Analysis and Optimization of Dual Arm Center Excited Surface Micro-machined Archimedean Spiral Antenna with Improved Wideband Characteristics

Presented by

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Outline

- Introduction
- Basic Structure and Configuration in COMSOL
- Effect of surface micromachining
- Effect of feed length structure
- Effect of ground plane
- Effect of symmetric excitation
- Conclusion and future scope
- Acknowledgements

Introduction

Why Archimedean spiral?

1) Frequency independent(Broadband)
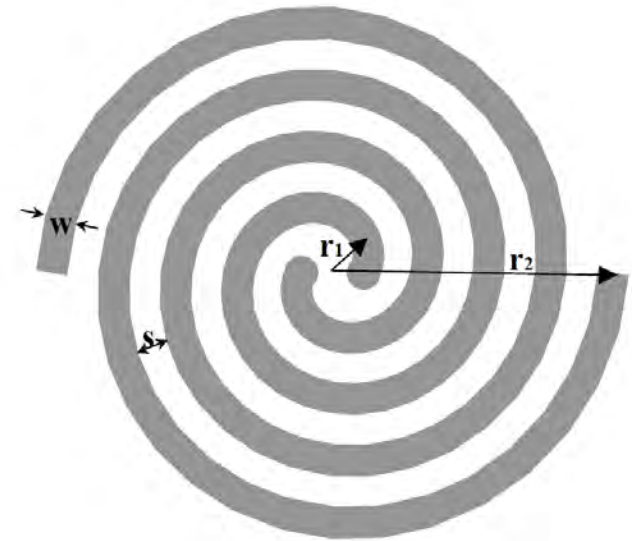2) Circular polarization

Equations governing the 2 arm Archimedean Spiral antenna

$$r = r_0\phi + r_1 \; ; \quad r = r_0(\phi - \pi) + r_1$$

Frequency cut off points

$$f_{high} = \frac{c}{2\pi r_1} \qquad f_{low} = \frac{c}{2\pi r_2}$$

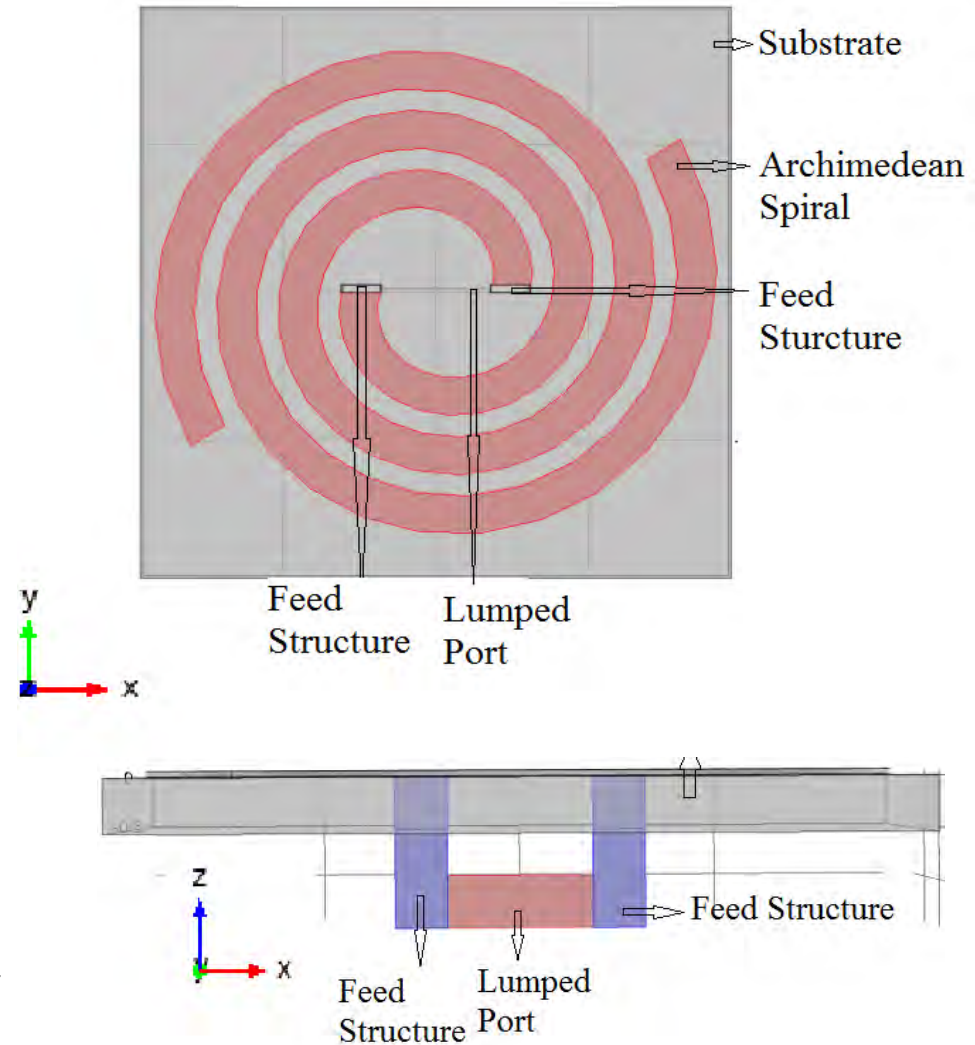where r_1 is the outer radius and r_2 is the inner radius

