A I P S L E T T E R

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

Written by a cast of *AIPS*

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General developments in *AIPS*

Linux news

RedHat has released versions 7.0 and now 7.1 of their Linux system. The good news is that version 7.1 in particular contains numerous system improvements including the 2.4.2 kernel. This kernel allows *AIPS* to read and write files larger than 2 Gbytes. The bad news is that both of these releases include and depend on the "GNU compilers version 2.96." The quote marks are added because the GNU compiler group never released a version 2.96 and they have washed their hands of this "version" on their web site. We have found that the g77 compiler appears to work on *AIPS* but produces optimized code that is unreliable. IMAGR is one of the tasks that does not work correctly under this compiler and one should never use IMAGR without optimization. There are also problems with TV window setting, TVFLG, and who knows what else. We do recommend RedHat release 7.1, but you must also install the older GNU compiler suite version 2.95 and change your local copies of FDEFAULT.SH, CCOPTS.SH, and FDOPTS.SH to point at it. Some other Linux distributions also include the 2.96 compiler with the same unfortunate results.

Personnel changes

Pat Murphy, because of the press of his other duties, has asked to be relieved of all official duties in the *AIPS* Group. He has been a valuable member of the Group for over ten years and he will be missed. Like Bill Cotton before him, he has volunteered to advise the remaining group privately as needed. Additional assistance with operating system matters will now be provided by the very capable members of the Computer Division at the Array Operations Center in Socorro. Please direct inquiries to daip@nrao.edu and not to Pat's e-mail address.

Amy Mioduszewski joined the *AIPS* Group in Socorro in January. She has already had a significant impact in writing and improving a variety of PROCEDUREs for simplified data reduction.

Current and future releases

We have reinstated the old practice of having formal *AIPS* releases, but on an annual basis with binary releases only for Solaris and Linux. All architectures can do a full installation from the source files. The next release will be called 31DEC01 and remains under development by the (reduced) *AIPS* Group. You may fetch and install a complete copy of this version at any time. This *AIPSLetter* is intended to advise you of developments to date in this new release. Having fetched 31DEC01, you may update your installation

whenever you want either as a whole or by running the so-called "midnight job" which uses transaction files to copy and compile the code selectively based on the code changes and compilations we have done. We expect users to take the source-only version of 31DEC01 *AIPS* over the Internet (via *anonymous* ftp).

Improvements of interest to users in 31DEC01

We expect to continue publishing the *AIPSLetter* approximately every six months along with the annual releases. Despite the reduction in personnel, there have been a surprising number of changes in 31DEC01 over the past six months. There are five new tasks: CHKFC to check the contents of an IMAGR BOXFILE, DEFLG to flag data based on the level of decorrelation, SNFLG to flag data on a baseline basis based on phase jumps in the SN or CL table, VPFLG to make sure that all polarizations are flagged in a sample if any are, and DRCHK to test the installation control files for correctness. A new verb was written called EPOCONV to convert epochs in the COORDINA adverb. New VLBA Utility procedures are also available.

Other than relatively minor differences, 31DEC01 is compatible in all major ways with the 2000, 1999, and 15OCT98 releases. There are significant incompatibilities with older versions.

Imaging

IMAGR

IMAGR was given a variety of more esoteric options during the past 6 months In the "OVERLAP *n*" mode, it tries to guess which field to Clean next by examining the residual images which mostly do not reflect the recently removed Clean components. IMAGR was changed to re-examine its selection after the particular field chosen is imaged with the current residual data. If the field no longer appears promising, IMAGR now tries again with another field. This can cause several fields to be re-imaged before one is Cleaned but avoids Cleaning noise. IMAGRPRM(20) was added to modify this action. The same loop that selects a field now checks to see if the FLUX level has been reached in all fields and causes the task to exit more reliably than it used to. The adverb FGAUSS was added so that a separate FLUX level could be used for each of multiple resolutions. The BOXFILE may now be used to add a spectral-channel-dependent scaling for the data weights. This allows bandwidth synthesis to use outer, less reliable channels but at a reduced weight.

A bug that caused all fields to be re-imaged whenever only one pixel in the field was cleaned has apparently been corrected.

Wide-field imaging

Because of a significant number of observation at 74MHz with the VLA, the tasks that assist with wide-field imaging received considerable attention. A new task called CHKFC was written. It makes "images" of all the fields and Clean boxes in a BOXFILE. Application of FLATN to the output produces an image of the wide field showing the location of each sub-field and each Clean box. This is particularly useful for finding areas not included in any Clean box.

SETFC was changed to take the maximum size of the circular Clean box into account as well as the user's overlap parameter. The latter needs to be only a few not something like 15 now. An option to write circular Clean boxes in outlier fields was added. This task and FACES were changed to try, in the fly-eye portion, an excessively large number of fields, selecting the innermost fields up to 512 and guaranteeing that (0,0) is in the center of the innermost field. A warning is issued if the 512 fields may not be enough to cover the requested area. The flux scaling was corrected and a scaling option was added to SETFC.

Improved VLA primary beam patterns at 327 and 74 MHz were measured by Rick Perley and added to the above tasks as well as to PBCOR and PATGN. PBCOR's handling of data cubes was repaired.

Other imaging changes

CCEDT was given both BOXFILE and CLBOX as alternative methods for entering Clean boxes. These are in pixels while CCBOX is in arc seconds.

SCMAP and SCIMG were corrected to handle taper properly, to set the correct defaults for Clean boxes, and to set and to propagate properly the "number of channels averaged" parameter.

WTMOD was improved to handle compressed data; that type of data is easier to deal with for weights than uncompressed.

New VLBA/VLBI calibration procedures in *AIPS*

For the past year the *AIPS* group has been developing procedures to simplify the reduction of VLBA data and, in many cases, other VLBI data as well. These procedures are contained in the RUN file VLBAUTIL available in the 31DEC01 release of *AIPS*. They include procedures to load, "fix", calibrate, and examine data, up to and including fringe fitting. Using these procedures, it takes only a few hours to take a typical twelve-hour continuum phase-referencing experiment from loading to imaging with most of the time being spent loading the data and fringe fitting. These procedures not only simplify the inputs to tasks, but run the variety of "bookkeeping" tasks that need to be performed for a calibration step. For example, the fringe-fitting procedures fringe fit and then apply the calibration by looping through the sources.

