RECOMMENDATION ITU-R RS.1813

Reference antenna pattern for passive sensors operating in the Earth exploration-satellite service (passive) to be used in compatibility analyses in the frequency range 1.4-100 GHz

(2009)

Scope

This Recommendation provides a reference antenna pattern for Earth exploration-satellite service (EESS) passive sensors to be used in compatibility studies in the frequency range 1.4-100 GHz when no other information is available on actual sensor antennas.

The ITU Radiocommunication Assembly,

considering

a) that reference satellite antenna patterns, which reflect to the maximum extent possible the actual antenna gain, are desirable for use in compatibility studies in the case of aggregate interference from multiple sources;

b) that antennas used for spaceborne passive sensors in the Earth exploration-satellite service (EESS) (passive) are usually designed to maximize main beam efficiency and minimize energy received through antenna side lobes;

c) that the impact of a dominating interference source on single pixel measurements or peak interference assessments may require consideration of maxima in the antenna side lobe pattern,

noting

a) that characteristics of passive sensors operating between 1.4 GHz and 100 GHz have been taken into account for the derivation of the proposed antenna pattern,

recommends

1 that, in the absence of an actual antenna pattern, the following equations for the average antenna pattern of a spaceborne passive sensor should be used, for antenna diameters greater than 10 times the wavelength[1]:

$$G(\varphi) = G_{max} - 1.8 \times 10^{-3} \left(\frac{D}{\lambda}\varphi\right)^2 \qquad \text{for} \quad 0° \le \varphi \le \varphi_m$$

$$G(\varphi) = \max\left(G_{max} - 1.8 \times 10^{-3} \left(\frac{D}{\lambda}\varphi\right)^2, 33 - 5\log\left(\frac{D}{\lambda}\right) - 25\log(\varphi)\right) \qquad \text{for} \quad \varphi_m < \varphi \le 69°$$

$$G(\varphi) = -13 - 5\log\left(\frac{D}{\lambda}\right) \qquad \text{for} \quad 69° < \varphi \le 180°$$

[1] Further work is needed to address the case of low gain antennas (with diameters lower than 10 times the wavelength).

In the case of $G(\varphi) < -23$ dBi, the value -23 dBi is to be used, where:

$$G_{max} = 10 \log\left(\eta\pi^2 \frac{D^2}{\lambda^2}\right)$$

$$G_1 = 33 - 5 \log\left(\frac{D}{\lambda}\right)$$

$$\varphi_m = \frac{22\lambda}{D}\sqrt{G_{max} - G_1}$$

G_{max}: maximum antenna gain (dBi)

$G(\varphi)$: gain (dBi) relative to an isotropic antenna

φ: off-axis angle (degrees)

D: antenna diameter (m)

λ: wavelength (m)

η: antenna efficiency (if η is unknown, 60% can be assumed as a representative value).

2 that in cases where a few interference sources dominate, or where peak interference values are required in the analysis, the following equations for the antenna pattern for spaceborne passive sensors should be used, for antenna diameters greater than 10 times the wavelength[2]:

$$G(\varphi) = G_{max} - 1.8 \times 10^{-3}\left(\frac{D}{\lambda}\varphi\right)^2 \qquad \text{for} \quad 0° \le \varphi \le \varphi_m$$

$$G(\varphi) = \max\left(G_{max} - 1.8 \times 10^{-3}\left(\frac{D}{\lambda}\varphi\right)^2, 40 - 5\log\left(\frac{D}{\lambda}\right) - 25\log(\varphi)\right) \qquad \text{for} \quad \varphi_m < \varphi \le 69°$$

$$G(\varphi) = -6 - 5\log\left(\frac{D}{\lambda}\right) \qquad \text{for} \quad 69° < \varphi \le 180°$$

In the case of $G(\varphi) < -23$ dBi, the value -23 dBi is to be used, where:

$$G_{max} = 10 \log\left(\eta\pi^2 \frac{D^2}{\lambda^2}\right)$$

$$G_1 = 33 - 5 \log\left(\frac{D}{\lambda}\right)$$

$$\varphi_m = \frac{22\lambda}{D}\sqrt{G_{max} - G_1}$$

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[2] Further work is needed to address the case of low gain antennas (with diameters lower than 10 times the wavelength).