r_1=0.75mm
r_2=3.4mm

Basic Structure and Configuration

- The dielectric is Quartz (3.78) and loss tangent of 1e-4

- The metal is Gold

- The spiral is 0.5mm width

- The thickness is 0.05 mm

- A sphere encompassing the model is used to calculate the electric far field pattern

- Uniform Lumped port of 50Ω and input voltage of 1V

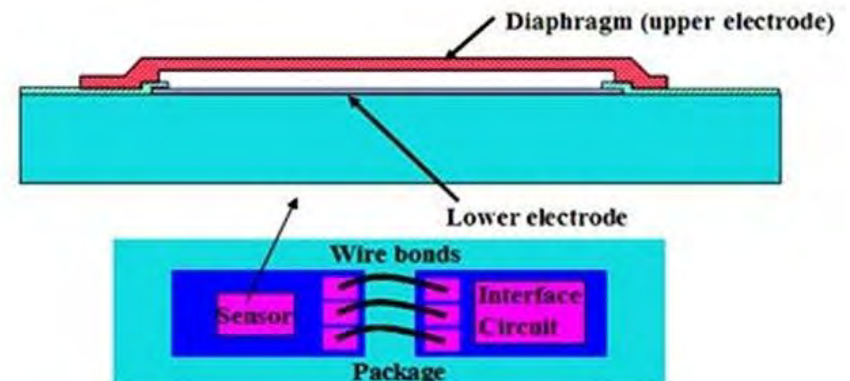# Effect of surface micromachining

What is surface micromachining?

deposition of structural and sacrificial layers followed by patterning and its subsequent removal
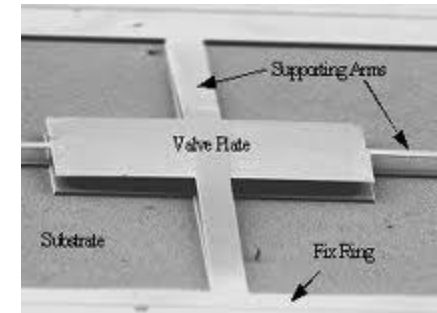
Why surface micromachining?

