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12 September 84

To: VLBA
From: W. D. Cotton
Subject: Data Processing Meeting 11 September 1984

Present: Benson, Burns, Cotton, Fickling, Greisen, K. Johnston,
L. Molnar, Romney, Schwab, R. Simon, van Moorsal,
Walker, Wells

The material sent out to committee members before the meeting is given as an appendix to these notes.

The names of the suggestion and specification files in UMA3:[VLBA.DATAPROC] have been changed to more mnemonic names. The names of files for routines are the names of the routines, the names of the other items are given in a table at the end of this document.

There was an extended discussion of the relative merits of using the DEC-10 command parser imbedded in AIPS tasks as the user interface for the calibration and editing functions. Unfortunately, no one from the VLA, or any other proponent of this scheme, attended the meeting. J. Romney suggested the possibility of using the DEC-10 parser in all AIPS tasks but W. Cotton pointed out that this would eliminate the use of procedures and various other heavily used features of AIPS.

The general sense of the meeting was that duplicating the functions of the DEC-10 was sufficient and using the DEC-10 parser was an unnecessary complication. Since there were no defenders of using the DEC-10 parser in AIPS further discussion was deferred.

The rest of the meeting was devoted to a discussion of what values should be included and what precision was required for values in the data base. The general scheme for storing data is to have tables of values tabulated at appropriate intervals. Values which are constant for an experiment will probably go in the catalogue header or antenna file. Values, such as calibration information, which vary on a time scale of a few minutes will go in the calibration table. Rapidly varying values such as u , v , w and the visibility data will go in the main data file; non visibility data in the main data file will be carried as random parameters.

K. Johnston restated the need for carrying the total model delay, rate etc. along with the data. These data can be carried as random parameters but various problems arise when the data are averaged. It was concluded that the proper location for the final, post fringe fitting, values of the geometric observables was in the gain table.

K. Johnston stressed the desire to have sub millisecond accuracy in the time labels. This forces the time to be kept as double precision. There was an extended but inconclusive discussion about the proper reference date for the time; the basic contenders being: 1) JD=2400000.5, (sometime around 1905), 2) Jan. 0 of the current year, and 3) the first day of the experiment. Strict time accountability will be maintained by recording the reference date in the catalogue header or antenna file.

L. Molnar brought up the need for tabulating ionospheric corrections on a short time scale. It was concluded that this should go in the gain table.

F. Schwab pointed out that at low frequencies the current, single gain per antenna per solution interval, approach is inadequate. Provision needs to be made in the gain table for multiple interpolation nodes as per Fred's suggested solution to the problem.

R. Simon suggested that we should consider the effects of Quasat on the project. All agreed that this was a useful exercise in handling an arbitrary interferometer geometry.

There was a discussion about the proper way to handle subarrays; everyone seemed unhappy with the current practice of adding a multiple of 5 days to the time. This is currently necessary to keep ASCAL from being confused as it ignores the subarray number which is also currently encoded into the baseline number. It was concluded that ASCAL etc. should recognize the subarray number and the multiples of 5 days should not be added to the time.

The current description of the gain table caused some confusion as to what should constitute an "IF" in the sense that it is given an entry in the table. There was general sentiment that each channel from bandwidth synthesis should have a separate gain entry and that individual spectral line channels should not.

The units of the values in the gain table were discussed and there was some sentiment expressed (especially by J. Romney) for using standard units rather than the current units of convenience.

A number of possible improvements to the AIPS program were discussed. The perennial favorite in such discussions is local adverbs for tasks. Another item was the truncation of the listing of an long adverb array by INPUTS when most of the values are not specified.

Agenda for Meeting

The basic agenda for tomorrows meeting (11 September, 1530 EDT ph (203) 797-9065) is a continuation of the discussion of the VLA/VLBA editing and calibration project.

1) Renamed specification and suggestion files. The names are being changed to something more memnomic.

2) User interface.

The have been a number of suggestions to retain the DEC-10 command parser in the new calibration software. The new calibration routines could have the DEC-10 command parser built in and talk directly to the user. This would retain the "feel" of the DEC-10 package but would look different to the user than the rest of AIPS.

An alternate approach is to add AIPS adverbs which try to emulate the functions of the DEC-10 parser. This would "feel" like the rest of AIPS but would be different from the DEC-10, in particular, adverbs would be global.

3) Gain table format. The current draft version is appended to the end of this document.

4) Outline data processing paths.
your choice.

