P.O. Box O, Socorro, NM 87801–0387
505–835–7236; Fax 505–835–7027
`daip@nrao.edu`
`http://www.aips.nrao.edu/`

General developments in *AIPS*

Happy birthday AIPS, changes in the *AIPSLetter*

We started work on the software system now known as *AIPS* on July 1, 1979, making it 30 years old. Had we realized its longevity, would we have had the nerve to start it?

With this issue, we have decided to discontinue paper copies of the *AIPSLetter* other than for libraries and NRAO staff. The *AIPSLetter* will be available in PostScript and pdf forms as always from the web site listed above. 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 `31DEC08` while `31DEC09` remains under active development. You may fetch and install a copy of these versions at any time using *anonymous* `ftp` for source-only copies and `rsync` for binary copies. This *AIPSLetter* is intended to advise you of improvements to date in `31DEC09`. Having fetched `31DEC09`, 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.

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Patch Distribution for 31DEC08

Important bug fixes and selected improvements in 31DEC08 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 31DEC09 are found, they are simply corrected since 31DEC09 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 31DEC08, which means that a MNJ run on 31DEC08 after the patch will fetch the corrected code and/or binaries rather than failing. Also, installations of 31DEC08 after the patch date will contain the corrected code.

The 31DEC08 release has had a number of important patches:

1. CALIB could go into an infinite loop if the first NX record was of 0 length *2009-01-27*
2. TYAPL would apply the highest flag table without permission when it should just be copied *2009-02-04*
3. OFM files were not adjusted to the new TV intensity ranges *2009-04-02*
4. IMAGR TV option FORCE A FIELD caused all facets to be re-imaged; scratch files were way too large under some circumstances *2009-04-22*
5. DBCON copied keyword MAXBLINE which confused later imaging routines *2009-04-27*
6. IMAGR had a limit test that was too small affecting restoration of large numbers of CCs from one facet to another *2009-05-18*
7. IMAGR had a tendency to sort input data sets when it did not really have to do so *2009-06-19*

Improvements of interest in 31DEC09

We expect to continue publishing the *AIPSLetter* approximately every six months along with the annual releases. Henceforth, this publication will be primarily electronic. There have been several significant changes in 31DEC09 in the last six months. The most significant of these are new tasks and options in IMAGR to assist in boxing of sources. New task SABOX will prepare a list of boxes by using a SAD-like search over a set of facet images. New task FILIT simplifies the interactive checking and setting of boxes for a set of facet images, even those larger than the TV display window. IMAGR now has the ability to add to the OBOXFILE list of Clean boxes automatically. A new verb ROAMOFF was written to convert a TV display in TVROAM mode into a simple display which other *AIPS* tasks and verbs can handle. Another new verb DELAY will let users put measured pauses into scripts and procedures. The new task RLCOR will correct a single- or multi-source data set directly for the RL phase difference. (CLCOR will do this but only for multi-source data sets.) Support for 64-bit Linux operating systems was added since it was discovered that Intel-compiled load modules had a performance improvement over those computed for 32-bit systems.

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. 31DEC04 through 31DEC09 use a new numbering scheme for magnetic tape logical unit numbers that is incompatible with previous versions. Thus all tape tasks and the server TPMON must be from one of these six releases. Other than these issues, 31DEC09 is compatible in all major ways with the with the 15OCT98 and later releases. There are significant incompatibilities with older versions.

Imaging

Leonia Kogan noticed a clever way in which the "W" problem could be recast allowing multiple facets to be imaged accurately while remaining in the same coordinate system as the central tangent plane. The mathematics of this method are described in AIPS Memo 113 by Kogan and Greisen available from the AIPS web site. The "new" mathematics have been implemented in `IMAGR` when the adverb `DO3DIMAG = FALSE`. The previous imaging done with this parameter set to false was known to be incorrect for significant shifts from the center, but the present imaging is believed to be nearly as good as that done with `DO3DIMAG = TRUE`. The latter produces facets on different geometries, each tangent to the center of the facet. The implementation of both values of `DO3DIMAG` is now very similar and means that u, v depend on facet. This violates fundamental structures in a variety of old software, causing tasks `MX` and `HORUS` to be removed from AIPS.

Although `FLATN` will be needed in both cases to deal with overlapping facets, bad corners, and the like, the regridding done with `DO3D FALSE` will be much simpler. `FLATN` was revised recently to weight the corners of images — actually all pixels outside an inscribed ellipse — much lower than those pixels inside the ellipse. These pixels are much less reliable in synthesis imaging due to aliasing and accumulated mathematical error which is emphasized in the corners of images. The revised `FLATN` provides a method to avoid this down-weighting when the input images are reliable all the way to the edge.

