

Test Case 8: Multilayer and Inhomogeneous Dielectric Cylinder

Chairmen : Jerome Simon (ONERA) & Matthieu Lecouvez (CEA)

Simulation Parameters

The target is a dielectric cylinder of height 0.25m and radius 0.1m. The phase center is assumed to be located at $(x,y,z) = (0,0,0)$ which is the center of the cylinder.

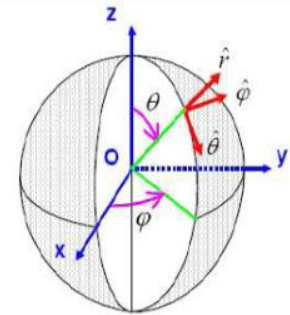
Two versions of the cylinder shall be studied:

- Cyl1 – Multilayer Dielectric Cylinder
- Cyl2 – Inhomogeneous Dielectric Cylinder

For each version, the following sub-case are proposed

Case a – Monostatic RCS

- $F=15\text{GHz}$
- $\varphi = 0^\circ$
- $\theta=[0^\circ, 90^\circ], \Delta\theta=0.5^\circ$
- Polarizations $\varphi\varphi$ and $\theta\theta$
- Electric incident field amplitude = 1V/m at the phase origin $(0,0,0)$



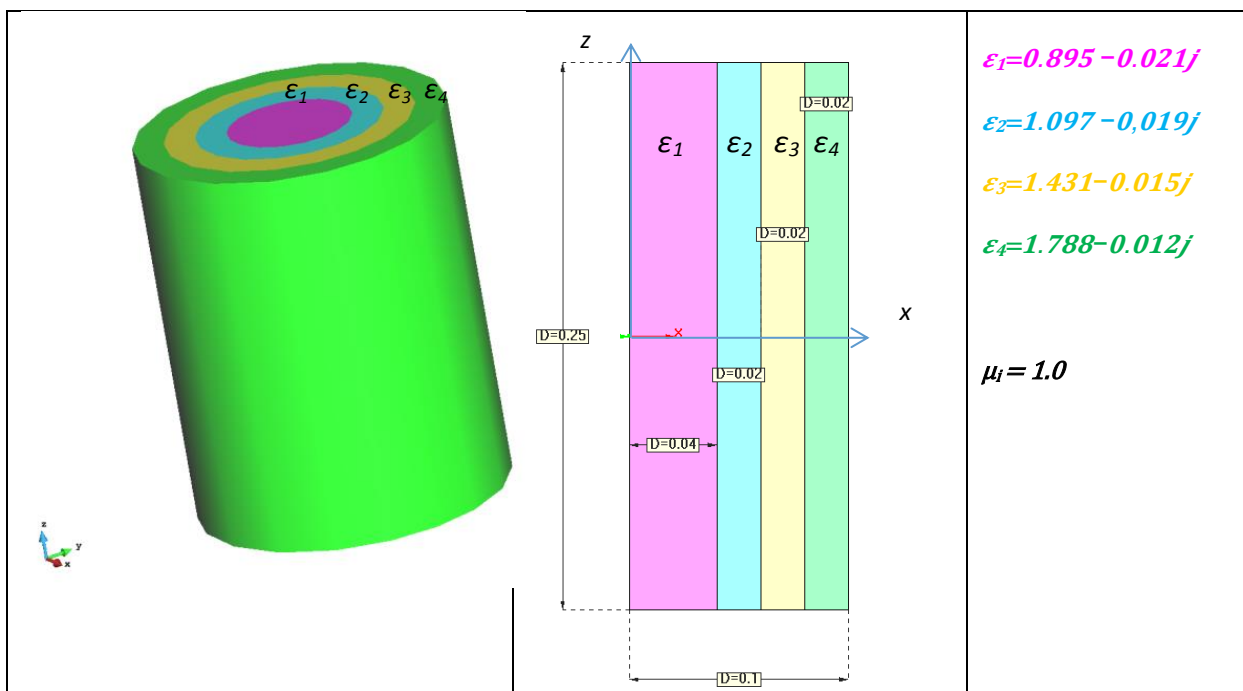
Case b – High Range Resolution Profil

- Frequency : $f = [5.0\text{GHz}, 15.0\text{GHz}]$, $\Delta f = 0.2\text{GHz}$
- $\varphi = 0^\circ$
- $\theta = 90^\circ$

The time dependency is assumed to be $\exp(j\omega t)$ and the electric incident field amplitude is 1V/m at the phase origin $(0,0,0)$.

