WORKSHOP EM ISAE 2020

TEST CASE #3

SPHERE-CONE-SPHERE COVERED BY RAM AND CONDUCTING SHEET

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1. Geometry of the case

The target geometry is axisymmetric and consists of a PEC cone-sphere-cone of length L = 1430 mm made by joining two spheres, one of radius R_1 = 315 mm and the other of radius R_2 = 50 mm, to a truncated cone using tangent connections. (Oz) is the revolution axis of the target, the conical part points towards +z and the sphere of radius R_1 is centered at the origin.

The PEC sphere-cone-sphere is covered by a radar absorbing material of constant thickness e = 35 mm and a thin conducting sheet of constant thickness h = 0.3 mm.

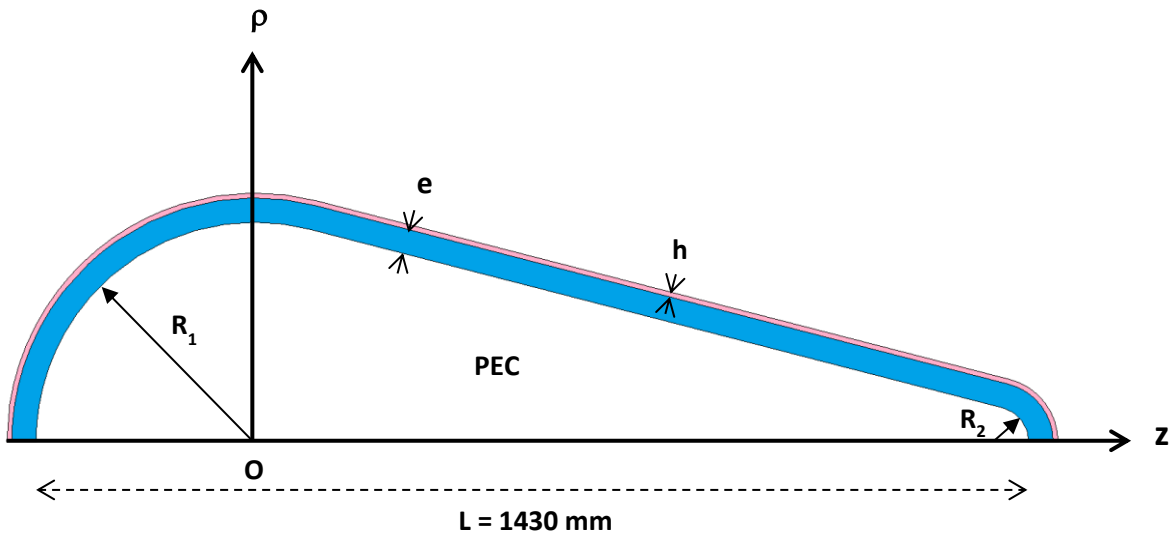

Figure 1 geometry of test case #3

2. Constitutive parameters

The radar absorbing material is a dielectric material with relative electric permittivity ε = 5 + j 2.5 and relative magnetic permeability μ = 1, where harmonic time dependence using $e^{-j\omega t}$ is assumed.

The conducting sheet is characterized by its relative electric permittivity ε = 1, its relative magnetic permeability μ = 1 and its electrical conductivity σ, for which three configurations shall be considered :

- σ = 10 S/m,
- σ = 100 S/m,
- σ = 1000 S/m.

3. Observable

3.1 Conventions

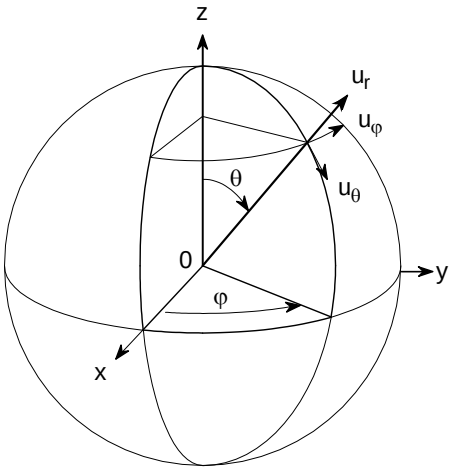

Figure 2 standard coordinate system

In the standard spherical coordinate system, we define the monostatic RCS $\sigma_{\theta\theta}$ and its phase $\varphi_{\theta\theta}$:

$$\sigma_{\theta\theta} = 4\pi \lim_{r\to\infty} r^2 \frac{\left|\vec{E}^s \cdot \hat{u}_\theta\right|^2}{\left|\vec{E}^i \cdot \hat{u}_\theta\right|^2}$$

$$\varphi_{\theta\theta} = arg\left(\lim_{r\to\infty} r \frac{\vec{E}^s \cdot \hat{u}_\theta}{\vec{E}^i \cdot \hat{u}_\theta}\right)$$

- $\vec{E}^i$: electric field of the plane wave incident upon the target in the direction $-\hat{u}_r$,
- $\vec{E}^s$: backscattered electric field in the direction $\hat{u}_r$,
- r : distance between the target and the point where E^s is measured.

3.2 Expected results

We are looking for the monostatic RCS $\sigma_{\theta\theta}$ and the phase $\varphi_{\theta\theta}$ of the target when it is illuminated by an incident wave with electric field along $\hat{u}_\theta$:

- for θ = { 0° ; 30° ; 60° } in the standard spherical coordinate system,
- for frequency ranging from 50 MHz to 1050 MHz with a step of 25 MHz (41 frequencies)

The results shall be stored in 3 ASCII files, one for each configuration of the electrical conductivity of the conducting sheet :

Conductivity	File name
10 S/m	case3_10.txt
100 S/m	case3_100.txt
1000 S/m	case3_1000.txt

Each file shall have 4 columns :

- Fist column for the frequency in MHz,
- Second column for the angle θ in degrees,
- Third column for the RCS $\sigma_{\theta\theta}$ in dBm²,
- Fourth column for the phase $\varphi_{\theta\theta}$ in degrees.