

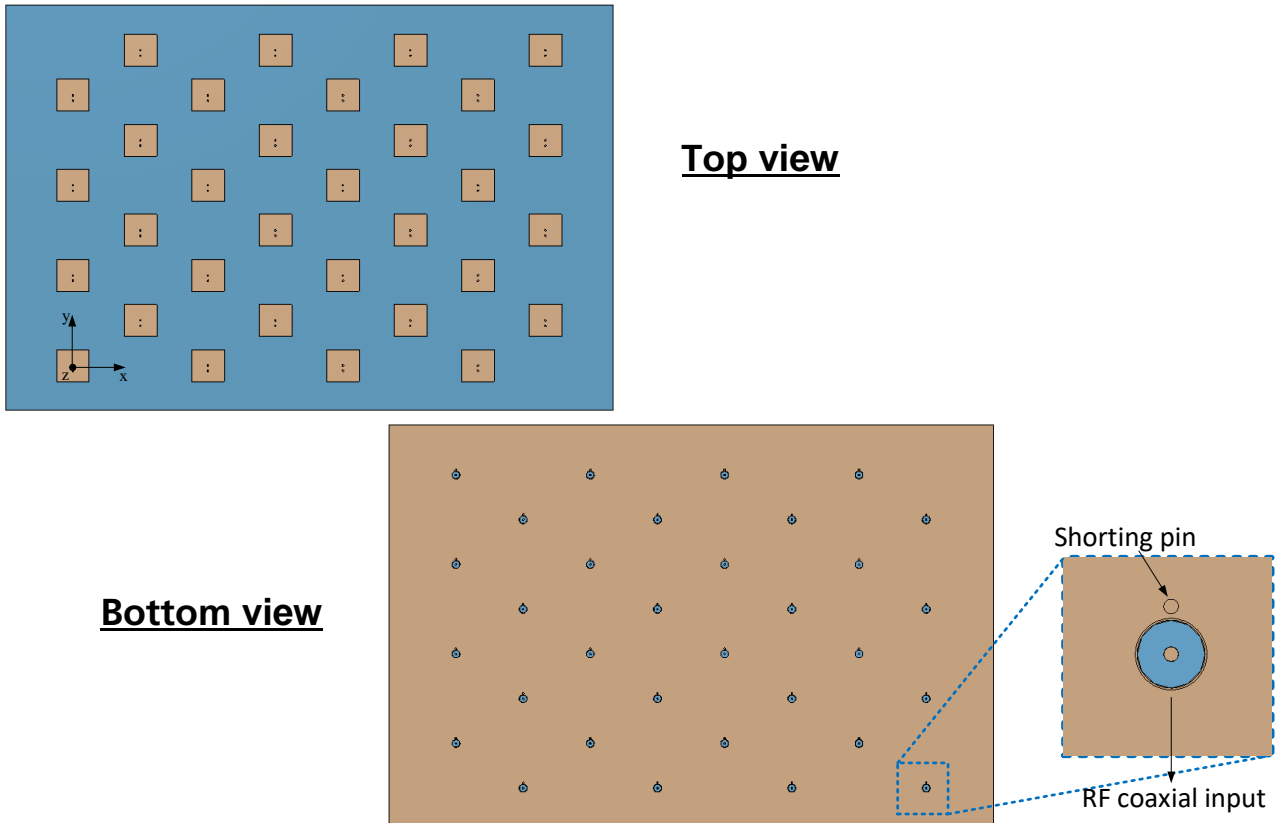
# TEST CASE 4: 8x8 Phased Array

## Monostatic and Bistatic RCS Simulations

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### 1. Definition of the Geometry

The target is a 8x8 active phased array antenna with triangular lattice operating at 9.4 GHz and with all ports terminated in various load conditions: open, short and matched load. CAD model for the antenna is available and can be obtained by email from the chair.

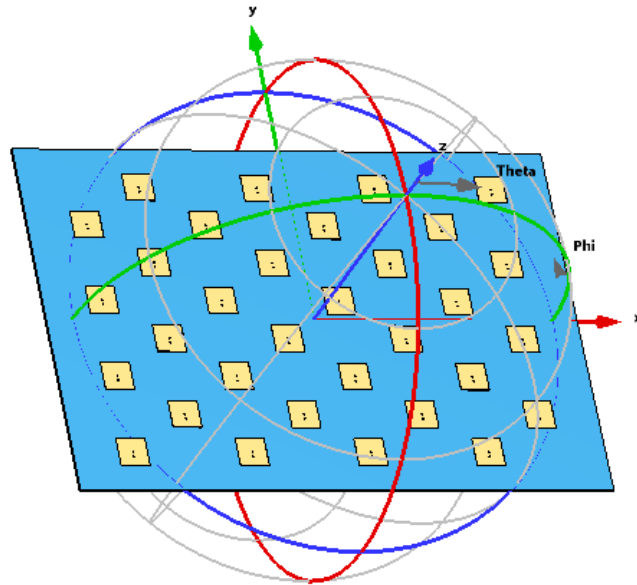


### 2. Simulation Parameters

The time dependency is assumed to be  $e^{j\omega t}$ . The ground plane, shorting pins and microstrip patches are made of copper ( $\sigma = 5.8e7$  S/m) with a cladding of 35  $\mu\text{m}$ . The substrate is the Rogers RO4003C ( $\epsilon_r = 3.55$ ,  $\tan \delta = 0.0027$ ) with a thickness of 0.813 mm.

