Study of Surface Wave and Transmission Properties in Radome Surface

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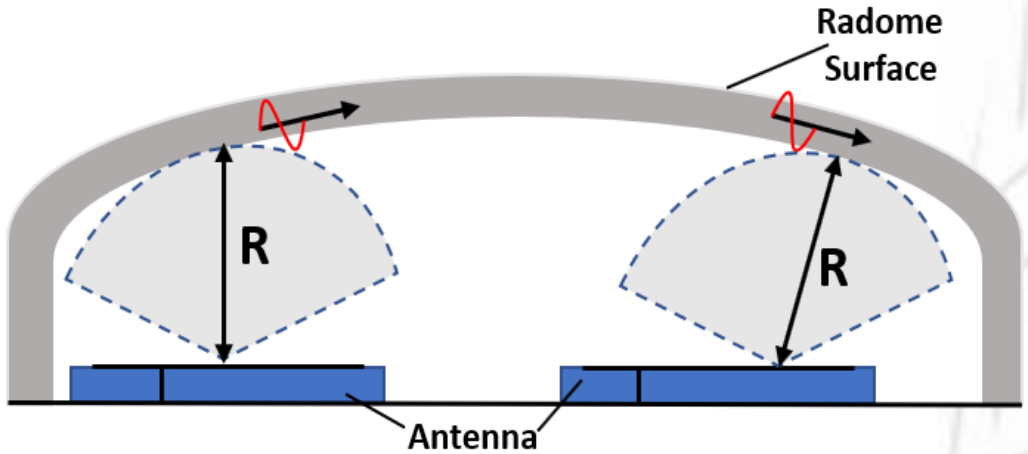
I. INTRODUCTION

1) Radome: It is a kind of structure which is popularly used to protect the antenna from the hostile condition (such as, heat, humidity, and cold etc.,) especially in the military applications [1].

2) Problem: In most of the cases, Radome surface are situated under the near field region (i.e., $R<2D^2/\lambda$, where, D is the maximum dimension of antenna, and λ is the operating wavelength) of the antenna [See, **Fig. (1)**]. This may cause excitation of surface wave.

3) Objective: To analyze the surface wave modes in Radome structure, generated due to the reactive-field of the antenna.

Fig (1)



Radome is placed under the near-field region (R) of antennas.

[1] Balanis, Constantine A. Advanced Engineering Electromagnetics. New York: Wiley, 1989.

II. PROPOSED MODEL

Basic terminology:

1) **Transmission coefficient (TC):** This parameter is defined to compute the transparency of the Radome.

$$TC = \frac{E_t}{E_i}$$

where E_t = E-field transmitted through the Radome surface. E_i = E-field incident on the Radome surface.

1) **Transverse Resonance Method (TRM):** Surface wave analysis is instead carried out by using transverse resonance method [1]:

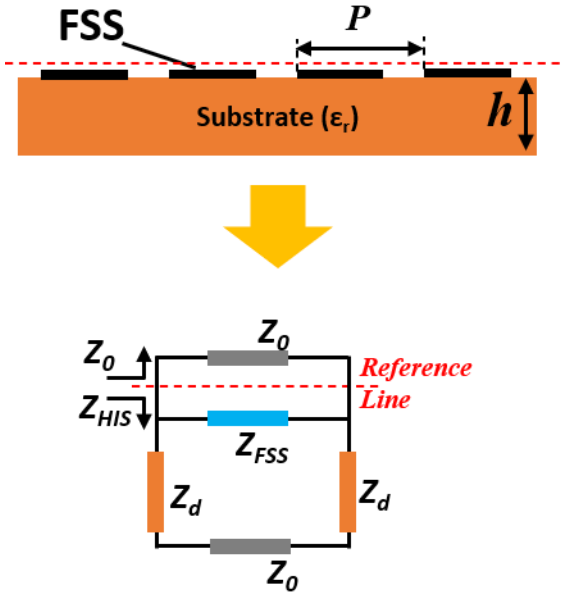
$$Z_{RS}^{-1} + Z_0^{-1} = 0,$$

where

$\mathbf{Z_0}$ = The impedance in free-space for TE and TM-polarized incident wave.

$\mathbf{Z_{RS}}$ = The equivalent impedance of the Radome surface (RS) in both TE and TM polarized wave.

