RECOMMENDATION ITU-R S.1717

Electronic data file format for earth station antenna patterns

(Question ITU-R 42/4)

(2005)

Scope

Although the standard reference patterns for FSS earth station antenna main-beam and side-lobe gain, such as those in Recommendations ITU-R S.465 and ITU-R S.580, are adequate for many interference studies, cases sometimes arise where more detailed gain patterns for specific antennas, or antenna types are needed in ITU-R studies. Also, the gain data for particular antennas are used in the refinement of existing reference patterns and/or the development of new reference patterns. Annex 1 to this Recommendation details a format in which gain data on specific FSS earth station antennas may be submitted by administrations in electronic form to, and includes examples.

The ITU Radiocommunication Assembly,

considering

a) that efficient utilization of the radio spectrum is a primary factor in the management of the GSO;

b) that the side-lobe characteristic of earth station antennas is one of the main factors in determining the minimum spacing between satellites and therefore the extent to which the radio spectrum can be efficiently used;

c) that the collection of measured earth station antenna pattern data would allow a continuous improvement of the ITU-R mathematical models for use in sharing studies or as reference patterns for antenna side-lobe limits or off-axis e.i.r.p. levels;

d) that a defined file format for the submission of measured earth station antenna pattern data would be useful for the analysis of these data by the Radiocommunication Study Groups;

e) that this file format should be sufficiently general to support data on different cut planes, angular ranges and polarization types of antenna patterns,

recommends

1 that the file format contained in Annex 1 may be used for the collection of electronic data containing information on earth station antenna radiation patterns for further studies concerning the modelling of the radiation patterns.

NOTE 1 – Recommendation ITU-R S.732 may be used as a guidance for the choice of an adequate number of points to achieve the necessary angular resolution in each electronic data file.

NOTE 2 – Further studies may be required for the establishment of antenna measurement procedures.

Annex 1

Electronic file format for earth station antenna pattern data

1 Generic description

The basic file types considered here are block structured. These data blocks are detailed in the next sections.

In all files, HEADER has to be formatted in accordance with:

Line	Description/content
1	Title
2	Comments
3	Comments
4	File identification code

Maximum number of characters:

– title: 52 characters

– comments: 80 characters.

NOTE 1 – Such comments lines are reserved for information related to the content of the file and or its purpose (e.g. antenna model or configuration).

1.1 File identification code

Code	File type
200	3D fields – co-polar, cross-polar

NOTE 2 – Different codes can be further proposed to identify other field representations.

1.2 Block-structured files

For the block-structured files a fifth row has to be used containing the total number of blocks.

Line	Description/content
5	Total number of blocks

After row five the sequence of blocks is included with the main function data.

A single file block has a generic structure as following:

Control line

n	*m*		
$a_{1,1}$	$a_{1,2}$	...	$a_{1,m}$
$a_{2,1}$	$a_{2,2}$	...	$a_{2,m}$
... ...	...	...	
... ...	...	...	
$a_{n,1}$	$a_{n,2}$	...	$a_{n,m}$

where:

Control line: contains relevant data concerning the specific block (see details in the following sections)

n: number of block rows

m: number of block columns.

1.2.1 File general structure

The general structure of a block-structured file is described as following:

1*Title*
2*Comments*
3*Comments*
4*File identification*
} *header*

5*Number of blocks*

control line of block 1

n_1	m_1		
$a_{1,1}$	$a_{1,2}$	...	$a_{1,m}$
...	...	...	...
...	...	...	...
$a_{n,1}$	$a_{n,2}$	...	$a_{n,\mathrm{m}}$

} *block* 1

.....
.....

control line of block f

n_f	m_f		
$a_{1,1}$	$a_{1,2}$	...	$a_{1,mf}$
...	...	...	...
...	...	...	...
$a_{nf,1}$	$a_{nf,2}$	...	$a_{nf,mf}$

} *final block*

2 3D fields – block-structured files

In this section the content of field data is described for the file type 200 (**3D fields – co-polar and cross-polar)**. See Fig. 1 as a reference for parameters described below:

Title

Comments

Comments

id pol orientation freq

Number of blocks

$$
\left.
\begin{array}{llllllll}
\varphi_k & r_j & & & & & & \\
n\ m & & & & & & & \\
\theta_1: & |Co(\theta_1,\varphi_k,r_j)| & \angle Co(\theta_1,\varphi_k,r_j) & |X(\theta_1,\varphi_k,r_j)| & \angle X(\theta_1,\varphi_k,r_j) & & & \\
.. & . & . & . & . & . & ... & . \quad .. \\
.. & . & . & . & . & . & . & . \quad .. \\
\theta_n: & |Co(\theta_n,\varphi_k,r_j)| & \angle Co(\theta_n,\varphi_k,r_j) & |X(\theta_n,\varphi_k,r_j)| & \angle X(\theta_n,\varphi_k,r_j) & & &
\end{array}
\right\} block
$$

where:

id: file identification, is 200

pol: antenna polarization, assumes values 1 (linear); 2 (circular/elliptical) or 0 (non-determined),

orientation:

when *pol* = 1, *orientation* indicates plane φ which contains the main component of the electric field (preferably 0° for horizontal polarization and 90° for vertical polarization);

when *pol* = 2, *orientation* is 1 (for left-hand circular/elliptical polarization), or 2 (for right-hand circular/elliptical polarization);

For non-determined cases use *pol* = 0 and *orientation* = 0.

freq: frequency (GHz). Not relevant in case of general side-lobe masks or envelops.

