Test case #4 – RCS interaction of diffuse surface clutter with large scattering objects

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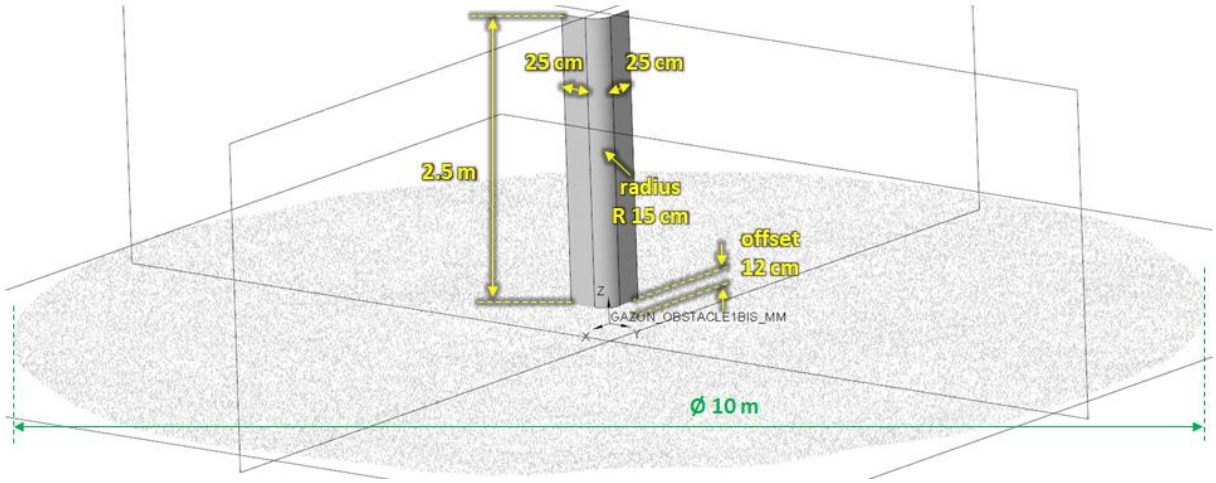
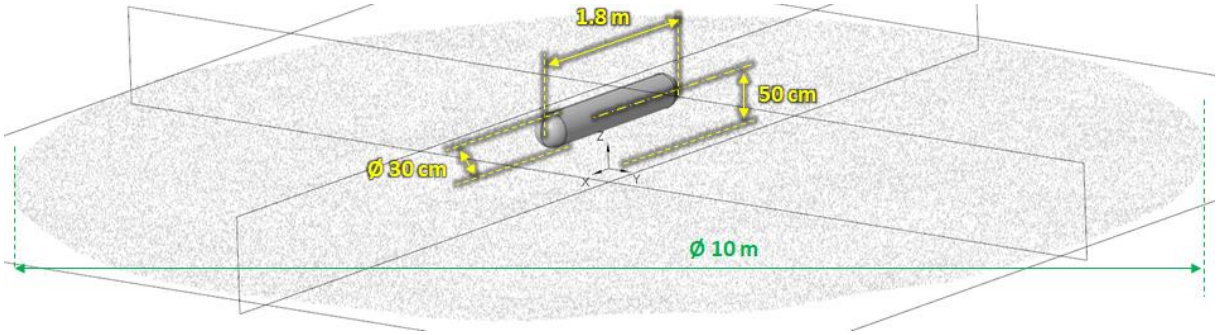
1 – Geometrical description

This test case deals with the monostatic RCS and synthetic aperture imagery at ~ 10 cm resolution of a test-scene combining two interacting components:

- a 10 m diameter circular patch of "surface clutter" **suggested** to be modelled as a "dipole lawn":
  - a moderately dense, deterministic set of straight, disconnected PEC wires,
    (~ 10 wires per resolution cell, hence ~ 1000 wires per m², and overall ~ 80,000 wires)
  - assumed infinitely thin (1D lines) or, wherever needed, their radii can be set to 0.1 mm,
  - base points of the wires are randomly distributed inside the diameter of the circular area,
    - floating in the vacuum (not planted in any kind of "ground" surface),
    - lying at randomly distributed heights close to the Z=0 plane (± 5 cm),
  - top points of the wires obtained by drawing a straight line from the base points:
    - randomly tilted away from the vertical, inside a 5° half-angle conical sector around Z,
    - approximately ½ wavelength long (± 5%) at the center frequency: 15 mm ± 0.75 mm.
- two types of large, smooth, PEC scattering obstacles with large reflecting surfaces (flat or curved) located above the Z=0 plane and interacting with the previous patch of "surface clutter"
  - **obstacle 1**: a tall vertical obstacle with flat perpendicular walls and a rounded corner, offset 12 cm above the Z=0 plane