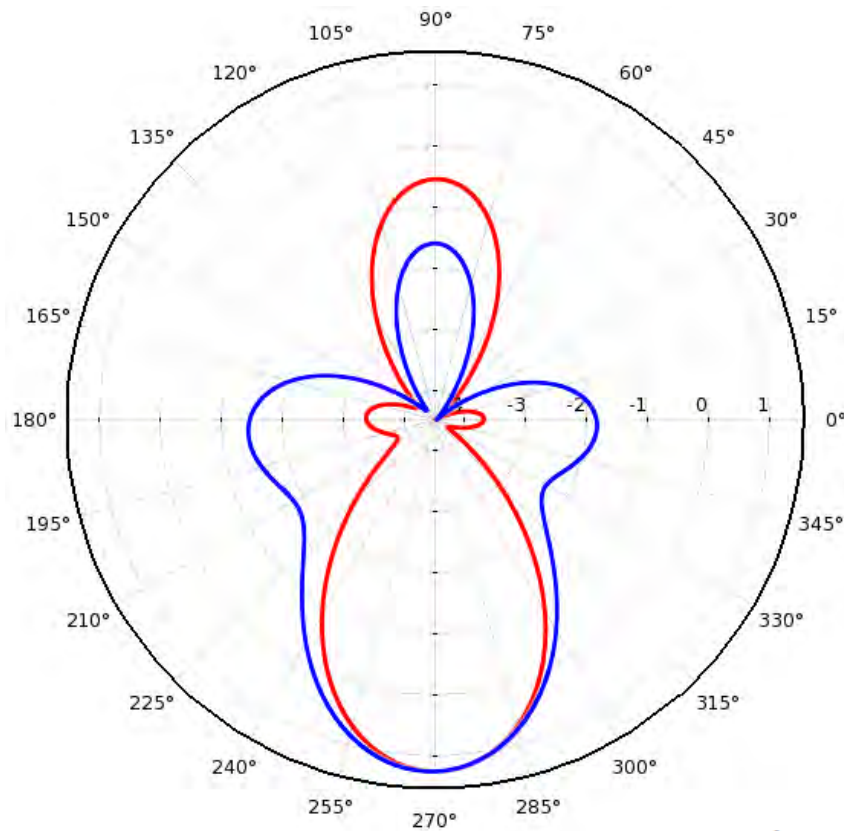1) reduce the dielectric loss

2) reduce the conductor loss
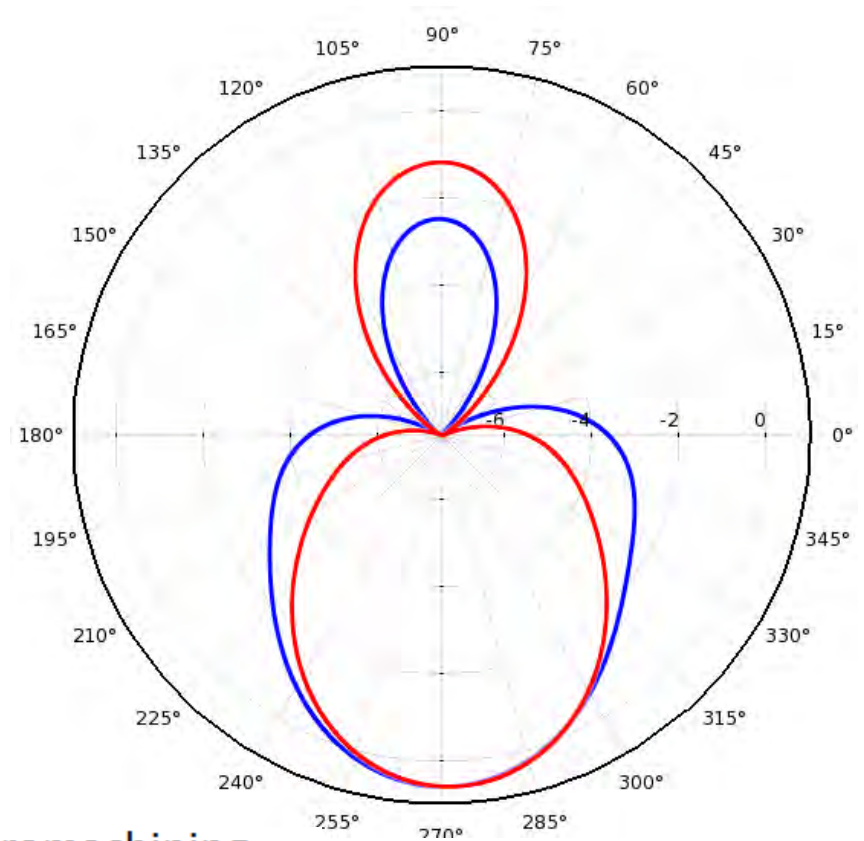
Effect of micromachining on the radiation pattern
Directivity increases
Symmetric Pattern