Also appended to this document is the current list of work to be done for the editing and calibration project. Any relevant items not on this list should be added.

VLBA Post Processing Software Specification

Post Processing ID: 4.3 Gain table (GAINTAB)

Version: 09/10/84

Type: AIPS table structure

Function: This table will contain editing and calibration information.

Details:

A. Overview

This extension table for a uv data set contains the editing and calibration information. This information may or may not have been applied to the data depending on the uv data file type. In either case the file should contain cumulative values, that is the total gain, delay, rate etc to apply to the uncalibrated data.

Names: The file name is GAdsssvv where d is disk number, sss=catalog number and vv = version number.

B. File structure.

Logical records consist of the information for a single group of IFs for a single antenna. An IF is considered to be the output from a single RF amplifier which needs to be calibrated independently, multiple frequency channels derived from a single receiver are not considered separate IFs. An exception to this may be bandwidth synthesis for which the calibration may vary significantly between bands. In this later case, the different bands may have separate entries.

A group of IFs consists of the IFs which are cross correlated, for example right and left circular polarized IFs at the same frequency. In practice a group will consist of a single IF or a pair of orthogonally polarized IFs. All IF groups must be identical, i.e. have the same number and types of IF.

The file header record contains the following KEYWORDS:

Keyword	Type	Description
INOANT	Integer	The number of antennas for which there is information
INOIF	Integer	The number of IFs per IF group.
INOGRP	Integer	The number of IF groups.
FMGMOD	Real	The mean gain modulus for the entire table.

Table entries:

Title	Units	Description
TIME	Days	Time of center of interval since 0h on reference day.
TIME INTERVAL	Days	Interval over which solution was obtained.
SOURCE ID	integer	Identification number of the source used.
ANTENNA NO.	integer	Antenna number.
IF GROUP NO.	integer	IF group number, the frequency channel no. of the IF group.
REAL 1	Unitless	Real part of the gain calibration factor; calibrated = raw * CALi * CALj for IFs i,j, for 1st IF of group.
IMAG 1	Unitless	Imaginary part of the gain calibration.
TSYS 1	Kelvins	System temperature of IF 1.
DELAY 1	rad/Hz	Group delay for 1st IF of group.
RATE 1	rad/day	Fringe rate for 1st IF of group.
WEIGHT 1	unitless	Weight of 1st IF of group.
SNR 1	unitless	Signal to noise ratio for solution for 1 st IF.
FLAG11	logical	an array of bits used as flags for correlators using the first IF of this group with the same IF for another antenna. There are INOANT bits the first corresponding to antenna 1 etc, with 1=>flagged 0=>unflagged

The following are present only if INOIF = 2

Title	Units	Description
REAL 2	Unitless	Real part of the gain calibration factor; calibrated = raw * CALi * CALj for IFs i,j, for 2nd IF of group.
IMAG 2	Unitless	Imaginary part of the gain calibration.
TSYS 2	Kelvins	System temperature of IF 2.
DELAY 2	rad/Hz	Group delay for 2nd IF of group.
RATE 2	rad/day	Fringe rate for 2nd IF of group.
WEIGHT 2	unitless	Weight of 2nd IF of group.
SNR 2	unitless	Signal to noise ratio for solution for 2 nd IF.
FLAG22	logical	an array of bits used as flags for correlators using the second IF of this group with the same IF for another antenna.
FLAG12	logical	an array of bits used as flags for correlators using the first IF of this group with the second IF for another antenna.

C. User notes.

The logical bit flags are returned as short integers which can be expanded to a logical array using the AIPS utility routine LG2BIT.

Fringe rates can be converted to mHz by multiplying by 1.8420711E-3 and group delays can be converted to nanoseconds by multiplying by 1.5915494E8.

D. Routines to write GA files:

Chapter 14 of "Going AIPS" given a detailed description of routines to access tables files.

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Chapter 14 of "Going AIPS" given a detailed description of routines to access tables files.

Special Requirements: none.

Revision:

09/10/84 W. Cotton Original specifications.

Calibration and Editing Functions in AIPS

10 September 1984

The following is a working list of functions need in AIPS or modifications to AIPS. Names of tasks in parentheses are provisional.

Function

Utility:

1.1 (CALIB)

Multi-source to single sources file conversion routine. This task should apply gain and editing tables.

1.2 (UVGET)

Subroutine to produce a file containing a selected subset of calibrated data from a raw data file plus a calibration table.

1.3 UVLOD

UVLOD needs to be modified to write multi-source AIPS files from EXPORT tapes.