Boxing — limiting Clean to portions of the input image only — has been well established as a method to reduce the problem of Clean taking noise bumps as sources. A completely unconstrained Clean often finds 10-40% more flux than is actually present in an image. If short spacings are missing, it is also capable of finding rather less flux than is present. However, in large imaging problems it is very time consuming to create the list of Clean boxes by hand using interactive verbs like `TVBOX`, `REBOX`, and `FILEBOX` OR their equivalents available with the TV display while `IMAGR` IS running. `IMAGR` has been given yet another array of parameters `IM2PARM`, the first of which are used to request and control a new auto-boxing capability. Each image facet is examined to find "islands" of emission above $n\sigma$. Those islands with a peak greater than F, where $F = \max(m\sigma, fP)$, $m \geq n$, P is the current peak residual, and $f = 0.1$ by default, may become a new Clean box if the peak is not already within a box. Only the strongest of these are actually taken as boxes at any one time. The maximum number of new boxes at any one time per facet, n, m, and f are set by `IM2PARM`, along with the number of pixels by which each box is extended outward and the diameter of the ellipse within the facet image which is examined for the rms and the islands.

To assist with the boxing, two new tasks were also written. `SABOX` uses the algorithm described above on a set of facets to make a list of boxes. One might do a preliminary image of a field with no boxing (*e.g.*, using the circles output by `SETFC`) and then run `SABOX` to produce a more accurate list of boxes for a deeper, more careful Clean. `FILIT` is an interactive task that allows the user to modify the list of boxes for a set of facet images. It uses a menu on the TV display to allow creation of new boxes, editing of existing boxes, and auto-boxing. It handles images larger than the TV display with a `TVROAM`-like function always followed by a `ROAMOFF` capture of the current sub-image. There is a full set of image enhancement functions and a way to alter the auto-boxing parameters while running the task. `FILIT` should be more efficient than the `FILEBOX` verb in `AIPS`, which functions only on a single sub-image of one facet at a time.

All interactive boxing routines were corrected to allow the display of the inscribed ellipse. Previously, they only understood circles, but rectangular images call for ellipses as do images loaded with `TXINC` not the same as `TYINC`. The creation of circular Clean boxes will now display ellipses when the display increments are not equal.

Three other changes were made to `IMAGR` as well. During Clean with `OVERLAP=2`, more than one facet is imaged at each cycle in an attempt to reduce the number of times it has to cycle through the uv work file looking for the strongest facet. This is useful some of the time, but has proved costly at other times. The parameter `IMAGRPRM(18)` was added to allow users to limit the number of facets imaged at each cycle. During testing with very large data sets (100 Gbyte uncompressed), it was found that `IMAGR` insisted on sorting the data when an `XY` sort was not required. Bugs in handling the sort test were found in two places and corrected to avoid excessive and time consuming sorts. The automatic restart of Cleaning after a "final" filtering was made an option, with the default being not to do this. The restart may be a good idea if the filtering (using `IMAGRPRM(8)` and `IMAGRPRM(9)`) changes the residual images significantly.

UV-data calibration and handling

CALIB continued to get corrections to the algorithm sub-dividing scans after the previous *AIPSLetter*. These made it into `31DEC08` directly and as patches. The `31DEC09` version only was changed to avoid counting fully flagged data as "failed" solutions.

FRING was corrected to remove a few spots that assumed the frequencies were in ascending order, after which it worked well on data in either order.

VLANT has had difficulties on some but not all Mac computers which were traced to a mysterious abort when the first record in a text file is null. We will avoid that in the VLA data files henceforth.

RLDIF was changed in the order of averaging and the reported sigmas which are now reasonable.

PCAL now allows the user control over the updating of the source table with the source polarization solutions.

RLCOR is a new task to apply the `POLR` corrections from `RLDIF` directly to a data set; the `CLCOR` route requires multi-source data.

CLCOR will now allow the `POLR OPCODE` on data which have not had `PCAL` run although it cannot correct the solutions in that case.

CLCOR has a new `OPCODE = 'IONO'` to correct delays for the ionosphere using data from an input text file.

SPLIT and `SPLAT` were corrected to deal smoothly with sources for which no data are found.

FITLD was corrected to handle files written by `FITAB` better. Multi-file tapes had trouble retaining the original file name/class and the `DOCONCAT` operation is no longer possible on such files. They are now written correctly which means that information needed to decide about concatenation is not available until well past the point where it would be required.