Fig (2)



J. Atmos. Oceanic Technol.. 2008;25(9):1590-1599. doi:10.1175/2008JTECHA1056.1

II. PROPOSED MODEL

Proposed specifications of FSS based unit cell structure:

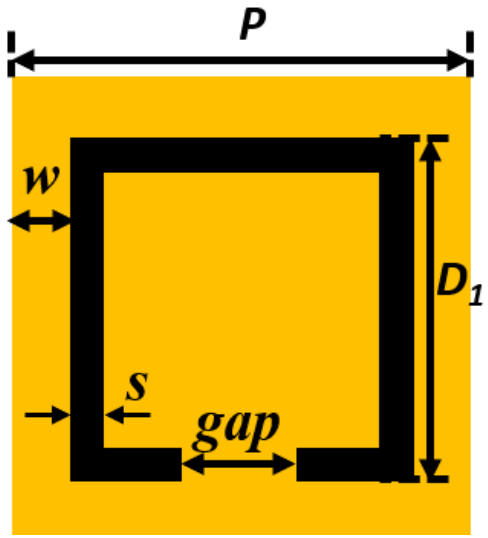
The transmission properties is computed of the frequency selective surface (FSS) based unit-cell structure. The considered unit-cell has transmission properties in wide range.

The substrate is lossless dielectric (ε=2.65) of thickness (t) 1.5 mm.

The periodicity (P) of unit cell is 32 mm, width (w) between two FSSs is 6.75 mm, width of ring (s) is 1.5 mm, length of outer ring (L1) is 18.5 mm, gap is varied from 1 mm to 5 mm.

The analysis of the selected unit-cell is carried out in ANSYS HFSS software 19.0.

Fig (3)



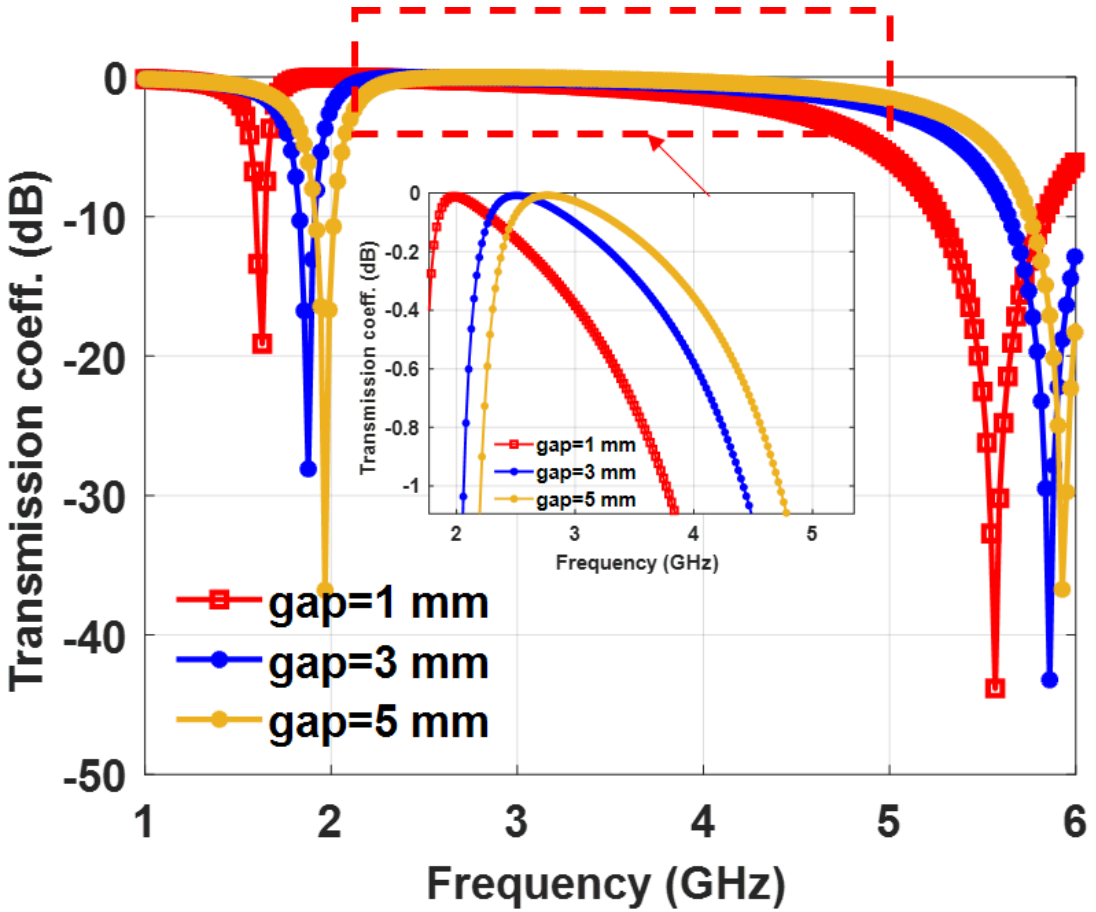
Top view of proposed unit cell

III. RESULTS AND DISCUSSION

The transmission band is obtained from 1.7 to 3.23 GHz (1.53 GHz) for gap=1 mm, 2.1 to 4.45 GHz (2.35 GHz) for gap=3 mm, and 2.3 to 4.7 (2.4 GHz) for gap=5mm.