The procedures can be separated into three categories: procedures that should be run for all experiments, special case procedures (multiple subarrays, multiple frequencies and polarization data), and data examination procedures. In the first category there are procedures to load, remove redundant calibration tables, determine a-priori amplitude corrections, determine instrumental phase corrections, and fringe fit the data. The special case procedures will find subarrays, copy different frequencies to separate files, fix polarization labelling, correct parallactic angles, and calibrate cross-polarized delays. To examine data there are procedures that print the antenna and scan information for the experiment, plot the calibration tables verses time, and plot the cross-correlation spectrum.

Procedures needed to simplify many of the initial VLBI data reduction steps in *AIPS* are available to users after they enter the command RUN VLBAUTIL. An *AIPS* Memo (see later in this *AIPSLetter*) has been written to describe these procedures. They are also described in the latest versions of Chapter 9 and Appendix C of the *CookBook*. The procedures include:

- VLBALOAD: loads VLBA data with simplified inputs
- VLBASUBS: finds subarrays in VLBA data
- VLBAMCAL: removes redundant calibration data from tables
- VLBAFQS: copies different frequency IDs to separate files
- VLBAFPOL: fixes polarization labelling for common cases
- VLBASUMM: makes summary listings of your data set
- VLBACALA: determines *a-priori* amplitude calibrations
- VLBAPANG: determines phase corrections for parallactic angles
- VLBACPOL: calibrates cross polarization delays
- VLBAPCOR: determines instrumental phase corrections
- VLBAFRNG: does global fringe fit using FRING
- VLBAKRNG: does global fringe fit using KRING
- VLBAFRGP: does global fringe fit for phase referenced experiments using FRING
- VLBAKRGP: does global fringe fit for phase referenced experiments using KRING

- VLBASNPL: plots the SN or CL tables versus time
- VLBACRPL: plots the cross-correlation spectrum

The old procedure CROSSPOL has been replaced in functionality by VLBACPOL. The VLAPROCS run file also received some improvements mostly to remove the "hidden" adverbs which were not shown in the INPUTS but which affected the outcome. A DOPRINT adverb has been added to VLACALIB to control the amount of printed output.

Data reading and writing

FILLM, the task that translates VLA on-line data into *AIPS* was found to have several subtle but unpleasant bugs. One bug caused the program to go into "solar" mode if the ninth character of a source name was S or to fail to go into solar mode when it should if the first scan of the data set was not an observation of the Sun. Another bug caused it to trash a few visibilities at the end of a scan if it found the need to create a new file to hold the data of the next scan. FILLM also failed to respond properly if the number of antennas changed. The "channel-0" data computed by the on-line system is computed before certain operations such as Hanning smoothing and, as a result, does not completely match the data on the tape. FILLM now computes new channel-0 data by default rather than using those provided by the on-line system. The spectral-line observer may choose to include or discard autocorrelation data with the adverb DOACOR.

FITLD was corrected to turn off VLBA-specific corrections when the data, written in IDI FITS format, are found to be from a correlator other than the VLBA correlator. This simplifies and corrects the processing of data from the EVN (JIVE) correlator. The use of FREQSEL in FITLD to select a single frequency ID was corrected. Several tables were found not to be rearranged and edited to have the new numbers and not to have the unselected data. The logic for handling this selection was greatly simplified and it is now believed to be reliable.

FITS disk files were read and written in *AIPS* using standard Fortran I/O methods. Several operating systems have been improved to allow the use of files larger than 2 Gbytes. Unfortunately, these improvements did not extend to the Fortran implementations. Therefore, the *AIPS* reading and writing of FITS disk files were converted to use C methods similar to those used on the internal data files. Any size file should now be handled.

UV data calibration

Editing

Three new editing tasks were written in the last six months. SNFLG is based on code submitted by Lincoln Greenhill and Mark Reid of CfA. It examines an SN or CL table and flags data whenever the phase changes between two solution times by more than a user-specified amount. It does this on a baseline basis since the phase may be stable enough for interpolation between certain antennas (probably adjacent) but not between more widely spaced antennas. The task DEFLG also looks for a loss of coherence by examining the ratio of the vector averaged amplitude to the scalar averaged amplitude over a moving window in time. Clearly, this algorithm requires a mostly unresolved source with good signal-to-noise, but the algorithm may have considerable use in phase-referenced observations. The third task, VPFLG is designed primarily for observations that require the same data sampling in all polarizations. By default, the VLA on-line system and *AIPS* do not flag, for example, LL when RR is bad. VPFLG flags the data of all polarizations in a sample when one or more of the polarizations is flagged and also edits the FG table for the same purpose. CLIPM was changed to copy the input flag table before appending new flags to it. This will make it much easier to undo the operation if needed.

Bandpass calibration

The shifting of the bandpass as a function of time was done on a baseline basis in BPASS before the antenna bandpass shapes were determined. This was corrected to shift the individual antenna bandpass shapes after the fit with no shifts in advance. Both BPASS and CPASS were supposed to be able to use Clean component source models for normalization instead of a self-determined "channel-0." A bug was found and corrected that prevented this mode from working and, for convenience and speed, the CMETHOD adverb was added to both tasks. The vector division by a channel-0 suffers from a Ricean noise bias in the amplitude which becomes very serious in cases of low signal-to-noise. New normalization options have been added to BPASS which help with this problem.

CPASS was also revised to include but give zero weight to channels outside the BCHAN to ECHAN range. It now offers three options for a weighted solution: uniform, input data weights, and apparent uncertainty from the pre-averaging (tempered some by the input data weights). A "new" method of bandpass calibration appears promising. First, BPASS is run on a single strong calibrator scan and applied with SPLAT to remove the main, time-invariant portion of the bandpass shape. Then CPASS, with only a modest number of parameters, is used on the main (weaker) calibrator source to find the time variable portion of the bandpass shape.

With most of our data, the weights should be independent of spectral channel. However, the complex gains need not average 1.0 for amplitude. Indeed, CALIB is really not needed; BPASS could be used for all parts of the complex gain. The calibration application code was changed so that, when calibrating data weights, the average amplitude in the bandpass shape is determined and that average is applied to the weights. For VLB data, the average is determined over all channels; for other telescopes, the average is determined over the inner three quarters of the channels.

Other changes

PCAL has not computed errors correctly in some time. They appeared reasonable however until the new (correct) weights were instituted. Steve Myers provided corrections to the error computation that seem to provide meaningful results.

PCAL had a bug that caused it to use the data of the first spectral channel and first IF rather than averaging the spectral channels and (optionally) the IFs as claimed. Answers produced from multi-spectral data were much noisier as a result.

CALIB was given the option to limit the gain normalization determination to elevations above a user-specified angle.

CLCOR was changed to put source coordinate or antenna location corrections into the SU and AN tables, respectively, as well as, in the form of phase corrections, into the CL table. This means that one cannot undo source and antenna corrections simply by deleting a version of the CL table. They must be undone by re-running CLCOR with parameters of the opposite sign.

LISTR was changed to allow the display of T_{ant} as well as T_{sys} from the TY table and the scaling of such displays was improved.

Model computations can cause *uv* data to be flagged if the baseline lies outside the area of the gridded modeling. The routine responsible issued a few warnings and then went silent. Now it continues to count the total number of such deletions and reports that loudly.

FRING had an error computing the addresses in the AP for fringe fitting in the case of unevenly distributed frequency channels. The results were rather obviously bad since the FFTs overlapped each other.

Modeling

The subject of Gaussian fitting in the presence of correlated noise is being studied again. So far the results of these studies have not been incorporated into code, but they will be. The good news is that the error estimates from JMFIT, IMFIT, and SAD are reasonable even if they are not completely right. The one change to the code was the removal of a reduction of the error estimate by $\sqrt{2}$ when the component widths are held fixed. Such a reduction is appropriate when the object is very much larger than the correlation length in the noise (*i.e.*, the Clean beam), but astronomical objects never look like Gaussians when observed with such good resolution. For small-diameter objects, the noise in the peak value is actually higher when the widths are not fit. *For such objects, the best estimate of the total flux is the peak value found when fitting all 6 parameters.*

The tasks UVCON and CONFI used to study array configurations will be discussed in a separate article in this *AIPSLetter*. CONFI was enhanced to allow up to 2000 antennas (*i.e.*, SKA) and to handle an initial configuration in the form of a hexagonal tile with an arbitrary number of antennas. It determines "bad" topography locations with greater accuracy and can now write an output file for use by CONFI as well as one used to restart UVCON. UVCON was corrected and enhanced to make images around any arbitrary coordinate from a normal *AIPS* multi-field Clean components model and to allow up to 2000 antennas.

Miscellaneous matters

EPOCONV is a new verb which converts the COORDINA adverb between J2000 and B1950 coordinate systems.

CookBook chapters have been updated to mention the new editing tasks, changes to VLACALIB, and especially the new VLBAUTIL procedures. See the *AIPS* Web pages for the changes and new copies of the relevant chapters.

PLOTR was enhanced to plot up to 10 parameters at the same time and to plot functions of the X and Y arguments other than simple linear axes.

POSSM was debugged yet again. It had trouble plotting multiple IFs particularly when looping for multiple time ranges. It listed frequencies incorrectly for single-source files as well.

VPLOT was changed to display the arbitrary 5-day offsets in multiple sub-array data sets; the absence of the offset was confusing since it is required in TIMERANGE and by UVFLG and other tasks.

TVFLG was corrected so that CLIP BY FORM would do its operation correctly. It was capable of aborting, doing nothing, or using the wrong Stokes-flag pattern half the time depending on the compiler.

Polar images encountered trouble when plotting the coordinate axes. The code for DOCIRCLE was corrected (and greatly simplified) although it may now be a bit slower.

Programmer tidbits

ZAP has been upgraded to deal with cases in which the file header is missing. The algorithm that attempts to delete all associated files is brutal but computers are fast now.

CCOPTS has been changed for Solaris Ultra and Linux to compile all C routines with 64-bit file offsets. This parameter is not known except to systems that can use it so, now, *AIPS* installations that can handle files greater than 2 Gbytes in size will actually be compiled to do so.

FDEFAULTS has been moved in part to system-dependent locations and reduced to handle only the appropriate system in each of the locations. The file will end up in $SYSLOCAL but the compile procedure searches first $SYSLOCAL, then $AIPS_VERSION/$ARCH/SYSTEM and finally $SYSUNIX. This will make it easier to make local versions of the file as required, for example, by RedHat 7.1.

PRTAC has been enhanced to allow the system manager to determine *AIPS* usage statistics over all computers at a site.

DRCHK is a new stand-alone utility that checks the HOSTS.LIST, DADEVS.LIST, and NETSP files for accuracy and agreement. It is very helpful for identifying missing computers, data areas, and incomplete descriptions of such things.

Accuracy of single-precision floating-point numbers became an issue twice in the last six months. Subarray numbers are stored as $0.01(Subar - 1)$ added to $256Ant_1 + Ant_2$ in the baseline code. If DBCON has to change the current subarray number too many times, the accumulated error in adding 0.01 several times was enough to make the scheme for finding the subarray number in most *AIPS* tasks fail. Comments were added to DBCON's help file and the scheme was improved uniformly. IMAGR occasionally makes images with large values in the corners. This is due to a very large number (*e.g.*, 10^5) samples being gridded into the same *uv* cell, a case that arose with small fields, large data sets, and many pseudo-continuum spectral channels. Making larger images usually resolves this problem.

