EM Design and Analysis of Antenna Enclosed Ground-Based Radome

Roshni N.[1], S. N. V. Durgesh[1], B. Choudhury[1], R. U. Nair[1]
1. CSIR – National Aerospace Laboratories, Bengaluru, KA, India

INTRODUCTION: EM design of a hemispherical radome surrounding a parabolic reflector antenna has been implemented using COMSOL Multiphysics® software to study the radome-antenna interactions.

Figure 1. Ground based spherical radome. (*src: Wikipedia*)

COMPUTATIONAL METHODS: A circular horn fed parabolic reflector antenna enclosed by an A-Sandwich radome has been simulated using the 2D axisymmetric formulation of the electromagnetic wave equation.

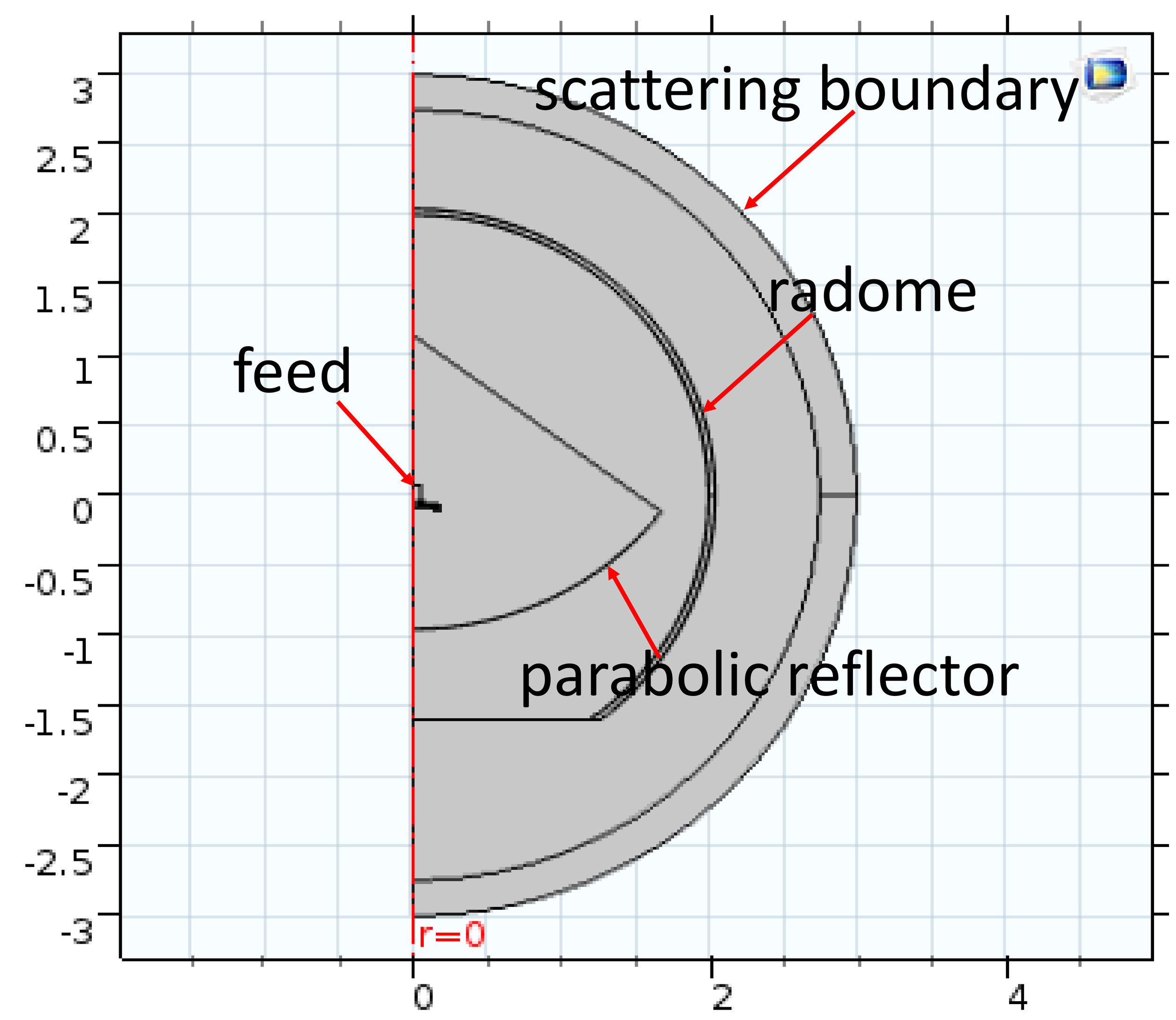

Figure 2. Geometry of the antenna enclosed radome.

The designed parabolic reflector antenna has a horn aperture radius of 0.054m and a waveguide radius of 0.162m. The total horn length of 0.162m has been considered in the design. The reflector aperture radius has a value of 2.1m. The reflector antenna assigned with a slit-conditioned circular port on the waveguide end to exciting the antenna with an operating frequency of 1.789GHz.