Far-field norm (dB) in XZ plane
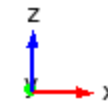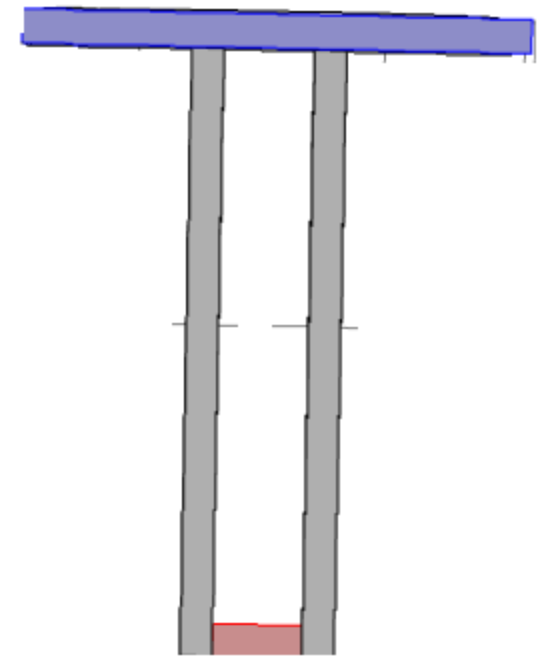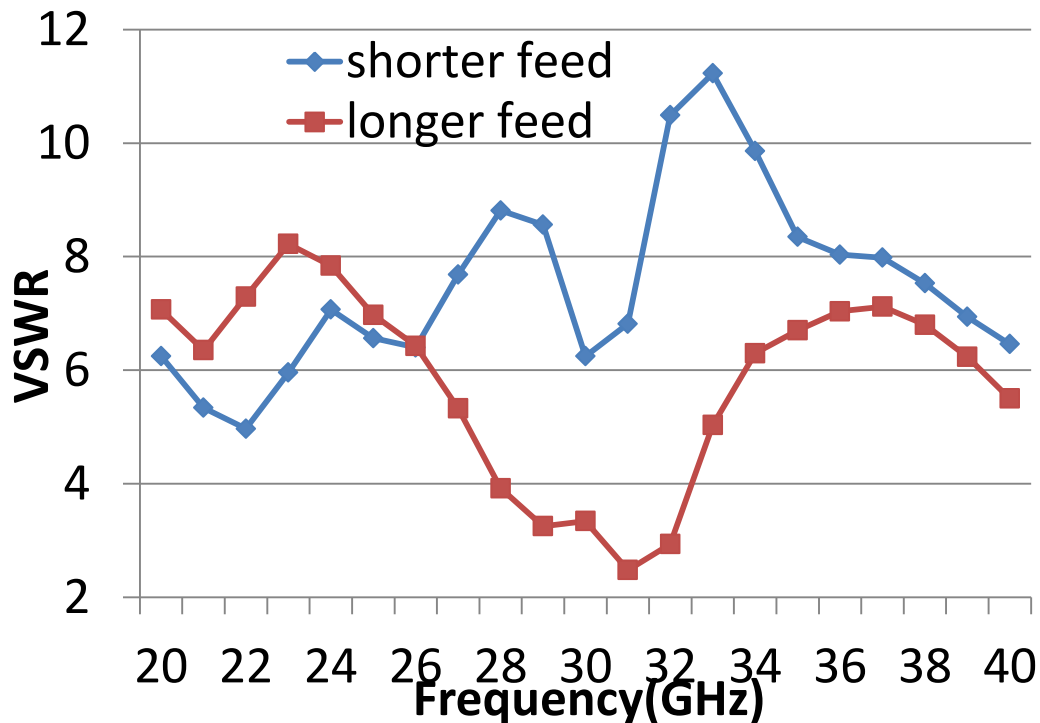
Far-field norm (dB) in YZ plane

with micromachining
without micromachining

Effect of feed length

- Length of the feed structure is increased form 1.5mm to 10 mm(1 cm)
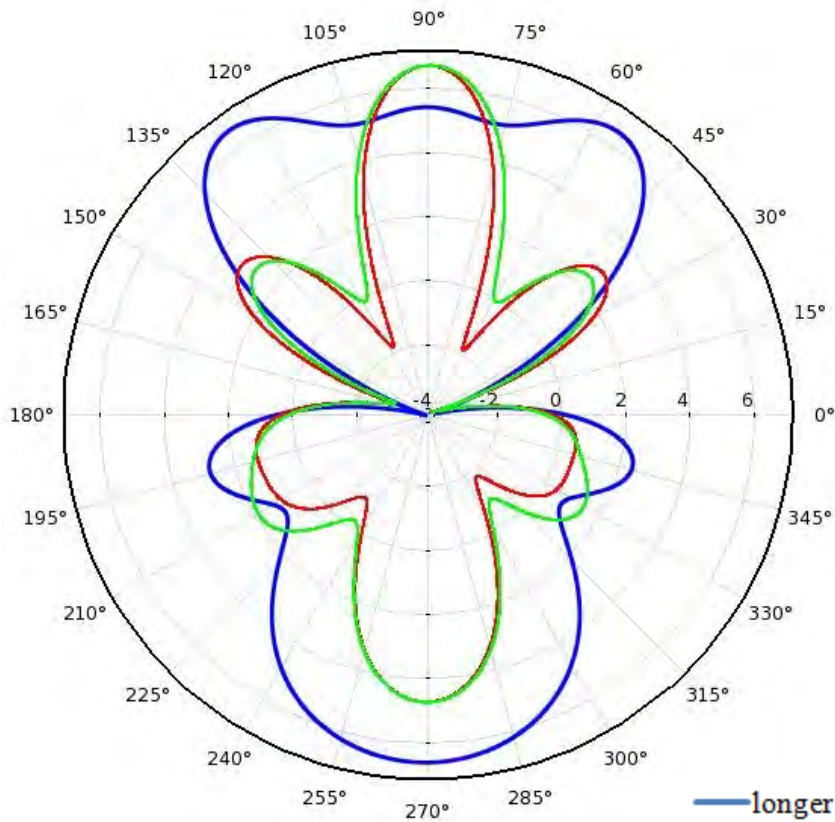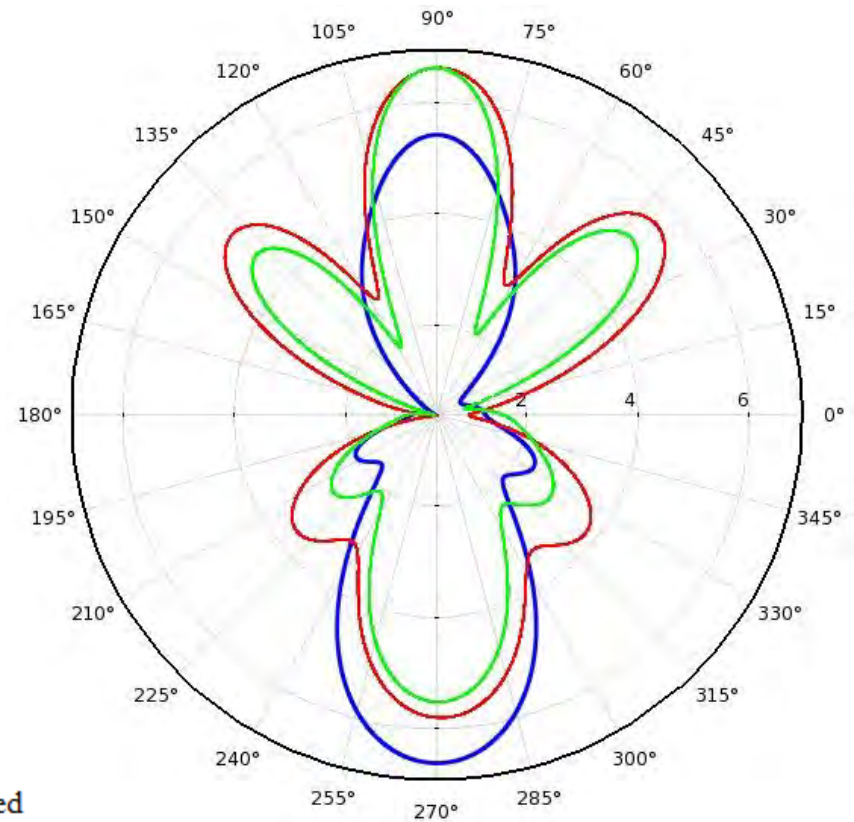
Advantages

lower VSWR

Effect of ground plane

The motivation in adding a ground plane was to create a symmetric pattern in the far field.
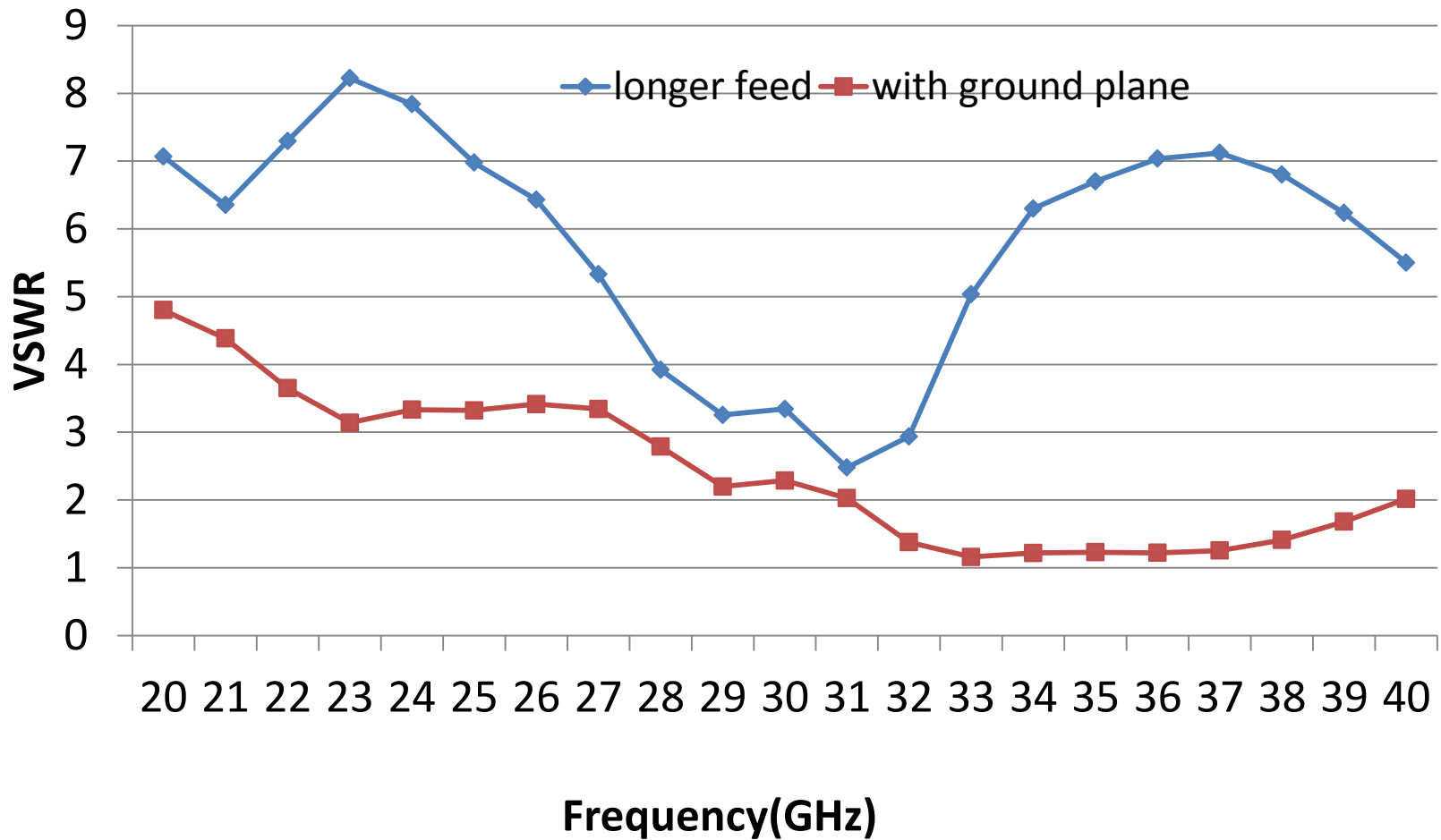
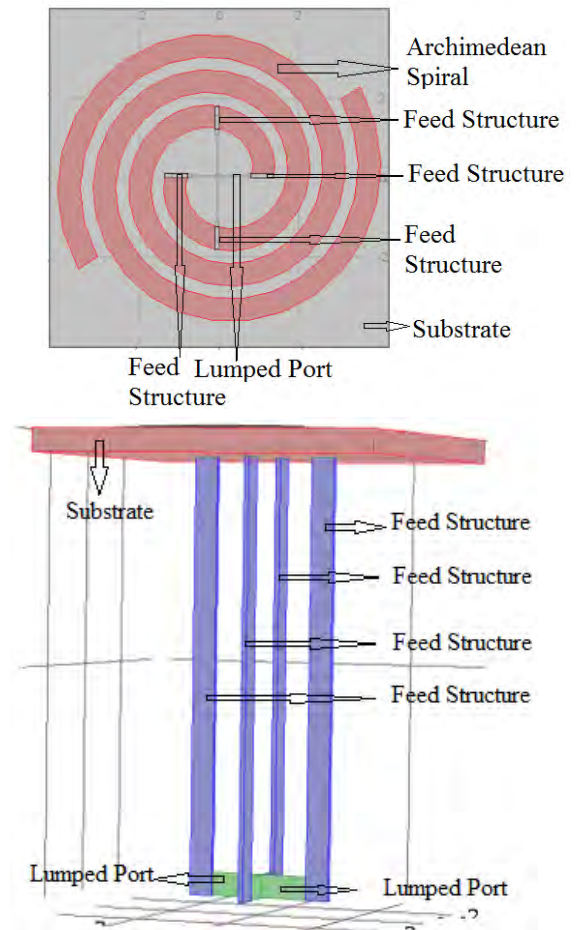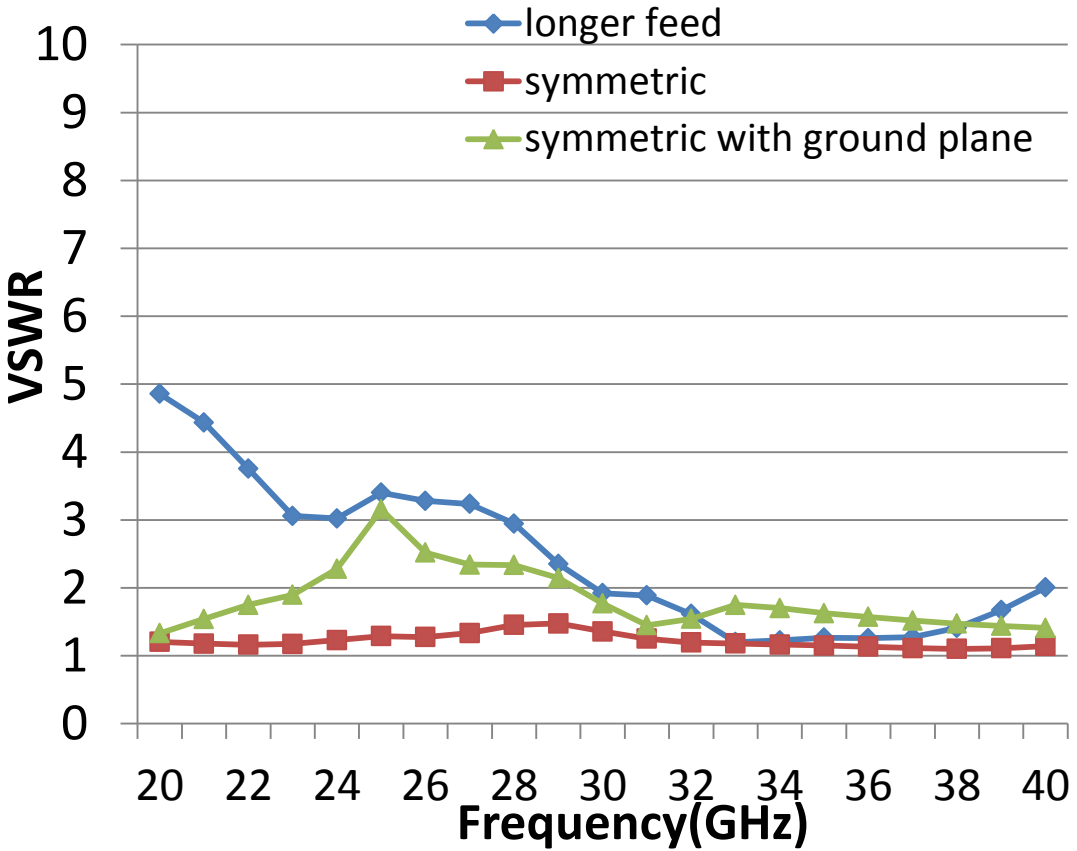Far-field norm (dB) in XZ plane