Given the coordinate system of the CAD model (see figure above), the definition of the spherical coordinate system is indicated and depicted below for clarity:

- Elevation angle Theta,  $\theta$ : starting from the positive +z axis,
- Azimuth angle Phi,  $\phi$ : starting from the positive +x axis,



Based on the above, the following sub-cases are proposed.

#### 1. Case (a): Open

The co- and cross-polar monostatic RCS for both polarizations is required in a discrete angular sweep that starts at  $\mp 60^\circ$  and ends at the aperture normal along the  $\theta$  direction for  $\phi = 0^\circ$ . This needs to be obtained for three frequency points.

- Discrete frequencies:  $f_1 = 5$  GHz;  $f_2 = 9.4$  GHz;  $f_3 = 14$  GHz.
- Discrete source positions:  $\theta_1 = \mp 60^\circ$ ;  $\theta_2 = \mp 45^\circ$ ;  $\theta_3 = \mp 30^\circ$ ;  $\theta_4 = 0^\circ$ ,  $\phi = 0^\circ$ .

#### 2. Case (b): Terminated

As (a), but the ports are terminated by a matched  $50\text{-}\Omega$  load, e.g., an absorbing waveguide port.

#### 3. Case (c): Short

As (a), but the ports are terminated by a PEC sheet.

#### 4. Case (d): open - bistatic (extra)

This sub-case requires co- and cross-polar bistatic RCS for both polarizations. The aperture is illuminated from three discrete positions, at  $\mp 30^\circ$  and with normal incidence ( $\theta = 0^\circ$ ) and then, an angular sweep that starts from the positive z-axis is demanded for the reception along  $\theta$  for  $\phi = 0^\circ$  and  $\phi = 90^\circ$ , respectively. This needs to be obtained for three frequency points.

- Discrete frequencies:  $f_1 = 5$  GHz;  $f_2 = 9.4$  GHz;  $f_3 = 14$  GHz.
- Discrete source positions:  $\theta_1 = \mp 30^\circ$ ;  $\theta_2 = 0^\circ$ ;  $\phi = 0^\circ$
- Receptor angular sweep:  $\theta_r = [0^\circ, 90^\circ]$ ,  $\phi = [0^\circ, 90^\circ]$ ,  $\Delta\theta = 1^\circ$ ,  $\Delta\phi = 90^\circ$

### 3. Data Formats

The results will be stored in ASCII files, labelled for cases a to c as:

- test\_case\_Xa\_f\_5\_CONTRIBUTOR\_NAME.txt
- test\_case\_Xb\_f\_5\_CONTRIBUTOR\_NAME.txt
- test\_case\_Xc\_f\_5\_CONTRIBUTOR\_NAME.txt
- test\_case\_Xa\_f\_9\_CONTRIBUTOR\_NAME.txt
- test\_case\_Xb\_f\_9\_CONTRIBUTOR\_NAME.txt
- test\_case\_Xc\_f\_9\_CONTRIBUTOR\_NAME.txt

- test\_case\_Xa\_f\_14\_CONTRIBUTOR\_NAME.txt
- test\_case\_Xb\_f\_14\_CONTRIBUTOR\_NAME.txt
- test\_case\_Xc\_f\_14\_CONTRIBUTOR\_NAME.txt

where "CONTRIBUTOR\_NAME" should be replaced by the name of the contributing institution, if necessary followed by a postfix indicating the method used for the simulations, e.g., Contributor1\_FDTD, Contributor1\_MoM,...

Each file will contain on each row the data :

$\theta \sigma$

where  $\theta$  is the angle in degrees and  $\sigma$  is the RCS in dBsm.

The results will be stored in ASCII files, labelled for case d as:

- test\_case\_Xd\_f\_5\_Theta\_Neg30\_CONTRIBUTOR\_NAME.txt
- test\_case\_Xd\_f\_5\_Theta\_Pos30\_CONTRIBUTOR\_NAME.txt
- test\_case\_Xd\_f\_5\_Theta\_0\_CONTRIBUTOR\_NAME.txt
- test\_case\_Xd\_f\_9\_Theta\_Neg30\_CONTRIBUTOR\_NAME.txt
- test\_case\_Xd\_f\_9\_Theta\_Pos30\_CONTRIBUTOR\_NAME.txt
- test\_case\_Xd\_f\_9\_Theta\_0\_CONTRIBUTOR\_NAME.txt
- test\_case\_Xd\_f\_14\_Theta\_Neg30\_CONTRIBUTOR\_NAME.txt
- test\_case\_Xd\_f\_14\_Theta\_Pos30\_CONTRIBUTOR\_NAME.txt
- test\_case\_Xd\_f\_14\_Theta\_0\_CONTRIBUTOR\_NAME.txt

Each file will contain on each row the data :

$\phi \theta \sigma$

where  $\phi$  is the receptor position in azimuth in degrees and  $\theta$  is the receptor position in elevation in degrees and  $\sigma$  is the RCS in dBsm.

#### 4. Additional Information

Each .txt-file should be accompanied by a .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),...