1.4 FILLR

FILLR needs to be modified to write multi-source AIPS files.

Data Display/Flaging:

2.1 (GRID)

This routine will convert a uv data set into an image which can be displayed on a television. E.g. time on one axis, baseline on another. Output image may have more than two dimensions.

2.2 (FLAG)

This routine would allow interactive flaging based on the results of GRID.

2.3 (FLAGB)

This routine would display data as a function of time on each baseline and allow interactive flagging.

2.4 (LISTR)

This routine will provide a flexible means of obtaining printer listings of data similar to the DEC 10 LISTER program. Optional plotted output is desired.

2.5 UVFLG

The current capabilities of UVFLG should be enhanced.

Calibration:

3.1 POLCA

This routine will determine polarization calibration parameters. Should also include frequency dependence.

3.3 ASCAL

ASCAL needs to be upgraded to handle the several types of multifrequency data. Could be given the ability to include fringe fitting.

3.4 ASCOR

ASCOR applies the results of ASCAL and needs to track ASCAL.

3.5 (GNED)

This routine or routines will allow manipulating gain files produced by ASCAL. Included are concatenation, editing and smoothing.

3.6 (ATMOS)

This routine would determine and apply atmospheric corrections to a uv data set. Should include both neutral (wet and dry) and ionized components with data from a wide variety of sources.

3.7 (MODEL)

This routine would determine and apply and/or correct the geometric model using a high quality model. Must correct both visibility and model data.

3.8 (SHAD)

This routine would compute and apply corrections for geometric shadowing and/or flag data if the antennas are shadowed.

3.9 MORAS

This routine applies spectral calibration using autocorrelation spectra.

3.10 SWAMP

This routine does a fringe fit in the time domain and gives a number of useful displays.

3.11 PHREF

This routine references the phases of a spectral data base to a particular channel or to the average of a range of channels or an external calibration table.

3.12 DUNE?

This routine makes fringe rate maps.

3.13 (VEL)

This routine makes velocity corrections to spectral data bases including doppler tracking.

3.14 (BAND)

This routine will determine and/or remove bandpass functions for both baseline and antenna based solutions. (May be done in fringe processor for VLBA).

3.15 (BASE)

This routine will fit and remove baselines from auto and perhaps cross correlation data.

3.16 (CALTN)

This routine will correct the channel to channel instrumental phases of VLBA data based on the phase calibration tone information.

Modifications to AIPS:

4.1 Multi-source data files.

This will include geometric observables and an attached but unapplied gain table.

4.2 Modified catalogue header.

There is a need to handle randomly spaced and/or time variable axes and the ability to properly handle more than 7 random parameters.

4.3 Gain table

Table for calibration and editing information.

4.4 Monitor data logs.

Table for monitor and other auxillary information.

4.5 Data selection adverbs.

There should be a standard set of data selection adverbs.

Needs for Geometric observations:

5.1

The following table lists the person(s) currently responsible for writing the specifications or software and the anticipated date of completion. The names of the suggestion and specification files for categories 1-3 are the names of the routines.

Item	Specifications		Software	
	Person	Date	Person	Date
Utility:				
1.1 (CALIB)				
1.2 (UVGET)				
1.3 UVLOD				
1.4 FILLR				
Display/Flagging:				
2.1 (GRID)	Cotton			
2.2 (FLAG)				
2.3 (FLAGB)	Romney		Romney	
2.4 (LISTR)				
2.5 UVFLG				
Calibration:				
3.1 POLCA	Molnar		Molnar	12/84
3.3 ASCAL				
3.4 ASCOR				
3.5 (GNED)				
3.6 (ATMOS)				
3.7 (MODEL)				
3.8 (SHAD)				
3.9 MORAS				
3.10 SWAMP				
3.11 PHREF				
3.12 DUNE				
3.13 (VEL)				
3.14 (BAND)				
3.15 (BASE)				
3.16 (CALTN)				
Modifications to AIPS:				
(names of files appear under the item)				
4.1 UV data base	Greisen/Cotton		Greisen/Cotton	
UVDATA				
4.2 Mod. cat. header	Greisen/Cotton		Greisen/Cotton	

CATHEAD
4.3 Gain table Cotton Cotton
 GAINTAB
4.4 Monitor log.
 MONLOG
4.5 Data sel. adverbs (or DEC-10 command parser)
 DATASEL
4.6 Index files.
 INDEX

Geometric needs: