DE LA RECHERCHE À L'INDUSTRIE

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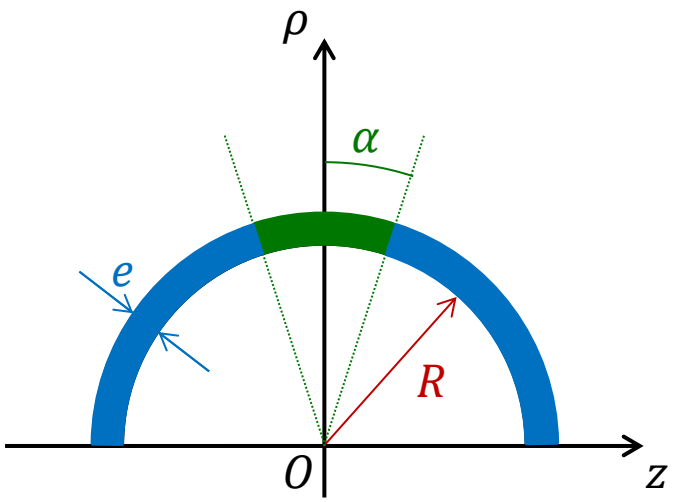
IMPACT ON THE RCS OF THE EXTRA-DIAGONAL TERMS OF A TENSOR OF ANISOTROPIC MATERIAL

GEOMETRY OF THE CASE

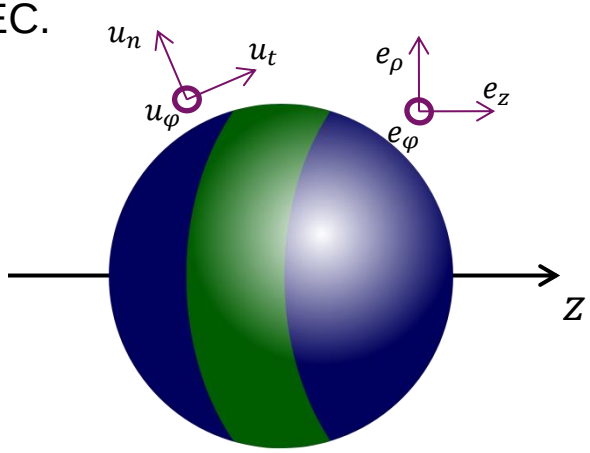
The geometry is axisymmetric, with Oz the rotation axe. It represents a shell, of inner radius $R = 300\ mm$ and constant thickness $e = 15mm$. An angular strip of anisotropic material, described by its semi-angle $\alpha = 7°$ (deg), is prescribed (green area). The remaining of the shell is made of isotropic material (blue area) and the interior is a PEC.



$R = 300\ mm$

$e = 15\ mm$

$\alpha = 7°$



Isotropic material, ε

Anisotropic material, $[\underline{\varepsilon}]$

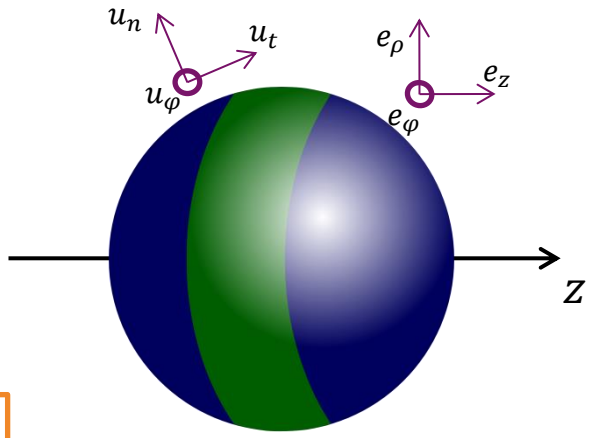
Two direct orthonormal systems (e_ρ, e_φ, e_z) and (u_n, u_φ, u_t) are introduced:

- (e_ρ, e_φ, e_z) is the classical axisymmetric system
- (u_n, u_φ, u_t) is a local system with:
  - u_n the unit outgoing normal vector
  - u_t the unit tangential vector lying in the plane (e_ρ, e_z)
  - $u_\varphi = e_\varphi$

ANISOTROPIC STRIP

In the isotropic region (blue area), the constitutive parameters are $\mu = 1$ and $\varepsilon = 2 - 3i$.

In the (possibly) anisotropic region (green area), the permeability is still $\mu = 1$, but the permittivity is given by a tensor. We distinguish three cases.



Note that the tensors here are given in the system (u_n, u_φ, u_t).

Case #1 : isotropic strip

$$\underline{\varepsilon} = \begin{bmatrix} \varepsilon & 0 & 0 \\ 0 & \varepsilon & 0 \\ 0 & 0 & \varepsilon \end{bmatrix}_{(u)}$$

$$\varepsilon = 2 - 3i$$

Case #2 : orthotropic strip

$$\underline{\varepsilon} = \begin{bmatrix} \varepsilon_{11} & 0 & 0 \\ 0 & \varepsilon_{22} & 0 \\ 0 & 0 & \varepsilon_{33} \end{bmatrix}_{(u)}$$

$$\varepsilon_{11} = 1.4 - 2.1i = 0.7\varepsilon$$
$$\varepsilon_{22} = 2 - 3i = \varepsilon$$
$$\varepsilon_{33} = 2.6 - 3.9i = 1.3\varepsilon$$

Case #3 : anisotropic strip

$$\underline{\varepsilon} = \begin{bmatrix} \varepsilon_{11} & 0 & \varepsilon_{13} \\ 0 & \varepsilon_{22} & 0 \\ \varepsilon_{31} & 0 & \varepsilon_{33} \end{bmatrix}_{(u)}$$

$$\varepsilon_{13} = 3i$$
$$\varepsilon_{31} = -3i = -\varepsilon_{13}$$

EXPECTED OUTPUT

In the standard spherical coordinate system, the RCS shall be computed

- for $(\theta, \phi) = (0°, 0°)$
- for the frequency range 0.5 to 3.5 GHz with $\delta F = 75$ MHz (i.e. 41 frequencies)
- for $\theta\theta$-polarization
- for each of the three cases

The results shall be stored in three ASCII files named `RCS_strip_case.res` (`case` being one of the following: `iso`, `ortho` or `aniso`).

Each file shall have three columns:

- Frequency in MHz
- norm of the RCS in $dB.m^{-2}$
- phase of the RCS in degrees

The chairman will evaluate the impact of the anisotropy on the impulse response (an inverse Fourier transform is applied) **by substracting** the RCS:

- Case 1 – Case 2
- Case 2 – Case 3