FILLM was changed to use, by default, the system shadowing bit in those format versions for which it was correct and 25m for the other versions. Shadowing is now correctly computed — except for sub-arrays — when the user specifies a shadowing diameter in the inputs. On-line `FILLM` should now actually stop when requested and the observation code changes.

Other UV-data matters

POLARXY the pole position will be tabulated in the usual arc seconds rather than the meters which was erroneously declared for *AIPS*. It is possible to tell the two units apart in the period 1979-2008 and all usages are checked and the units corrected if necessary.

FLOPM has a new option to reverse the IFs as well as the spectral channels.

DIFUV has a new `OPTYPE = 'DIV'` that will divide one data set into another, making a gains file which can be plotted with `UVPLT` and `VPLOT`, et al.

UVMOD will now read in a text file with up to 9999 source components, allowing more general models including components of all types and spectral index.

UVCON was changed to use the W term with the same sign as used in `UVMOD` and `IMAGR`. It was enhanced to allow multiple IFs with frequencies specified in the inputs.

LISTR was changed in a variety of ways to improve the `LIST` and `MATX` displays, including avoiding missing antennas and controlling whether a baseline is shown both as $n - m$ and $m - n$.

CMODEL was added to numerous tasks that compute models and the defaults were changed so that an error occurs on missing `CC` tables only when they are required by the user.

PRTAN was corrected to stop confusing row number with antenna number and was changed to recognize the new `EVLA` station names from the Widar correlator.

Display and image analysis matters

SNPLT was given the option of plotting the locations of failed (blanked) solutions.

TVROAM creates a scrolled, split screen display that baffles most *AIPS* TV functions. Added defenses to those functions so that they don't do bad things if they encounter such a display.

ROAMOFF is a new verb to take a display left by `TVROAM` and convert it into a single-plane image of the selected sub-image.

OFM files were updated to the new range of TV intensities. They worked when used in plotting but not when loaded to the TV.

ISPEC and `BLSUM` were given the option to save their results in `SL`ice extension files and all slice plotting and fitting routines were adjusted to use them.

XBASL was improved in its defaults, in its behavior when not writing output images of the parameters, and in its setting of windows. More information is now available in the `EXPLAIN` section.

WIPER was changed to display during editing the x, y coordinates in the scaled units of the display and the menu was re-arranged to reduce the chance of inadvertent `ABORT`s and `EXIT`s.

EDITR `EDITA`, `SNEDT`, and the edits in `SCMAP` and `SCIMG` had a blank menu item added before `ABORT` and `EXIT` to avoid inadvertent use.

System-wide matters

LNX64 is a new "operating system" supported by *AIPS*; it uses Intel-compiled tasks for 64-bit Linux computers and achieves some performance enhancement.

DELAY is a new verb to delay `AIPS` by a specified number of seconds; it should be useful in scripts.

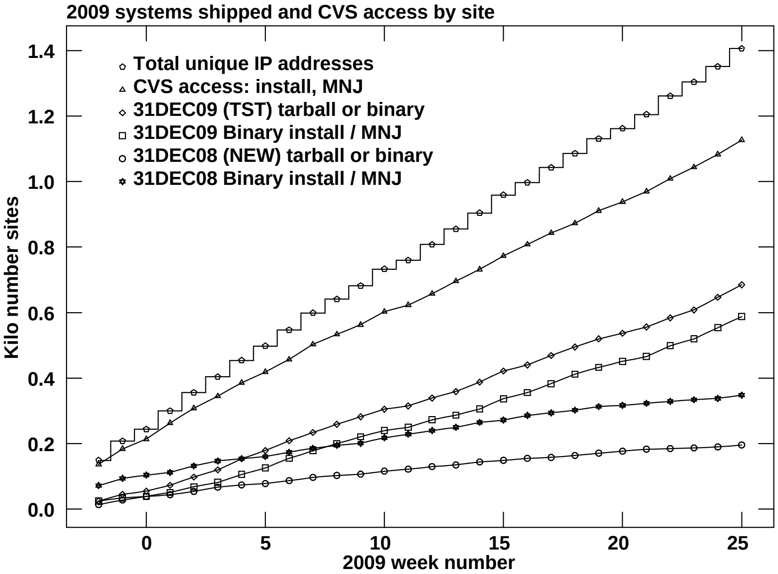
RENUMBER verb can now renumber an image or data set to slot numbers larger than those currently on the disk.

