Wide-Band Antenna for UAVs

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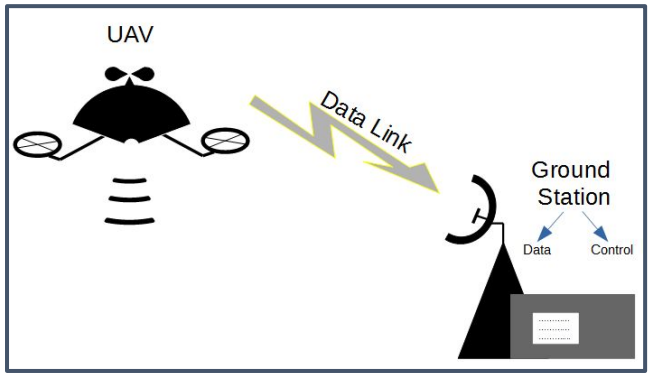
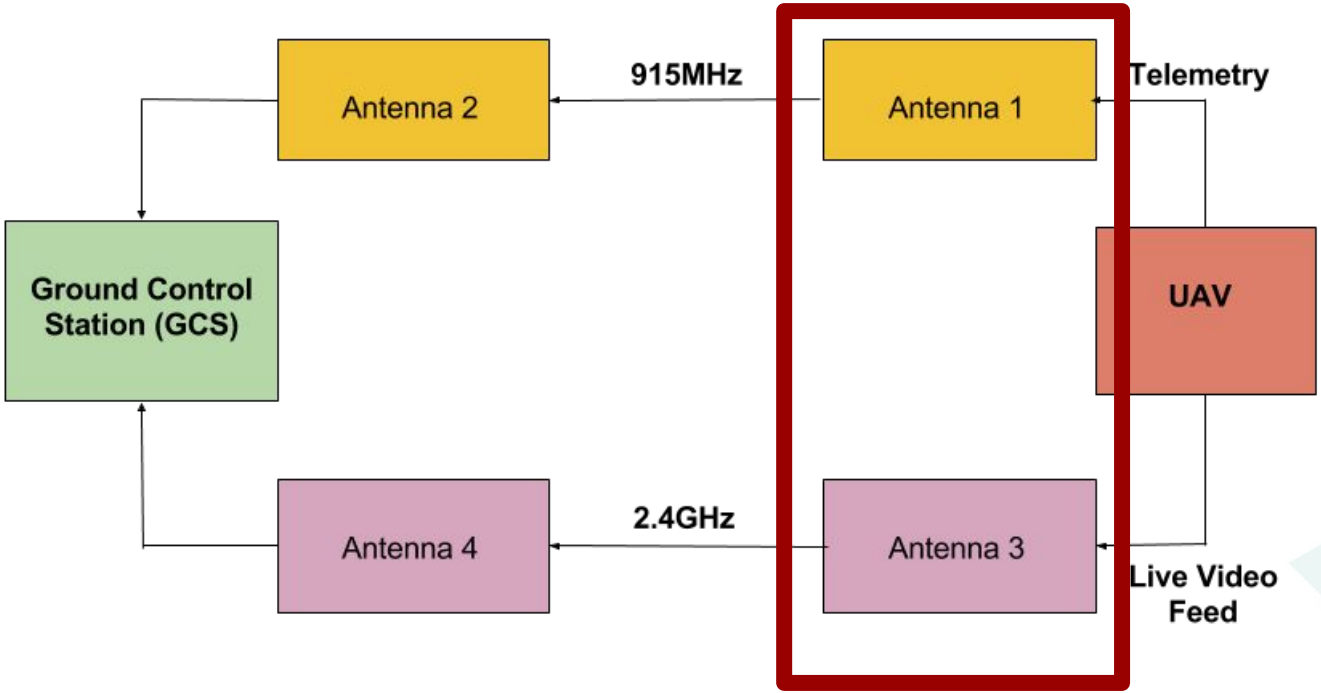
Motivation: UAVs

- Unmanned Aerial Vehicles (UAVs), more commonly known as *Drones*
- Applications range from reconnaissance, payload drop, transportation of goods, mapping, search and rescue etc
- Usually (in most cases), they are controlled/monitored via Ground Control Station (GCS)



http://mobnet-h2020.eu/index.php/news/item/what-is-a-ground-station-and-basics-of-a-data-link

Motivation: Communication in UAVs



Motivation

Benefits of a single dual-band antenna:

- Reduces complexity of two antenna systems
- Reduces payload weight!

