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27th March 2008

GBT SOFTWARE PROJECT NOTE 25.4

Active Surface Manager FITS File Specification

HTML version Available¹

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Abstract

The FITS format structure is presented for the Active Surface Manager scan data files. The scan data FITS files are permanently archived after each observation, together with the scan data files from other devices selected for the scan.

The scan data FITS files contain a complete description of the Active Surface setup for the observation. This description includes the model filename used by the Active Surface Manager when determining the best fit paraboloid for the GBT's Active Surface.

¹<http://www.gb.nrao.edu/GBT/MC/doc/dataproc/gbtActiveSurfaceFits/gbtActiveSurfaceFits/gbtActiveSurfaceFits.html>

History

19th February 2003 Initial version (Amy Shelton).

7th March 2003 Added RMS keywords and residual binary table (Amy Shelton).

11th March 2003 Added specifics of residual numbers (Amy Shelton).

29th April 2004 Added specifics of zernike table (Melinda Mello).

27 March 2008 Added ACTZEROV primary header keyword. (Joe Brandt).

10 May 2008 Added specifics of thermal zernike table. Fits version 2.4 (Melinda Mello).

1 Background

All GBT scan data FITS files should conform to the standards specified in the GBT Software Project Note 4.0, “Device and Log FITS Files for the GBT.”

2 Primary HDU keywords

The Active Surface FITS keywords for the primary HDU conforms to the definition for common FITS headers as described in GBT Software Project Note 4.0 “Device and Log FITS Files for the GBT.”

The primary header keywords for monitor are as follows:

```

SIMPLE =                               T / file does conform to FITS standard
BITPIX =                               8 / number of bits per data pixel
NAXIS  =                               0 / number of data axes
EXTEND  =                               T / FITS dataset may contain extensions
COMMENT FITS (Flexible Image Transport System) format defined in Astronomy and
COMMENT Astrophysics Supplement Series v44/p363, v44/p371, v73/p359, v73/p365.
COMMENT Contact the NASA Science Office of Standards and Technology for the
COMMENT FITS Definition document #100 and other FITS information.
ORIGIN  = 'NRAO Green Bank' /
INSTRUME= 'ActiveSurfaceMgr' / device or program of origin
GBTMCVER= '3.12' / telescope control software release
FITSVER = '2.4' / FITS definition version for this device
DATEBLD = 'Wed Feb 19 20:15:13 GMT 2003' / time program was linked
SIMULATE= 0 / Is the instrument in simulate mode?
DATE-OBS= '2003-02-20T17:15:51' / Manager parameter startTime
TIMESYS = 'UTC' / time scale specification for DATE-OBS
TELESCOP= 'NRAO_GBT' / Green Bank Telescope (Robert C. Byrd 100m)
OBJECT  = 'test' / Manager parameter source
PROJID  = 'test' / Manager parameter projectId
OBSID   = 'test' / Manager parameter scanId
SCAN    = 1 / Manager parameter scanNumber
FEMFILE = 'femA59wM95bG.fef' / FE model filename or NONE if not active
FEMELEV = 4.550000E+01 / Elevation used for FEM calculations
NBAD    = 0 / Number of disabled actuators
NACTIVE = 2209 / Number of active actuators
MEAN    = 0.000000E+00 / Mean (cmd-ind) of active actuators
STDDEV  = 0.000000E+00 / Std deviation of non-disabled actuators
GINIMD  = 0.000000E+00 / Gini's mean diff of all actuators
WINSK   = 0 / Winsor k value used for WINSRMS
WINSRMS = 0.000000E+00 / Winsorized RMS of all actuators
IQRSTDDV= 0.000000E+00 / Interquartile stddev of all actuators
ZERO    = 1 / correctionSelect,zero parameter value
FEM     = 1 / correctionSelect,fem parameter value
RANDOM   = 0 / correctionSelect,random parameter value
ZERNIKE = 1 / correctionSelect,zernike parameter value
ZERNGMOD= '2005WinterV2' / selected zernike gravity model or NONE
ACTZEROV= '1.3' / Actuator zero point file revision
END

```

There are ten non-standard GBT keywords: FEMFILE, FEMELEVA, NBAD, NACTIVE, MEAN, STDDEV, GINIMD, WINSK, WINSRMS, IQRSTDDV, ZERO,FEM, RANDOM,ZERNIKE,ZERNGMOD and ACTZEROV.