AIPS Distribution

By June 18, 2001, 266 copies of the 31DEC01 release had been distributed, all by ftp. This version remains under active development, so a few of the sites have begun taking updates regularly via the "midnight job." We recommend this to all serious *AIPS* users. Of the 40 sites which have registered their use of 31DEC01, 2/3 report that Linux is their primary architecture and 1/3 Solaris.

Also by June 18, 2001, 174 copies of the now frozen 31DEC00 release had been distributed, 161 by ftp. (This is added to the 407 sites that took copies of 31DEC00 when it was called 31DEC99, via ftp before it was frozen.) We believe that some sites have taken the full release more than once at different dates, but we do not have an accurate count of these. The distribution of 31DEC00 continues. Almost all of the distribution has been of source-code only. Binaries are distributed on CDs and 10 sites downloaded binaries via ftp in the last 6 months. Of 581 non-NRAO sites receiving 31DEC00 only 84 (14%!!) have registered. We remind serious *AIPS* users that registration is expected in order to receive user support.

The first table below shows the breakdown of how the (preliminary and frozen) copies of 31DEC00 were distributed. The second table below is based on the disappointing number of registered installations of the various releases. It indicates that the distribution over operating systems was heavily weighted toward Solaris previously, but that Linux is now slightly preferred. However, when asked about "primary" architecture, 71% of our users answered Linux for 31DEC00 and 20% answered some flavor of Sun OS. Linux has, for the moment, won.

	ftp	CDrom	8mm	4mm	ZIP	Floppy
15OCT98	242	71	8	1	0	0
15APR99	290	69	0	2	0	0
15OCT99	277	102	1	2	0	0
31DEC00	568	13	-	-	-	-

OS	31DEC00 %	15OCT99 %	15APR99 %	15OCT98 %	15APR98 %	15OCT97 %	15APR97 %	15OCT96 %
Linux	46	33	27	27	19	23	16	19
Solaris	46	54	53	61	66	50	66	46
Dec Alpha	3	1	4	3	7	9	6	10
SGI	3	4	13	1	3	1	1	5
HP-UX	2	5	2	5	2	3	6	4
SunOS 4	0	1	1	1	4	14	5	13
Alpha Linux	0	1	0	0				
IBM /AIX		0	0	2	1	0	0	4

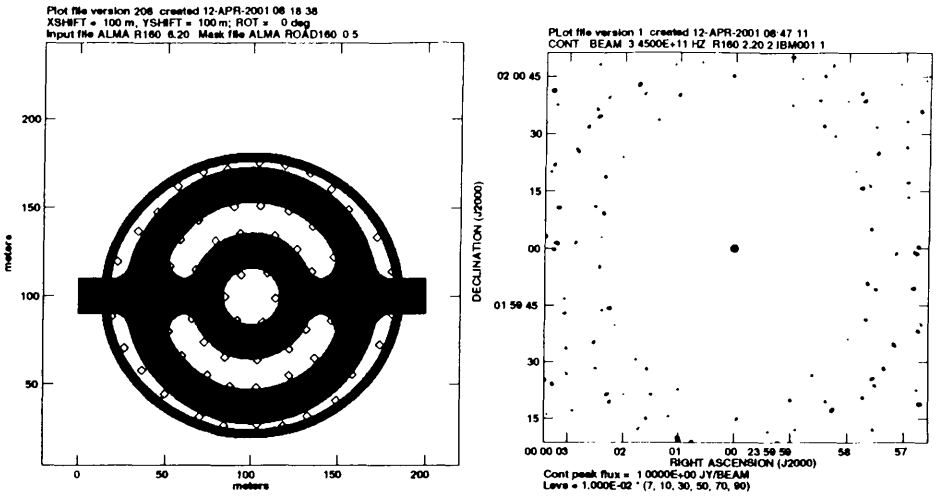


Figure 1: The version of ALMA's compact configuration including the road design. The optimization of the side lobes is carried out for the double total size of the antenna primary beam. The left plot presents antenna positions (diamonds) and roads to make an access to the antennas for the reconfiguration. The roads are specified as the input 'topography' file to the task CONFI. The right plot presents the two dimensional beam of the array.

AIPS participation in the design of array configurations

The optimization of an array configuration is very important in obtaining the best image quality from a given number of antennas of a given diameter. The algorithm of the optimization minimizing the worst side lobe at the given circle in the sky was designed by L. Kogan (*IEEE Transactions on AP*, Vol 48, No. 7, July 2000). The algorithm is coded as *AIPS* task `CONFI`. This task starts with an initial configuration given either as a table of antenna coordinates in an input text file or as one of several standard configurations such as one, two, or three circles or a hexagon tile. The optimization can be carried out under the following constraints: two circles, doughnut, topography, minimum distance between the antennas. The optimum configuration found is stored in the output file in two formats: (1) `CONFI` format to use the output file as input for `CONFI` to continue the process of optimization or (2).`UVCON` format to use the output file as the input for the simulation task `UVCON`.

The *AIPS* task `UVCON` is used to generate a *uv* database for an interferometric array whose configuration is specified by the user. Visibilities corresponding to a specified model and Gaussian noise appropriate for the specified antenna characteristics are calculated. The model can be specified as a point, a Gaussian source, an image, or a set of Clean components. The output is a standard *AIPS* *uv* data file. This task replaces and enhances an old procedure which required use of the *AIPS* tasks `UVSIM`, `UVSUM`, and `UVMOD` and verb `PUTHEAD`. The array geometry can be specified in four different coordinate systems: earth-centered equatorial, local tangent plane, geodetic, and array-centered equatorial. The coordinate system can be mixed for different antennas in the array. This feature allows for example adding new antennas in geodetic coordinates to the existing VLA antennas which use an array-centered equatorial coordinate system (as for the EVLA project).