Cyl1: Multilayer Dielectric Cylinder

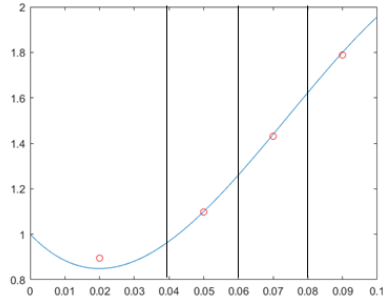
The first version of the cylinder is Multilayer Dielectric Cylinder with 4 layers and 4 different value of permittivity. For each layer, the permeability is equal to 1.



Cyl2: inhomogeneous Dielectric Cylinder

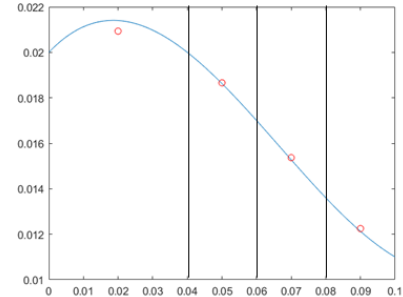
The second version of the cylinder is Inhomogeneous Dielectric Cylinder whose permittivity varies as a function of its distance "r" from the axis of rotation.

$$\epsilon_r(r) = 1 - 16r + 464r^2 - 2083r^3$$



$$\begin{aligned}\epsilon_1 &= 0.895 - 0.021j \\ \epsilon_2 &= 1.097 - 0.019j \\ \epsilon_3 &= 1.431 - 0.015j \\ \epsilon_4 &= 1.788 - 0.012j\end{aligned}$$

$$\epsilon_i(r) = 0.02 + 0.16r - 5r^2 + 25r^3$$



The red circles are the 4 values of the permittivity of the cyl1.

Results

Data Formats

Case a – Monostatic RCS

The results shall be stored in 2 ASCII files:

- case8a_cyl1_CONTRIBUTOR_NAME.txt
- case8a_cyl2_CONTRIBUTOR_NAME.txt

Each file will contain on each row the data: θ , $\text{Re}(E_{\varphi\varphi})$, $\text{Im}(E_{\varphi\varphi})$, $\text{Re}(E_{\theta\theta})$, $\text{Im}(E_{\theta\theta})$.

Case b - HRRP results:

The results shall be stored in 2 ASCII files:

- case8b_cyl1_CONTRIBUTOR_NAME.txt
- case8b_cyl2_CONTRIBUTOR_NAME.txt

Each file will contain on each row the data: f , $\text{Re}(E_{\varphi\varphi})$, $\text{Im}(E_{\varphi\varphi})$, $\text{Re}(E_{\theta\theta})$, $\text{Im}(E_{\theta\theta})$.

Where θ is the angle in degrees, f is the frequency in GHz, $E_{\theta\theta}$ and $E_{\varphi\varphi}$ are the complex copolar scattered fields in V/m in $\theta\theta$ -polarisation and $\varphi\varphi$ -polarisation. $E_{\theta\theta}$ and $E_{\varphi\varphi}$ shall be normalized according to $\sigma_{\theta\theta/\varphi\varphi} = 20 \cdot \log_{10}(\text{abs}(E_{\theta\theta/\varphi\varphi}))$, where σ is the RCS in dBsm.

Additional Information

Each .txt file should be accompanied by an .info file, stating additional information relevant for the simulation, e.g., short description of the method used, CPU time, memory usage, number of unknowns, characteristics of simulation hardware (number of cores, processor speed),...