TEST CASE 2: Near field RCS cylinder

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Abstract :
This test case concerns the near field RCS simulation of a perfectly conducting cylinder. The illumination is modelized by an array of four electric dipoles. Two calculations are required: the near field RCS simulation of the cylinder and the near field RCS simulation of the calibration object. The results of these simulations will be compared to the measurement results realised at the CEA-CESTA facilities.

1 – *Definition of the geometry*

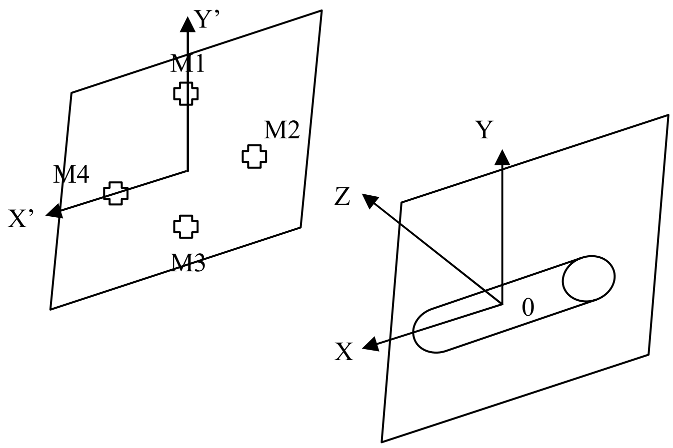


Figure 1 : Configuration of the computation.

1.1 Definition of the object

The diffracting object is a perfectly conducting cylinder of 2m length and 98mm diameter. The rotation center of this cylinder coincides with the center of gravity and with the origin of the coordinates system. The axis of revolution is along (Ox).

1.2 Definition of the calibration object

The calibration object is a perfectly conducting sphere with 400 mm diameter. The center of the sphere coincides with the origin of the coordinates system.

2 – *Definition of the illumination*

The illumination is modelized by an array of four electric dipoles. Each dipole is defined by a position M_k and an orientation $\vec{p}_k$ .The four dipole (M1, M2, M3, M4) are localized in the vertical plane (xOy), z=3m. Their coordinates are:

Dipole M_k	x (metre)	y (metre)	z (metre)
M_1	0	0.42	3
M_2	0.42	0	3
M_3	0	-0.42	3
M_4	-0.42	0	3

Tableau 1 : Central position of the dipoles.

The dipoles are all oriented in the same direction as defined either by the P_H vector or by the P_V vector :

$\vec{p}_k \quad (k=1,4)$	X	Y	Z
P_H	1	0	0
P_V	0	1	0

Tableau 2 : Orientation of the dipoles.

The electric incident field ($+j\omega t$ convention) at each point M of the space is given by :

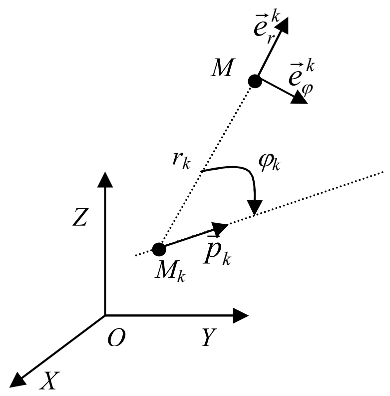


Figure 2 : Definition of the incident field at each point of the space.

$$\vec{E}(M)=\sum_{i=1}^{4} E_r^k(M)\vec{e}_r^k + E_\varphi^k(M)\vec{e}_\varphi^k, \quad \vec{H}(M)=\sum_{i=1}^{4} H_\theta^k(M)\vec{e}_\theta^k$$

With

$$\begin{cases} E_r^k(M)=j\eta_0\dfrac{1}{2\pi k r_k^3}\cos(\varphi_k)(1+jkr_k)\exp(-jkr_k) \\ E_\varphi^k(M)=-j\eta_0\dfrac{1}{4\pi k r_k^3}\sin(\varphi_k)(1+jkr_k-k^2r_k^2)\exp(-jkr_k) \\ H_\theta^k(M)=\dfrac{1}{4\pi r_k^2}\sin(\varphi_k)(1+jkr_k)\exp(-jkr_k) \end{cases}$$

and $\eta_0=120\pi, k=\dfrac{2\pi f}{c}$, f the frequency, c the light celerity and $(\vec{e}_r^k,\vec{e}_\varphi^k,\vec{e}_\theta^k)$ the direct coordinates system defined by :

$$\begin{cases} \vec{e}_r^k=\dfrac{M_kM}{|M_kM|} \\ \vec{e}_\varphi^k=\dfrac{\vec{p}_k-(\vec{p}_k\cdot\vec{e}_r^k)\vec{e}_r^k}{|\vec{p}_k-(\vec{p}_k\cdot\vec{e}_r^k)\vec{e}_r^k|} \\ \vec{e}_\theta^k=\vec{e}_r^k\wedge\vec{e}_\varphi^k \end{cases}$$

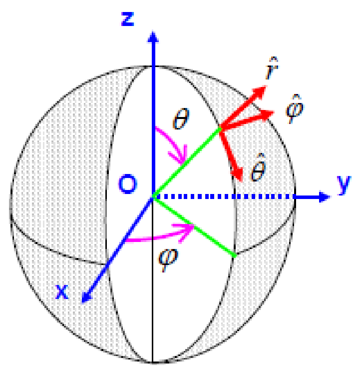
3 – *Definition of the near field RCS*

$$RCS\_NEARFIELD_H = \sum_{k=1}^{4} \vec{E}_H^d(M_k) \cdot \vec{p}_H , \quad RCS\_NEARFIELD_V = \sum_{k=1}^{4} \vec{E}_V^d(M_k) \cdot \vec{p}_V$$

$\vec{E}_H^d$ electric field diffracted by the object for an incident field generated by the dipoles oriented along P_H
$\vec{E}_V^d$ electric field diffracted by the object for an incident field generated by the dipoles oriented along P_V

4 – *Output results*

Two cases are defined.



• **Case 1, monostatic near field RCS of the cylinder:**

- **frequency f=400 MHz**
- **incident angles :** φ = 0°, θ from 0° to 90°, angular step 1°
- **polarisations** : H and V

• **Case 2, monostatic near field RCS of the sphere:**

- **frequency f=400 MHz**
- **incidence angles :** φ = 0°, θ from 0° to 90°, angular step 1°
- **polarisations** : H and V

3 – *Diagram formats*

The results must be supplied in two ASCII files with 5 columns:
Angles (degrees), real($RCS\_NEARFIELD_H$), imag($RCS\_NEARFIELD_H$), real($RCS\_NEARFIELD_V$), imag($RCS\_NEARFIELD_V$)

With the following suggestions for the name of each ASCII file: CYLINDER_Contributorname,
SPHERE_Contributorname.