Design Objectives

Thus we require an antenna with the below characteristics:

- Wideband
- Omnidirectional
- Lightweight
- Compact

Antennas considered:

- Traditional antennas like patch, dipole, horn (*not wideband*)
- Dipole Array (*bulky*)
- Fractal (*complex*)

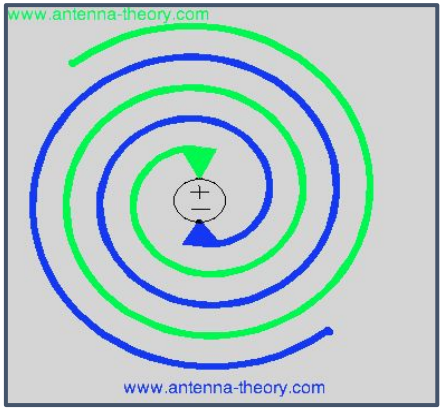
Design Objectives - Spiral Antenna

The below reasons make Spiral Antenna an ideal choice:

- Ultrawide-wideband (*frequency independent*)
- Easy to build
- Compact & Lightweight
- Add more systems in future (like 5.8GHz)

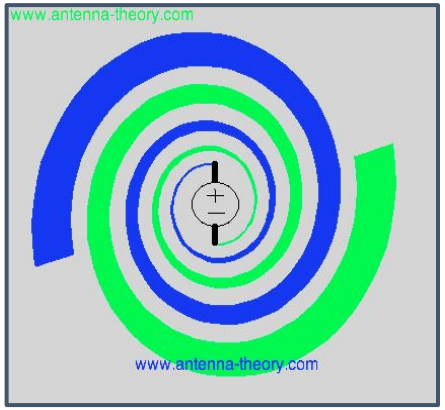
http://enggate.net/general-engineering/t2454.html

Spiral Antenna Design - Types



Archimedean

$r = a\phi$



Equiangular

$r = R_o.e^{a\phi}$

Spiral Antenna Design - Archimedean

$F_{Low} = 900MHz$ $F_{High} = 2.5GHz$

- Outer radius: $r_2 = c/(2\pi f_{low})$ **[5.3 cm]**
- Inner radius: $r_1 = c/(2\pi f_{high})$ **[0.75 cm]**
- No. of turns: N = **3.5**
- Strip width: $w = (r_2 - r_1)/(4N)$ **[0.325 cm]**
- Spacing: s = w **[0.325 cm]**