FEMFILE is a string that indicates the filename from which the model used by the Active Surface Manager was extracted. The "fem" prefix of the filename is a general classification code for the file, which indicates that it contains the FEM. The next four characters of the filename refer to the alidade model; in this case, the alidade model is A59w. The next four characters identify the tipping structure model; in this case, the tipping structure model is M95b. The final character provides additional information about the model. The choices for the last character are "F" for a full asymmetrical model, "G" is for gravity models, "E" for eigenvector models of vibrational modes of the structure, "S" for special static force models, or "GE" for gravity models that contain eigenvectors.

FEMELEVA indicates the elevation of the antenna that was used as input to the FEM calculations. Currently, this is the antenna elevation for the midpoint of the scan.

NBAD indicates the number of disabled actuators during the scan and NACTIVE indicates the number of enabled actuators during the scan. These two numbers should always sum to 2209.

MEAN is the conventional mean of all non-disabled actuator (NACTIVE) residuals. STDDEV is the conventional standard deviation of all non-disabled actuator (NACTIVE) residuals.

GINIMD is the Gini's mean difference of all actuator residuals.

WINSRMS is the Winsorized mean difference of all actuator residuals. WINSK is the "k" value used in calculating the Winsorized mean difference. Note that WINSK should be the same value as NBAD.

IQRSTDDV is the interquartile range standard deviation of all actuator residuals.

ZERO, FEM, RANDOM, and ZERNIKE are boolean values indicating whether or not the actuator zero point, finite element model, random displacement and Zernike corrections were selected in the manager. (A 1 indicates the module was selected or 'on'.)

ZERNGMOD documents which Zernike coefficient model was selected.

ACTZEROV documents the CVS revision number of the actuator zero point file (usually named SurfaceActZeros.conf).

3 Actuator Residuals

The Active Surface Manager FITS keywords for the SURFACE table conforms to the definition for common FITS headers as described in GBT Software Project Note 4.0 "Device and Log FITS Files for the GBT."

SURFACE Binary Table Extension: Header

```
XTENSION= 'BINTABLE'           / binary table extension
BITPIX  =                    8 / 8-bit bytes
NAXIS   =                    2 / 2-dimensional binary table
NAXIS1  =                   25 / width of table in bytes
NAXIS2  =                   2209 / number of rows in table
PCOUNT  =                    0 / size of special data area
GCOUNT  =                    1 / one data group (required keyword)
TFIELDS =                    5 / number of fields in each row
TTYPE1  = 'HOOP'             / label for field 1
TFORM1  = '1J'               / data format of field: 4-byte INTEGER
TUNIT1  = 'none'             / physical unit of field
TTYPE2  = 'RIB'              / label for field 2
TFORM2  = '1J'               / data format of field: 4-byte INTEGER
TUNIT2  = 'none'             / physical unit of field
TTYPE3  = 'INDICATED'       / label for field 3
TFORM3  = '1D'               / data format of field: 8-byte DOUBLE
```

```

TUNIT3 = 'm          ' / physical unit of field
TTYPER4 = 'DELTA    ' / label for field  4
TFORM4 = '1D       ' / data format of field: 8-byte DOUBLE
TUNIT4 = 'm          ' / physical unit of field
TTYPER5 = 'ENABLED  ' / label for field  5
TFORM5 = '1L       ' / data format of field: 1-byte LOGICAL
TUNIT5 = 'none      ' / physical unit of field
EXTNAME = 'SURFACE  ' / name of this binary table extension
END

```

SURFACE Binary Tables Extension: Data (complete)

	HOOP	RIB	INDICATED	DELTA	ENABLED
	1J	1J	1D	1D	1L
	none	none	m	m	none
1	0	0	0.000000E+00	0.000000E+00	F
2	0	0	0.000000E+00	0.000000E+00	F

The columns HOOP and RIB uniquely identify the location of an actuator on the surface of the GBT's dish.