The radome skin has the properties of glass fiber and thickness of 1/20th of the operating wavelength. The radome core has been assigned the property of foam and has a thickness of 1/4th of the operating wavelength. The metal surfaces have been considered as perfect electric conductors. The remaining domains have been assigned air in the design.

RESULTS: A very sharp far-field radiation pattern observed for the parabolic reflector antenna enclosed inside the A-Sandwich radome. Further, a comparison study of the performance of parabolic reflector antenna with and without radome has been carried out.

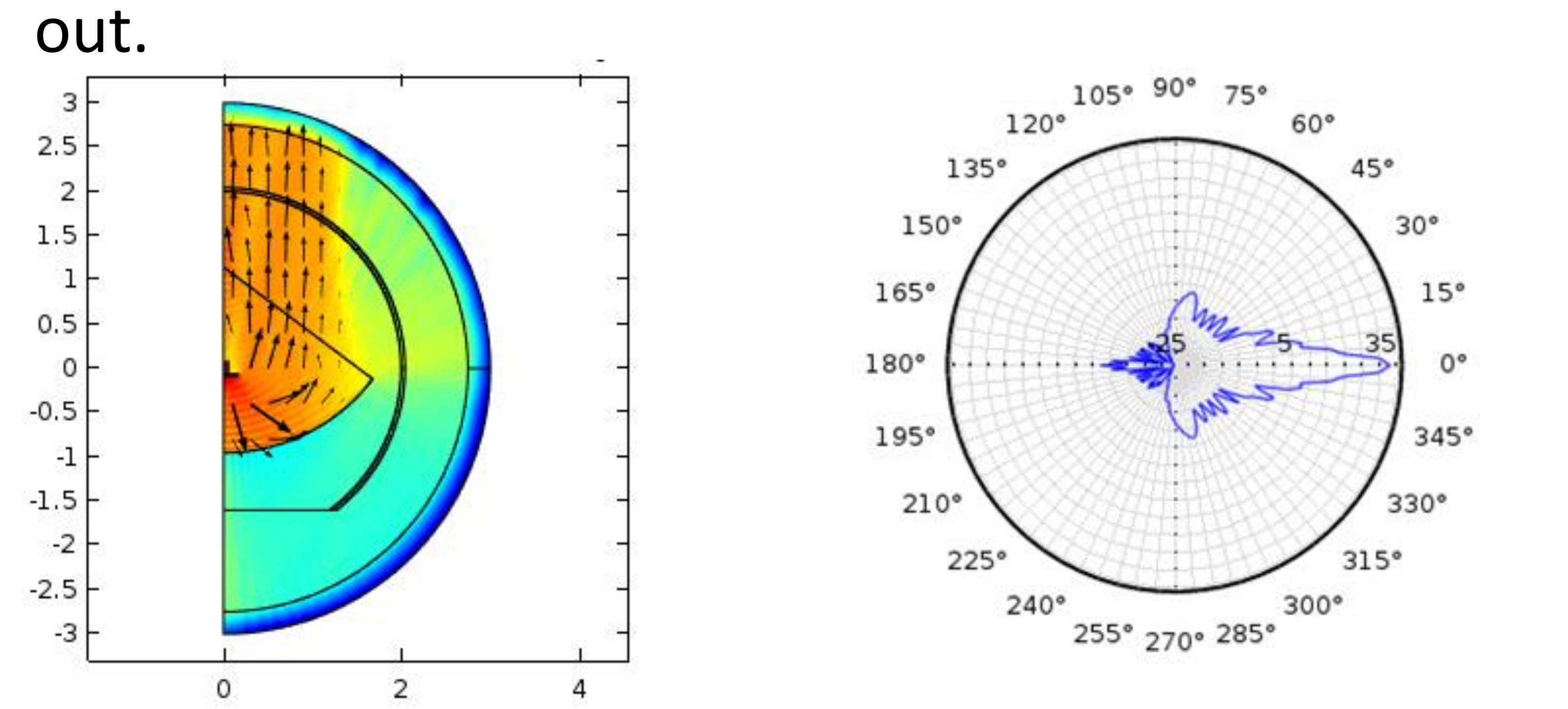

Figure 3: The simulation results of parabolic reflector antenna enclosed inside radome. (a) The field from horn antenna propagating in the z-direction. (b) The 2D plot of far-field gain in dBi.