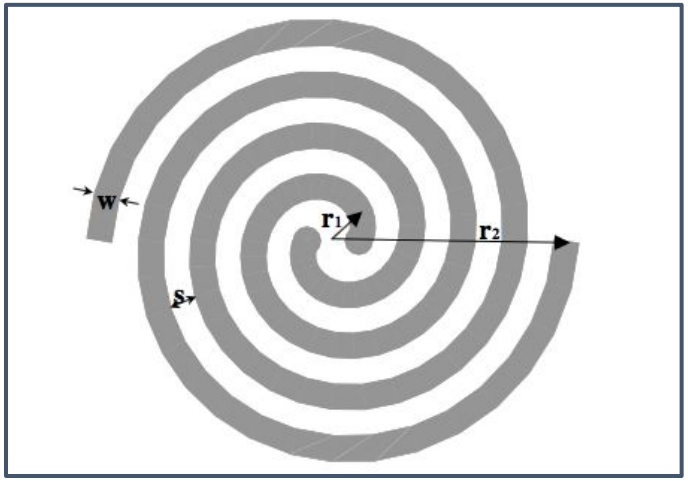
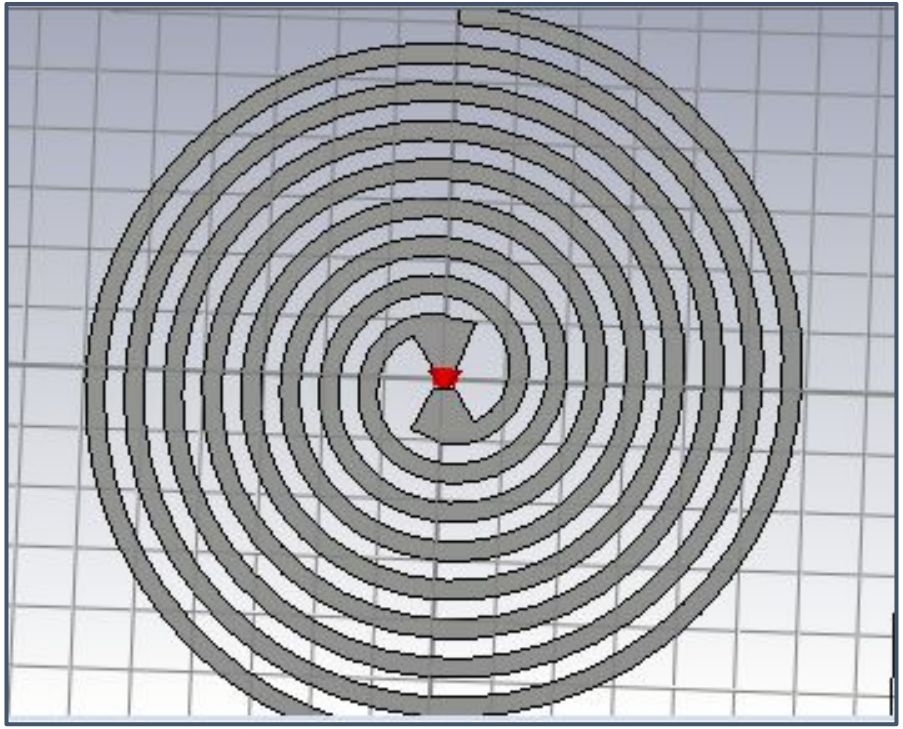
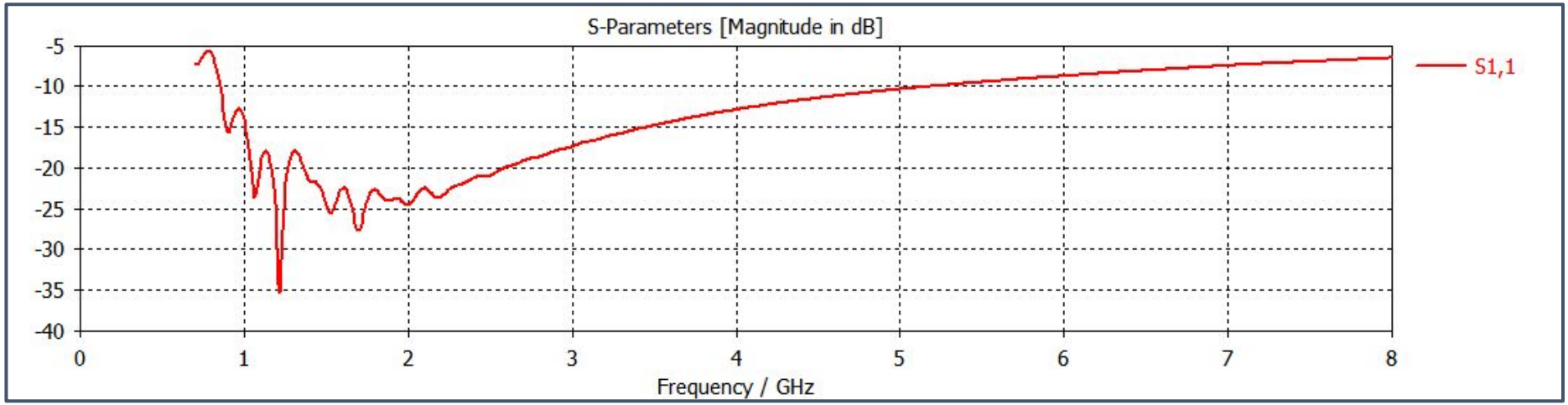