The INDICATED column is the position reading, in meters, of the actuator.

The DELTA column is the residual between the commanded position and the indicated positions of the actuator in meters. It is the commanded position minus the current position.

The ENABLED column indicates whether or not an actuator was enabled or disabled for a given scan.

4 Zernike Polynomials

The Active Surface Manager FITS keywords for the ZERNIKE table conforms to the definition for common FITS headers as described in GBT Software Project Note 4.0 "Device and Log FITS Files for the GBT."

SURFACE Binary Table Extension: Header

```

XTENSION= 'BINTABLE' / binary table extension
BITPIX = 8 / 8-bit bytes
NAXIS = 2 / 2-dimensional binary table
NAXIS1 = 12 / width of table in bytes
NAXIS2 = 36 / number of rows in table
PCOUNT = 0 / size of special data area
GCOUNT = 1 / one data group (required keyword)
TFIELDS = 2 / number of fields in each row
TTYPER1 = 'Name    ' / label for field  1
TFORM1 = '1J      ' / data format of field: 4-byte INTEGER
TUNIT1 = 'none    ' / physical unit of field
TTYPER2 = 'Value   ' / label for field  2
TFORM2 = '1D     ' / data format of field: 8-byte DOUBLE
TUNIT2 = 'none    ' / physical unit of field
EXTNAME = 'ZERNIKE ' / name of this binary table extension
ZERNCLIP= F / Clipping enabled = T, F = disabled
ZERNLIM = 4.000E+04 / Maximum actuator zernike displacement used

```

END

 ZERNIKE Binary Tables Extension: Data (complete)

	Name	Value	
	1J	1D	
	none	none	
1	0	0	0.000000E+00
2	1	0	0.000000E+00
.			
.			
.			
36	35	0	0.000000E+00

The column ZERNCLIP in the header indicates whether zernike limiting was enabled.

The column ZERNLIM in the header contains the value used as the limit for the zernike displacements.

The columns Name and Value identify the zernike polynomial designator and the value of the polonomial.

5 Thermal Zernike Polynomials

The Active Surface Manager FITS keywords for the THRMZERN table conforms to the definition for common FITS headers as described in GBT Software Project Note 4.0 "Device and Log FITS Files for the GBT."

 SURFACE Binary Table Extension: Header

```
XTENSION= 'BINTABLE'           / binary table extension
BITPIX  =                8 / 8-bit bytes
NAXIS   =                2 / 2-dimensional binary table
NAXIS1  =               12 / width of table in bytes
NAXIS2  =               36 / number of rows in table
PCOUNT  =                0 / size of special data area
GCOUNT  =                1 / one data group (required keyword)
TFIELDS =                2 / number of fields in each row
TTYPE1  = 'Name'           / label for field 1
TFORM1  = '1J'            / data format of field: 4-byte INTEGER
TUNIT1  = 'none'          / physical unit of field
TTYPE2  = 'Value'         / label for field 2
TFORM2  = '1D'            / data format of field: 8-byte DOUBLE
TUNIT2  = 'none'          / physical unit of field
EXTNAME = 'THRMZERN'      / name of this binary table extension
ZERNCLIP=                F / Clipping enabled = T, F = disabled
ZERNLIM =                4.000E+04 / Maximum actuator zernike displacement used
END
```

 ZERNIKE Binary Tables Extension: Data (complete)

	Name	Value	
	1J	1D	
	none	none	
1	0	0	0.000000E+00
2	1	0	0.000000E+00
.			
.			
.			
36	35	0	0.000000E+00

The column ZERNCLIP in the header indicates whether zernike limiting was enabled.

The column ZERNLIM in the header contains the value used as the limit for the zernike displacements.

The columns Name and Value identify the zernike polynomial designator and the value of the polonomial.

6 Summary

The definition of FITS file keywords and table columns conforms to the standard for the GBT project as a whole.

In conclusion it is important to emphasize that the scan data FITS files contain only a Primary HDU, which lists keywords to describe the Active Surface setup for the observation. The Active Surface Manager does not produce data.