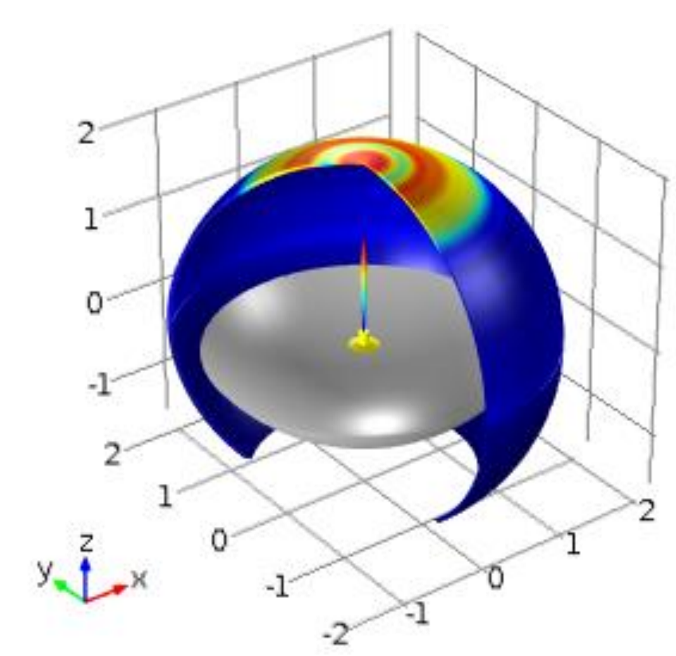

Figure 4. 3D far-field radiation pattern visualized over parabolic reflector antenna.

Parameters	Without Radome	With Radome
Maximum Gain (dB)	33.206	33.1373
S11 (dB)	-16.89	-16.988
VSWR	1.33	1.33

Table 1. Antenna parameters estimated through simulation.

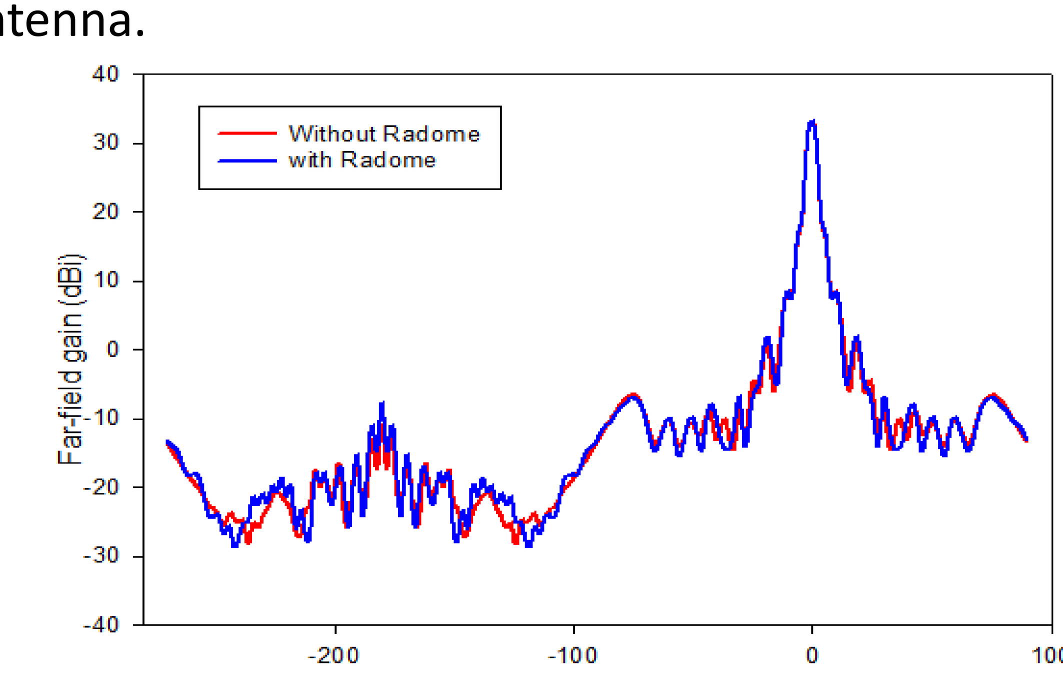

Figure 5. Far-field radiation pattern of the parabolic reflector.

CONCLUSIONS: The effect of radome on the parabolic reflector antenna analyzed at operating frequency of 1.789GHz. The radiation pattern of the parabolic reflector antenna in the presence of radome remains almost unaffected with a slight fall of 0.07 dBi in the main lobe.

REFERENCES:

1. Mashury Wahab, "Radar Radome and Its Design Considerations", Int. Conf. on Instrumentation, Communication, Information Tech, and Biomedical Eng., Nov. 2009.
2. Kyung-Won Lee, Yeong-Chul Chung, Ic-Pyo Hong, and Jong-Gwan Yook , "An Effective Design Procedure for A-Sandwich Radome", IEEE Antennas and Propagation Society International Symposium, Jul. 2010.
3. Kirti Chaurasiya, and Satish Kumar, "Design and Analysis of Parabolic Reflector Using MATLAB", Int. J. of Adv Research in Electrical, Electronics and Instrumentation Engineering, Vol. 4, Issue 3 (2015)