φ_k: pattern cut half plane angle φ (degrees), related to block data, (use φ = 90° for upper elevation cut). Varies from 0° to 360°.

θ_i: Angular direction (degrees) relative to the antenna boresight (θ_i = 0°) which shall indicate satellite pointing and maximum gain direction.

r_j: radial distance *r* (m) related to specific block, (this value can be suppressed if data relates to far-field region).

n: number of block rows, i.e., number of θ_i samples (where θ varies from 0° to 180°). Value of *n* shall be adequate to allow pattern resolution for data plotting or for use in coordination and interference calculations.

m: number of block columns (for the 200 type file *m* = 5),

$|Co(\theta_i, \varphi_k, r_j)|$: co-polar field amplitude (dB or dBi), at the point (θ_i, φ_k, r_j),

$\angle Co(\theta_i, \varphi_k, r_j)$: co-polar field phase (degrees), at the point (θ_i, φ_k, r_j),

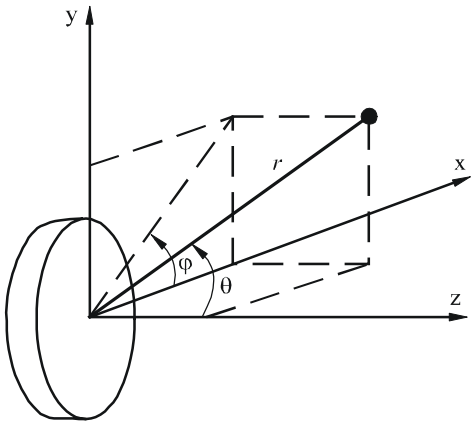
$|X(\theta_i, \varphi_k, r_j)|$: cross-polar field amplitude (dB or dBi), at the point (θ_i, φ_k, r_j),

$\angle X(\theta_i, \varphi_k, r_j)$: cross-polar field phase (degrees), at the point (θ_i, φ_k, r_j),

When amplitudes are indicated in dB, the antenna maximum gain (dBi) value must be supplied (use comments lines). When phase values are not available or not relevant, insert 0.0 (not blanks).

FIGURE 1

Example of reflector antenna in a spherical coordinate system as per the proposed standard file format



Note 1 – Antenna upper elevation half-plane shall be coincident with +yz half-plane (φ = 90°)

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3 Examples

In this section a pattern data file is illustrated as an example as well as some resulting applications.

Table 1 shows some parts of the example file containing four blocks with n = 360 rows in each and representing the radiation pattern cut planes φ_k equal to 0°, 90°, 180° and 270° respectively.

TABLE 1

Example of a measured radiation pattern file in the proposed format

Title	**Offset antenna XXX - 1.8 m Measured frequency 14 GHZ - EL/H - Pol H**				
Comments	**Model BO 05355**				
Comments	**Original MI - 2095 file:F:\XXX\HCOHELTX.TXT**				
id pol orientation freq	200	1	0	14.000	
Number of blocks	4				
	0				
	360	5			
	0	46.13	132.131	–1.976	48.183
	0.5	42.503	119.138	3.083	–63.6
	1	29.327	86.983	3.126	–48,484
	1.5	20.601	9.116	–5.148	–7.781
	2	15.948	81.549	–23.206	86.305
	2.5	7.158	60.242	–17.033	89.719
	...				
	177.5	–5.305	–143.914	–34.487	–175.838
	178	–5.006	–14.855	–17.404	86.68
	178.5	–5.433	130.715	–20.464	158.715
	179	–5.928	–77.425	–29.24	–9.018
	179.5	–5.846	65.336	–30.317	123.385
	90				
	360	5			
	0	46.13	38.426	14.575	–14.098
	0.5	43.405	40.238	22.746	165.781
	1	32.697	24.047	20.087	168.983
	1.5	22.179	–36.461	0.228	71.216
	2	2.554	17.435	4.258	99.239
	2.5	15.386	–165.509	0.391	161.129
	...				

Figure 2 illustrates the graphical representation of the co-polar field pattern measured in the cut plane $\varphi_k = 0^o$ (1st block/2nd row). In this case, this cut-plane corresponds to one side of the azimuth plane and the polarization is horizontal. In Fig. 2 a reference pattern envelope is represented based on Recommendations ITU-R S.580 and ITU-R S.465 for the co-polar pattern side-lobes.

FIGURE 2

Co-polar field measured pattern example in the cut plane φ_k = 0° (Az/Pol H)