TIMDEST verb has been rendered inaccessible — it is really dangerous.

USERID adverb has been removed from all tasks and verbs except those that require it (`DISKU`, `MOVE`, and `PRTAC`). It was left in all plot-file tasks to avoid breaking `PLGET` and `EXTLIST`, but those tasks now ignore the `USERID` value entirely.

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 2009, there have been a total of 1406 IP addresses so far that have accessed the NRAO cvs master. Each of these has at least installed *AIPS* and **310** appear to have run the MNJ on `31DEC09` at least occasionally. During 2009 more than 196 IP addresses have downloaded the frozen form of `31DEC08`, while more than 685 IP addresses have downloaded `31DEC09`. The binary version was accessed for installation or MNJs by 348 sites in `31DEC08` and 588 sites in `31DEC09`. The attached figure shows the cumulative number of unique sites, cvs access sites, and binary and tar-ball download sites known to us as a function of week — so far — in 2009. These numbers are more than 12% greater than those reported one year ago for last year's releases.



Recent AIPS and related Memoranda

All AIPS Memoranda are available from the AIPS home page. There are three new memoranda in the last six months. In addition, a paper entitled "Aperture Synthesis Observations of the Nearby Spiral NGC 6503: Modeling the Thin and Thick Disks" by Greisen, E. W, Spekkens, K., & van Moorsel, G. A. has appeared in the Astronomical Journal, volume 137, pages 4718-4733. It contains an appendix which is a good description of imaging in AIPS and may be useful as a reference.

113 Faceted imaging in AIPS
Leonid Kogan & Eric W. Greisen (NRAO)
May 22, 2009
"Image-plane faceting," in which each small image plane or facet is computed as tangent to the celestial sphere, has been the solution to the "W problem" in AIPS for some time. This memo describes another approach in which the facets are all in the same plane which is tangent to the sphere at the center of the field of view. This "uv-plane faceting" method may have some computational advantages and has replaced the `DO3DIMAG = FALSE` methods in AIPS.

114 The FITS Interferometry Data Interchange Convention
Eric W. Greisen (NRAO)
June 25, 2009
The FITS Interferometry Data Interchange Convention ("FITS-IDI") is a set of conventions layered upon the standard FITS format to assist in the interchange of data recorded by interferometric telescopes, particularly at radio frequencies and very long baselines. It is in use for the VLBA telescope for data from the current hardware correlator and the future software correlator and has also been used with other correlators such as the JIVE correlator for the EVN. This convention is intended to separate a standard set of conventions from those used within particular software packages such as AIPS.

115 Auto-boxing for Clean in AIPS
Eric W. Greisen (NRAO)
June 29, 2009
Cotton (EVLA Memo 116) has demonstrated the importance of constraining the Clean deconvolution to search for model components only within restricted regions ("Clean boxes") of the dirty image. An option to create such boxes in an unbiased and automatic fashion has been added to the AIPS task `IMAGR` and two new tasks have been written to find these boxes in images which have already undergone a preliminary Clean. This memo describes the implementation of auto-boxing in AIPS.

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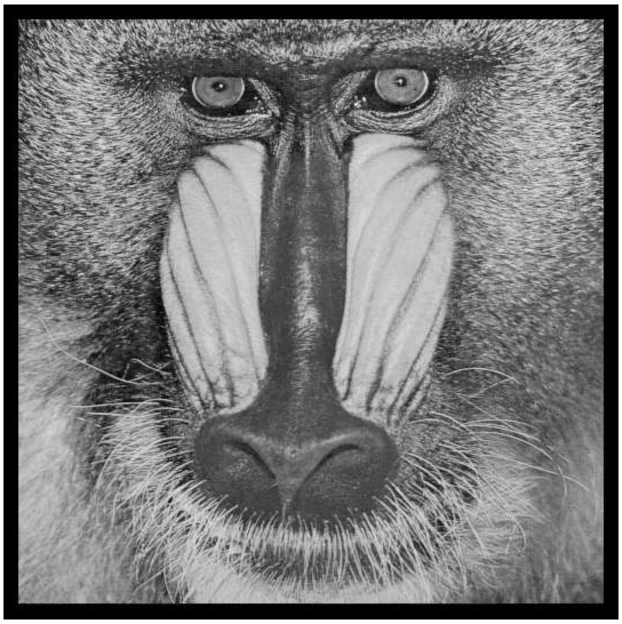

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National Radio Astronomy Observatory
Post Office Box O
Socorro, NM 87801-0387
USA