The tasks `CONFI` and `UVCON` have been actively used in the study of configurations for ALMA by both the USA (M. Yun, L. Kogan) and European group (J. Conway). The simulation task `UVCON` has been used very intensively by Steven Heddle (Royal Observatory at Edinburgh, UK) for ALMA to compare the two group's designs (Alma Memo #290, March 2000, "Automation of Imaging simulation for array configurations using Classic *AIPS*" by S.Heddle and A. Webster, `http://www.heddle97.freeserve.co.uk/ALMA/CLEANIND.HTM`). `UVCON` was used for simulation of the future EVLA configuration (EVLA Memo #20 December, 2000, "Configuration Studies for the Expanded Very Large Array" by A. Cohen and R. Perley). Recently `CONFI` and `UVCON` were enhanced so they may be used in design of SKA, allowing up to 2000 antennas.

Recent *AIPS* and related Memoranda

The following new *AIPS* Memoranda are available from the *AIPS* home page.

105 *AIPS* Procedures for Initial VLBA Data Reduction
Jim Ulvestad, Eric W. Greisen, & Amy Mioduszewski (NRAO)
Version 2.0: April 26, 2001
This memo provides a guide to procedures currently available in *AIPS* (some in 31DEC00, all in 31DEC01) to do the initial processing steps of VLBA data reduction. These procedures are designed for VLBA-only observations, and make a number of assumptions that may not be appropriate for other types of VLBI experiments. Therefore, they should be used only with extreme caution for observations including non-VLBA antennas. The present memo discusses the key defaults that are used in the VLBA procedures, as well as the times when these procedures may not be appropriate. For more details regarding the procedures in the full context of VLBI data reduction, see Chapter 9 and Appendix C of the *AIPS CookBook*.

106 Making Movies from Radio Astronomical Images with *AIPS*
C. C. Cheung, D. C. Homan, J. F. C. Wardle, and D. H. Roberts
Brandeis University
June 6, 2001
We present a detailed recipe for making movies from multi-epoch radio observations of astronomical sources. Images are interpolated linearly in time to create a smooth succession of frames so that a continuous movie can be compiled. Here, we outline the procedure, and draw attention to specific details necessary for making a successful movie. In particular, we discuss the issues pertaining specifically to making polarization movies. The procedure described here has been implemented into scripts in NRAO's AIPS package (Brandeis AIPS Movie Maker – BAMM) that are available for public use (`http://www.astro.brandeis.edu`).

Patch Distribution for 31DEC00

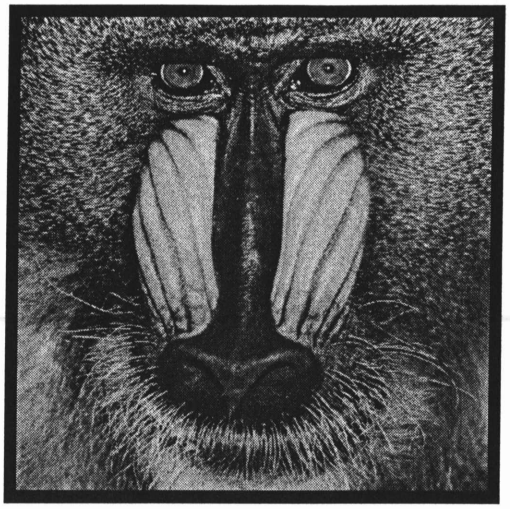
As before, important bug fixes and selected improvements in 31DEC00 can be downloaded via the Web beginning at:

`http://www.cv.nrao.edu/aips/patch.html`

Alternatively one can use *anonymous* `ftp` on the NRAO cpu `aips.nrao.edu`. Documentation about patches to a release is placed in the anonymous-ftp area `pub/aips/`*release-name* and the code is placed in suitable subdirectories below this. Information on patches and how to fetch and apply them is also available through the World-Wide Web pages for *AIPS*. As bugs in 31DEC01 are found, they are simply corrected since 31DEC01 remains under development. Corrections and additions are made with a midnight job rather than with manual patches. Remember, no matter when you received your 31DEC00 "tape," *you must* fetch and install its patches if you require them. Also note that we do not expect to make any more patches to 31DEC00.

The 31DEC00 release had a few important patches including a new one in late May. These were:

1. SCMAP and SCIMG fail to handle taper correctly and SCIMG does not average channels and IFs. *2001-01-23.*
2. FILLM failed to catch Solar mode when it should and asserted that mode sometimes when it shouldn't *2001-01-26.*
3. UVCON needed updating to match changes made to the handling of model computation *2001-02-01.*
4. PBCOR fails to work correctly on data cubes *2001-04-09.*
5. FRING fails to work correctly on irregularly sampled data *2001-05-29.*



June 30, 2001

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AIPSLETTER

Volume XXI, Number 2: December 31, 2001

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

Written by a cast of *AIPS*

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General developments in *AIPS*

Move of the *AIPS* home

Since what remains of the *AIPS* programming group is now all in Socorro, we have decided to move all software functions to the Array Operations center. The primary address for reaching the *AIPS* group remains daip@nrao.edu. The web address will change to http://www.aoc.nrao.edu/aips and the ftp address will become ftp://ftp.aoc.nrao.edu/computing/aips. Ernie Allen in Charlottesville will continue to assist the group by handling registrations, usage statistics, and requests for tapes, CDroms, and paper documents. Ernie may be reached at aipsmail@nrao.edu for which he performs triage and at eallen@nrao.edu.

The "Midnight Job" has been changed. The secure shell, with all its fragile complexities, will no longer be required. Instead mnj.aoc.nrao.edu will serve up *AIPS* incrementally — or as a whole — using the Unix tool cvs running with anonymous ftp. 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 at present. Further changes to the MNJ will be discussed later in the *AIPSLetter*.

Linux news

RedHat has released versions 7.0, 7.1, and 7.2 of their Linux system. The good news is that version 7.1 and beyond contain numerous system improvements including the 2.4.2 kernel. This kernel allows *AIPS* to read and write files larger than 2 Gbytes. The bad news is that these releases include and depend on the "GNU compilers version 2.96." The quote marks are added because the GNU compiler group never released a version 2.96 and they do not support this "version." We have found that this g77 produces optimized code that is unreliable. There are problems with IMAGR, TV window setting, TVFLG, and who knows what else. We do recommend RedHat release 7.2, but you must also install the GNU compiler suite version 2.95 (now 2.95.3) or 3.0+ (now 3.0.3) — both of which work well — and change your local copies of FDEFAULT.SH, CCOPTS.SH, and FDOPTS.SH to point at it. Some other Linux distributions also include the 2.96 compiler with the same unfortunate results. Instructions for fetching and installing the real GNU compilers are given on the *AIPS* web page.