Hence, as the gap varied from 1 to 5 mm, bandwidth of the transmission band also increases from 1.53 GHz to 2.4 GHz, respectively.

The maximum bandwidth of -1 dB S21 is 2.4 GHz (at gap=5 mm).

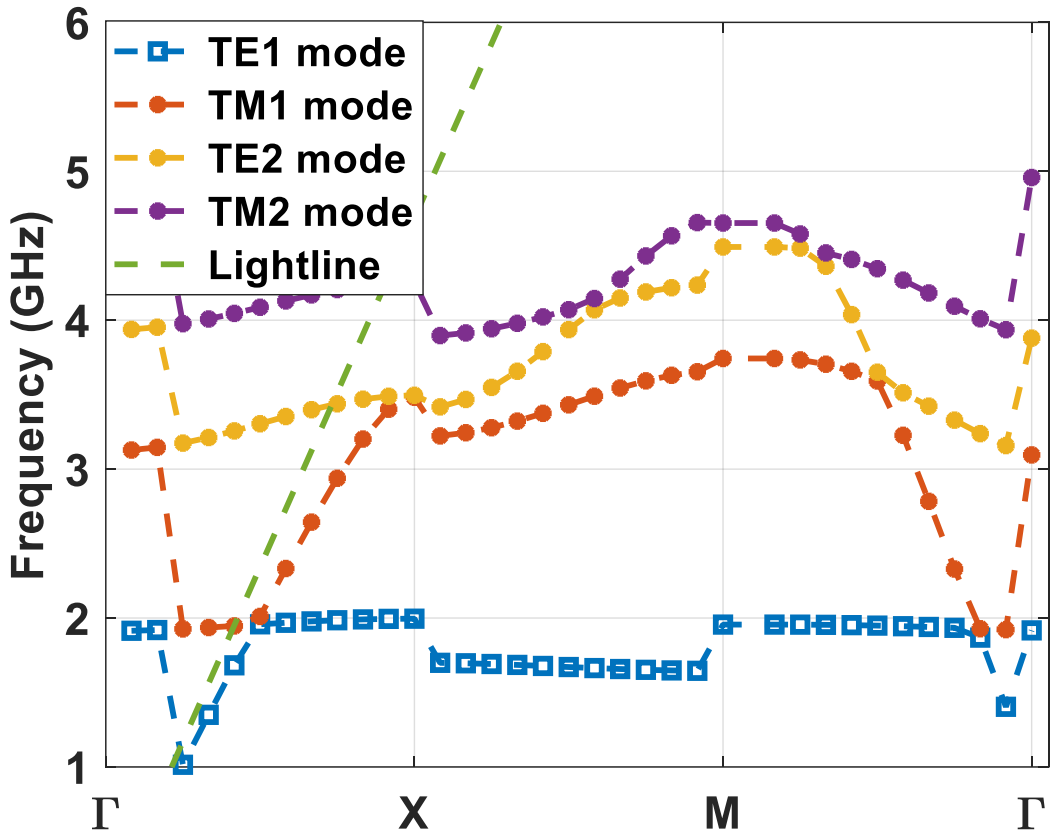


Transmission Coefficient (in dB) of selected unit cell in TE polarized wave

III. RESULTS AND DISCUSSION

Fig (5)

- Fig. shows the k-β dispersion diagram from 1.0 to 6.0 GHz of frequency range.
- It shows the surface wave modes correspond to the whole transmission band.
- Hence, it is obvious that the presence of surface wave in the transmission region may cause the attenuation of EM wave.



k-β dispersion diagram of the unit-cell

CONCLUSION

- The transmission coefficient and k-β dispersion diagram of Radome surface is analyzed.
- Unit cell of Radome surface shows the existence of surface wave in the transmission band, hence transparency of the radome surface for the transmission band is reduced.

Future developments: In future, we can work on the improvement in Radome transparency by reducing the surface wave in the Radome surface.

THANK YOU

for your

ATTENTION

FOR Questions
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