Far-field norm (dB) in YZ plane

longer feed
ground plane inclusion
micromachining inclusion

The additional effect the ground plane is in its reduction of VSWR

Effect of symmetric excitation feed structure

With the introduction of the additional feed structure the matching improves to the extent that the VSWR is between 1-1.5 in the frequency band width(20GHz-40GHz).
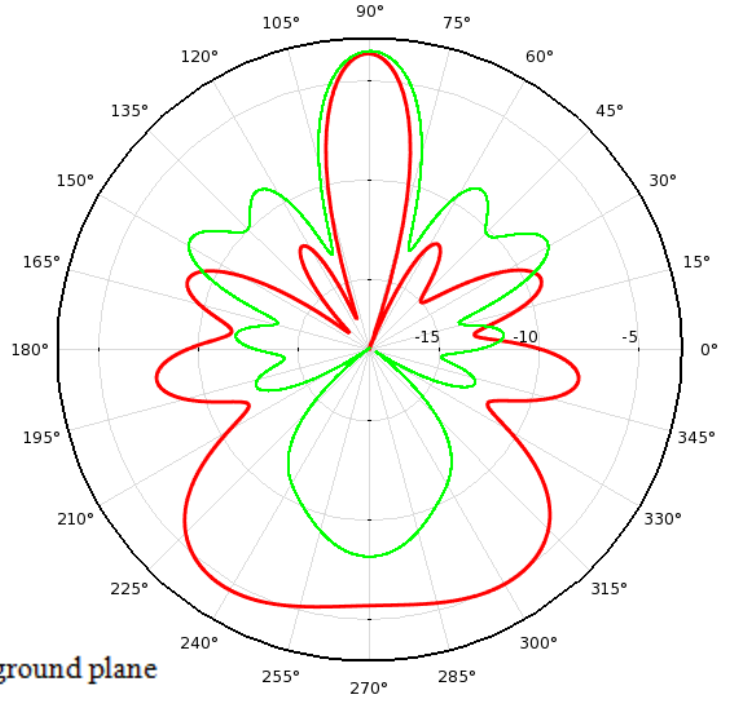
A ground plane together with the symmetric feed structure makes the far field pattern symmetric but increases the VSWR.

TRADE OFF exists at the inclusion of both the ground plane and additional feed structure

Far-field norm (dB) in XZ plane
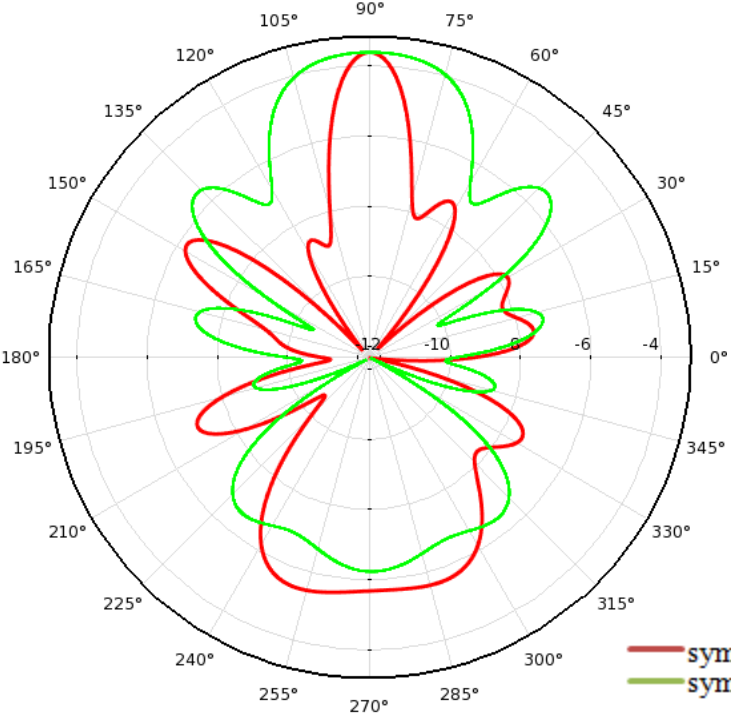
Far-field norm (dB) in YZ plane

symmetric
symmetric with ground plane

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Conclusions and Future Scope

- Far field pattern improvisation (gain, directivity)

- Decrease in lateral dimensions

- Effect of coaxial feed

- Array integration

- Effect of scaling on current , magnetic field and electric field variation

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