Current and future releases

We have reinstated the old practice of having formal *AIPS* releases, but on an annual basis with binary releases only for Solaris and Linux. All architectures can do a full installation from the source files. The current release is called 31DEC01 and is now frozen. You may fetch a copy of this version from either our Charlottesville (www.cv.nrao.edu/aips) or Socorro (www.aoc.nrao.edu/aips) web sites. Copies of 31DEC01 on CDrom or magnetic tape may be ordered from Ernie Allen at aipsmail@nrao.edu. This issue of the *AIPSLetter* is intended to advise you of developments in the last six months in this new release; the June 30 issue of the *AIPSLetter* covered the first six months.

A new version of *AIPS*, called 31DEC02, is now under development by the *AIPS* Group. You may fetch (from the aoc web site only) and install a complete copy of this version at any time. Having fetched 31DEC02, you may update your installation whenever you want either as a whole or by running the so-called "midnight job" which uses transaction files to copy and compile the code selectively based on the code changes and compilations we have done. We expect users to take the source-only version of *AIPS* over the Internet (via *anonymous* ftp).

Improvements of interest to users in 31DEC01

We expect to continue publishing the *AIPSLetter* approximately every six months with the December *AIPSLetter*s tied to the annual releases. The June 30, 2001 *AIPSLetter* described a surprising number of changes in 31DEC01 over its first six months. That *AIPSLetter* described five new tasks: CHKFC to check the contents of an IMAGR BOXFILE, DEFLG to flag data based on the level of decorrelation, SNFLG to flag data on a baseline basis based on phase jumps in the SN or CL table, VPFLG to make sure that all polarizations are flagged in a sample if any are, and DRCHK to test the installation control files for correctness. A new verb was written called EPOCONV to convert epochs in the COORDINA adverb. New VLBA Utility procedures also became available. Significant improvements in IMAGR, SETFC, FILLM, FITLD, BPASS, PCAL, CLCOR, SAD, TVFLG, ZAP, and others were described. That *AIPSLetter* is available from either of the two web sites above.

In the last six months, the level of activity has been less surprising. There is a new procedure FITDISK to write data using FITTP to disk files with names based on the internal file names. A new pseudoverb USAVE allows the POPS environment to be saved to another user number. The new task RMSD computes the local rms in a moving 2-dimensional window. Wendy Lane and Joe Lazio of NRL contributed a new task UVWAX to delete data based on the (u, v, w) location. Bryan Butler has contributed some significant improvements to FILLM. TECOR was made more convenient to use and was discovered to be very helpful even at relatively high frequencies.

Other than relatively minor differences, 31DEC01 is compatible in all major ways with the 2000, 1999, and 15OCT98 releases. There are significant incompatibilities with older versions.

Data reading and writing

FILLM

FILLM, the task that translates VLA on-line data into *AIPS* was enhanced significantly by Bryan Butler. For moving sources, FILLM now creates and fills a source position (PO) table. For the present there are no tasks that use these data other than the various generic table-handling tasks such as PRTAB, TAPLT, TASRT, etc. In all cases, FILLM now also creates a weather data (WX) table and fills it with the weather data recorded at the VLA. The task now puts real information into the initial CL calibration table using the weather

data to calculate opacity and a text file (called $AIPSIONS/VLA.GAINS) to provide the gain curve correction. These operations are controlled by a variety of user adverbs. Note that this change means that, in later calibration steps, users will need to set DOCALIB = 2 even when GAINUSE is one. The shadowing checks, by default, now use internal information covering all antennas rather than simply checking those antennas in the current subarray. A new option was added to CPARM(2) to have the task ignore all source qualifier numbers.

Other changes included a correction to the center coordinate used for the VLA. The default behavior of CPARM(7) was changed for spectral-line data: = 0 gets a new FQ number on a 30 km/sec change in velocity, < 0 gets only 1 FQ number in all cases, and > 0 is the frequency tolerance in kHz for a new FQ number. FILLM now renames a source if its RA and/or Dec differ from those of an identically named and qualified source. Added a bit to CPARM(2) for planetary observations where position changes are to be ignored.

Others

A new standard procedure called FITDISK was written. After a RUN FITDISK you may use the procedure to construct an output disk file name from the *AIPS* internal file name and sequence number and then to run FITTP. In the output name, trailing blanks are discarded and embedded blanks are replaced with underscores. The name, class, and sequence number are connected by periods.

A non-trivial error was found in the precession routines used for J2000 coordinates. When a coordinate was precessed from apparent to mean and back again it did not return to its initial value. Some of this was due to a scheme for interpolation in the routines that attempted to avoid excess computation, primarily by UVFIX. FITLD misinterpreted this parameter and a bug within the routines caused coordinate errors of 0.2 arc seconds or more. This bug and the usage of the routines by FITLD and CLCOR was corrected. A more subtle set of errors was also present. The routines assumed that the conversion could be done simply by changing the sign of the time interval. If all terms used only odd powers of time, that would be okay. But they don't. Proper inverse matrices were found to implement the precession properly.

FITLD was corrected to rebuild CQ tables after reading each file. The previous code simply made a mess of things. The DELCORR adverb was removed since the correction should always be done for VLBA Correlator data and never done for other correlators. The attempt to guarantee that there is always data for FQ number 1 caused incorrect frequencies to be written to the FQ table when the first data encountered were from a correlator FQ number other than 1. The parameters controlling the maximum number of channels and the like were changed to those used in the rest of *AIPS*; a data set with 8192 spectral channels and 2 polarizations needed to be read! This data set also uncovered a bug comparing the buffer sizes to those needed. Data sets with different FQ numbers but identical frequencies caused some errors in logic which have been repaired.