  - **obstacle 2**: an axisymmetric horizontal "capsule-like" obstacle, its axis of revolution parallel to the X axis and lying 50 cm above the Z=0 plane



In an attempt to foster partial repeatability across some of the submitted results (mostly full-wave approaches), reference geometries (IGES and STEP formats) will be provided for the entire test-scenes,

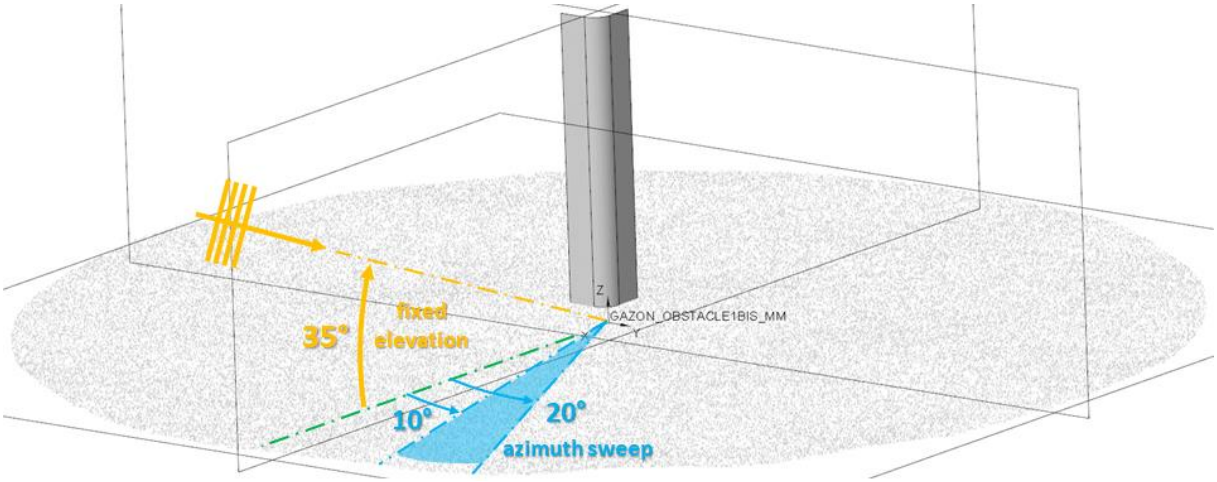
including a deterministic, non-symmetric instance of the random “wire lawn”: in this sample instance, the wires’ base points have been distributed around a spatially-correlated (slightly undulating) random Z surface but this is only an example and not mandatory. **Moreover, participants are fundamentally allowed to use or generate their own modelling of the surface clutter patch (as wires or otherwise)**, as long as they try to stick roughly with the same scatterer distribution / density as above: results will be mainly analyzed and compared for their qualitative behavior in synthetic aperture RCS images.

Also, participants are – of course – encouraged to use (and document) any computational strategy (hybrid, domain decomposition, symmetries…) allowing them to reduce the computation resource needs. In particular, it is explicitly allowed to assume symmetry of the clutter patch with respect to the principal planes X=0 and Y=0 of the coordinate system, for example keeping only a single quadrant of the provided reference “wire lawn” geometry.

2 – Computational parameters

For each one of three test scene configurations (see below), the participants shall compute a double-sweep across frequency and azimuth (201 × 201 far field samples) of the **complex far-field backscattering coefficients**, according to the following ~ 10 cm resolution RCS imaging parameters:

- monostatic VV-polarization (co-polarized, with vertically polarized electric field)
- plane wave illumination at constant elevation (conical cut): 35° above the horizontal plane
- 10° azimuth sweep around a center position at 15° and sampled at a step of 0.05°
  ➔ 1st dimension of double-sweep: 201 azimuth angle steps spanning interval [10° , 20°]
- 1.5 GHz bandwidth around a 10 GHz center frequency and sampled at a step of 7.5 MHz
  ➔ 2nd dimension of double-sweep: 201 frequency steps spanning interval [9.25 , 10.75] GHz
- phase reference for the computation will preferably be chosen at the origin of the coordinate system (or will otherwise be explicitly specified in the submission)



Participants shall provide results for **at least one** of the three following configurations of the test-scene:

- **sub-case 1:** surface clutter patch alone
- **sub-case 2**: surface clutter patch with obstacle 1
- **sub-case 3**: surface clutter patch with obstacle 2

It may be worth emphasizing that sub-case 1 could **possibly** be used as a reference result for phase-coherent (complex) subtraction from the other two sub-cases (in order to better isolate and analyze interaction effects). Depending on the chosen approach, it **could** thus be beneficial to seed any random number generator appropriately, in order to generate exactly the same deterministic surface clutter distribution in all three sub-cases.