UVLOD and its copy in FITLD attempted to convert abnormal Stokes and Complex axes to normal ones. The conversion was suppressed for another case that would not be handled properly.

UV data calibration

VLBA ionospheric calibration

Application of global ionospheric models has been found, in many cases, to improve greatly the calibration of the phases of VLBA visibility data, particularly near solar maximum. This can be especially important in phase-referencing observations, where determination of the relative phase ambiguity between two adjacent calibrator scans is necessary to calibrate the program source properly. The calibration can be performed by correcting the ionospheric dispersive delay using global GPS models for the ionosphere and the *AIPS* task TECOR; for details see the TECOR explain file as well as VLBA Scientific Memos 22 and 23. TECOR has been upgraded to permit the use of global ionospheric models that cover multiple UT days, necessary for any observations that approach or cross UT midnight.

We have determined recently that, in at least some circumstances, the ionospheric effects are large enough to have a significant impact at observing frequencies as high as 5 GHz or 8 GHz. This result has been written up as VLBA Test Memo No. 68; the Test Memo and the aforementioned Scientific Memos are available on the VLBA web site. We strongly recommend that VLBA observers using phase-referencing at frequencies

up to 8 GHz run TECOR before final fringe-fitting on the calibrator. The most careful observers may wish to compare fringe-fit solutions with and without TECOR to insure that the correction has helped their data, since at times, it may not be necessary at the higher frequencies. However, using TECOR when it is not necessary is unlikely to harm the data.

Editing

A new task, UVWAX, was submitted by Wendy Lane and Joe Lazio of the Naval Research Laboratory. It flags data when the values of $|u|$ and $|v|$ are in a specified rectangular box and/or when $|w|$ is in a specified range of values. Primarily this is used to get rid of data with near-zero fringe rates and data with large $|w|$ which may require large numbers of small facets in imaging.

TVFLG and SPFLG were given a new option to expand the time ranges flagged by DPARM(5) seconds. The times assigned to data in these tasks result from a gridding process and therefore may not exactly match those in the data, making this option essential. UVCOP was changed to apply all flag table entries regardless of source number to single-source data sets. Previously, flags with non-zero source number were not applied.

Other changes

ELINT now displays the uncertainties in the polynomial coefficients it has fit.

ACCOR no longer writes SN entries for integration periods which are significantly less than SOLINT since they are excessively noisy. The source number is no longer written when SOLINT is > 0, since multiple sources may be involved. The default SOLINT has been reduced to 2 minutes since the automatic gain control can change sampler voltages on fairly short time scales.

FRING was corrected to use the adverb CMETHOD which it had ignored. All model computations using Gaussian components were made more likely to work with gridded methods by loosening the requirement for exact match in all width parameters.

SPLIT was corrected to leave the velocity system parameters alone when calibrating single-source data.

Various calibration procedures were also revised:

VLACALIB (in VLAPROCS) was given the DOBAND and BLVER adverbs so that it can be used with spectral-line data.

VLACLCAL (in VLAPROCS) was changed to remove numerous "hidden" adverbs and to give the user control over the LISTR output.

VLBACALA (in VLBAUTIL) was corrected to have a reasonable, rather than way too small, clip level to apply to the SN table generated by APCAL. This replaces an absence of amplitude clipping and, for November 23 – December 19, an excess of such clipping.

VLBACPOL (in VLBAUTIL) was changed to apply the SN table to all antennas. Clarifications were made in the help file.

Imaging

IMAGR received less than its usual share of attention. The handling of BOXFILEs was clarified so that leading blanks are always ignored by IMAGR and FILEBOX. Errors giving a field number to IMAGR no longer cause it to quit. The use of negative FLUX caused confusion in the default values for FGAUSS. The changing of FLUX with TELL also caused a problem with the actual cutoffs used for each field, which are set by FGAUSS. If the field cutoff value matches the FLUX before the TELL the the new field cutoff will match the new FLUX. Note that the actual field cutoff is controlled by FGAUSS in a way that does not allow that adverb to be changed by TELL.

Modeling, analysis, and related plotting

Model fitting

The subject of Gaussian fitting in the presence of correlated noise is still being studied. So far the results of these studies have not been incorporated into code, but they will be. The good news is that the error estimates from JMFIT, IMFIT, and SAD are reasonable even if they are not completely right. This study has led to some changes to the code in the last six months. These three tasks now have the option to scale the printed peaks and fluxes by the primary beam and the printed peak values are increased by the beam smearing factor (when invoked). The attempts at deconvolution have been made more useful, allowing partial solutions with more sensible position angles. The deconvolutions were extended by adding the deconvolution of the Clean beam plus one sigma to the others; this may be the best estimate of the upper limit to the source size.

SAD was given the option to loop over clip levels in selecting islands. It was found that an initial low clip level caused the automatic fit of strong sources to become confused by low-level "signals." By looping from higher to lower clip levels, strong sources are removed before the lower level signals are considered. Another reason to discard a fit source — total flux — was added. This gets rid of weak and small sources which are less reliable than weak but extended objects. A bug in the position angle of the deconvolved results and the bandwidth smearing, affecting only SAD, was corrected.

Miscellaneous matters

RMSD is a new task that computes the rms at each pixel by self-consistent methods using a two-dimensional window centered on the pixel. The output may be either the computed rms or the input image clipped using the computed rms. The latter, after transposition, will be an interesting input to XMOM.

COMB was given a new OPCODE = 'SUMM' which is identical to SUM except that, when one image is blanked, the result is taken from the other image as in MEAN.

SLCOL was changed substantially in the format and type of data displayed. It now does X, Y with respect to the true reference pixel plus the distance from a user-specified pixel (default is the reference pixel) with a sign set by the X difference from that point. All components of all models are now displayed. A pre-existing output file may be replaced or have the new information appended.

DFTPL had errors in the computation of the I polarization from RR and LL. These errors would produce both wrong answers and zero-divide aborts under normal conditions.

UVPLT has a new option (number 17!) to plot against *uv* distance in a user-specified position angle (given by ROTATE).

CLPLT was found to make a complete mess when asked to average over spectral channels and IFs. It now works as advertised.

System management

USAVE allows a user to SAVE his POPS environment to another user number on the same computer. Users frequently use more than one number in order to separate projects and this should help facilitate that process.

XAS was corrected. For some internal computations, the byte order in the computer running XAS matters. But for the display of TrueColor images, it is the byte order in the computer running XWindows that matters. Added code to determine the latter and then use it in the relevant place.

Midnight Job procedures were changed to use the UT time precise to 1 second rather than the Charlottesville and site local times in integer days. The putbck system in Charlottesville was changed to record the time in UT. Now there should be no way for a change to slip though a "time warp."

AIPS Distribution

The first table below shows the breakdown of how the (preliminary and frozen) copies of recent AIPS releases have been distributed. Magnetic tapes seem to have gone out of favor. Also, with annual releases, many sites are opting to download preliminary (still changing) versions of the current release. The second table below is based on the always disappointing number of registered installations of the various releases. It indicates that the distribution over operating systems was heavily weighted toward Solaris, but that Linux is now slightly preferred. However, when asked about "primary" architecture, 72% of the 98 sites answered Linux for 31DEC00 and 18% answered some flavor of Sun OS. For 31DEC01, 73% of the 110 sites answered that Linux is their primary architecture and 26% Solaris.

By December 30, 2001, 556 copies of the 31DEC01 release had been distributed, all by ftp. That version remained under active development throughout 2001. A few of the sites have begun taking updates regularly via the "midnight job." We recommend the midnight job to all serious AIPS users. It is hard to convert the 556 downloads recorded by the ftp monitoring system to a number of sites. A good estimate would be 448 "sites" with 48 of them taking multiple full copies through the year. This may be an overestimate since multiple computers at the same university are counted as multiple "sites" if the user identification is different or generic (*e.g.*, mozilla).

Also by December 30, 2001, 230 copies of the frozen 31DEC00 release had been distributed, 209 by ftp. (This is added to the 407 sites that took copies of 31DEC00 when it was called 31DEC99, via ftp before it was frozen.) We believe that some sites have taken the full release more than once at different dates, but we do not have an accurate count of these. The distribution of 31DEC00 has now been terminated. Almost all of the distribution has been of source-code only. Binaries are distributed on CDs and 24 sites downloaded binaries via ftp. Of 637 non-NRAO sites receiving 31DEC00 only 98 (15%!!) have registered. The rate of registration has been rather better for the 31DEC01 release. We remind serious AIPS users that registration is expected in order to receive user support.

	ftp	CDrom	8mm	4mm	ZIP	Floppy
15OCT98	242	71	8	1	0	0
15APR99	290	69	0	2	0	0
15OCT99	277	102	1	2	0	0
31DEC00	637	21	-	-	-	-
31DEC01	448	-	-	-	-	-

OS	DEC01 %	DEC00 %	OCT99 %	APR99 %	OCT98 %	APR98 %	OCT97 %	APR97 %	OCT96 %
Linux	50	47	33	27	27	19	23	16	19
Solaris	41	43	54	53	61	66	50	66	46
SGI	6	2	4	13	1	3	1	1	5
SunOS 4	2	0.3	1	1	1	4	14	5	13
HP-UX	0.5	2	5	2	5	2	3	6	4
FreeBSD	0.2								
Dec Alpha	0	5	1	4	3	7	9	6	10
Alpha Linux	0	0.3	1	0	0				
IBM /AIX	0	0	0	0	2	1	0	0	4

Patch Distribution for 31DEC00

As before, important bug fixes and selected improvements in 31DEC01 can be downloaded via the Web beginning at `http://www.aoc.nrao.edu/aips/patch.html`. Alternatively one can use *anonymous* `ftp` on the NRAO cpu `ftp.aoc.nrao.edu`. Documentation about patches to a release is placed in the anonymous-ftp area `pub/software/aips/`*release-name* and the code is placed in suitable subdirectories below this. The 31DEC00 release had a few important patches all of which were listed in the previous *AIPSLetter*. They applied to SCMAP, SCIMG, FILLM, UVCON, PBCOR, and FRING.

AIPS Order Form for 31DEC01 (Unix, "tar" format)

Available under the Free Software Foundation's General Public License

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Include hardware/software/quantity info, e.g. _____

Pentium III/Linux 2.2, etc. _____

5. Y2K test package: ☐ (includes small, medium, large data sets; FITS tape)

NOTE: Also available via ftp on ftp.aoc.nrao.edu in `/pub/software/aips/FITS/*` and on the CDROM

6. Printed Documents Requested:

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☐ Vol 2 ☐ Vol 1 of Going AIPS (15APR90)

☐ paper copy of the Aipsletter (always available at `http://www.aoc.nrao.edu/aips/`)

☐ AIPS Memos: _____

See separate list at `ftp://ftp.aoc.nrao.edu/pub/software/aips/TEXT/PUBL/AIPSMEMO.LIST`

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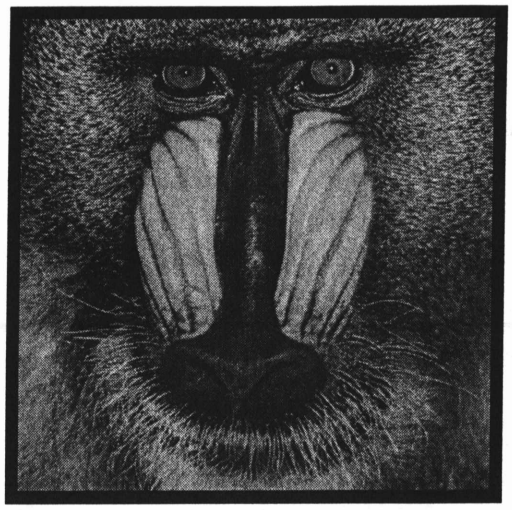

December 31, 2001

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