Image Source: Modern Antenna Design by Thomas A Milligan, 2005, p.541

Simulation Results - Design



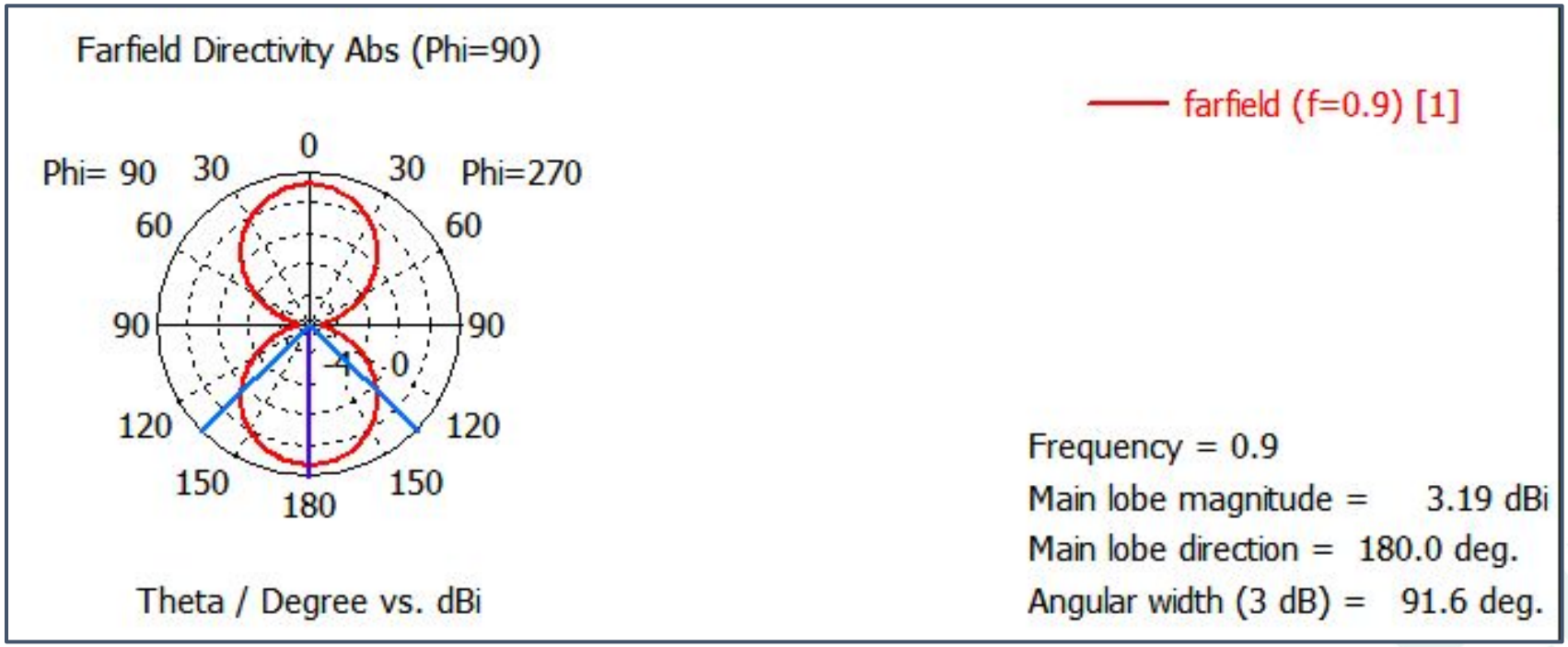
Simulation Results - S11



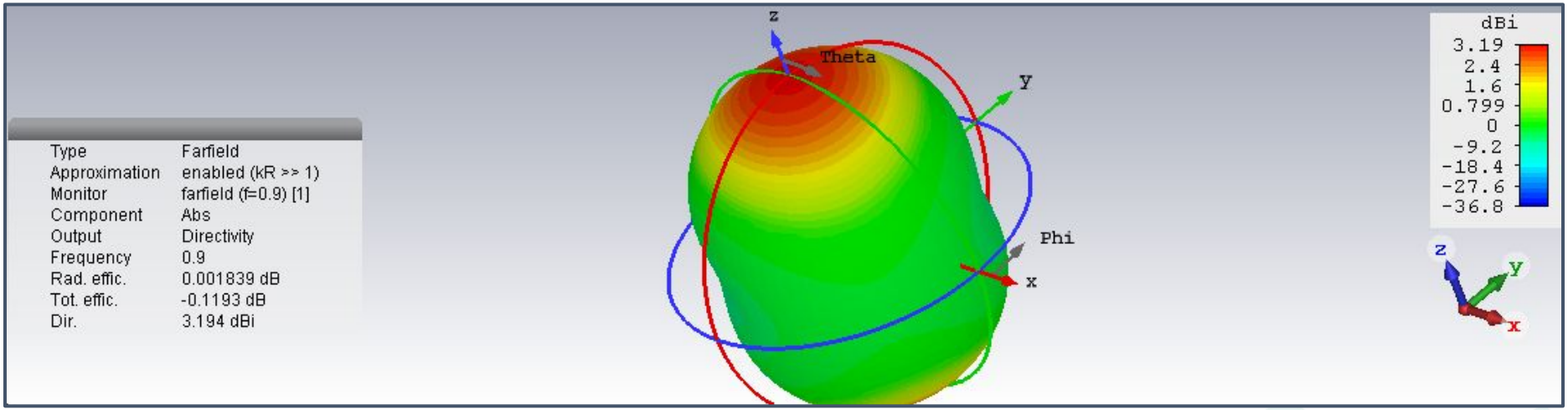
Min and Max frequencies for S11 < -10dB :

- Min = 0.85 GHz
- Max = 5.2 GHz

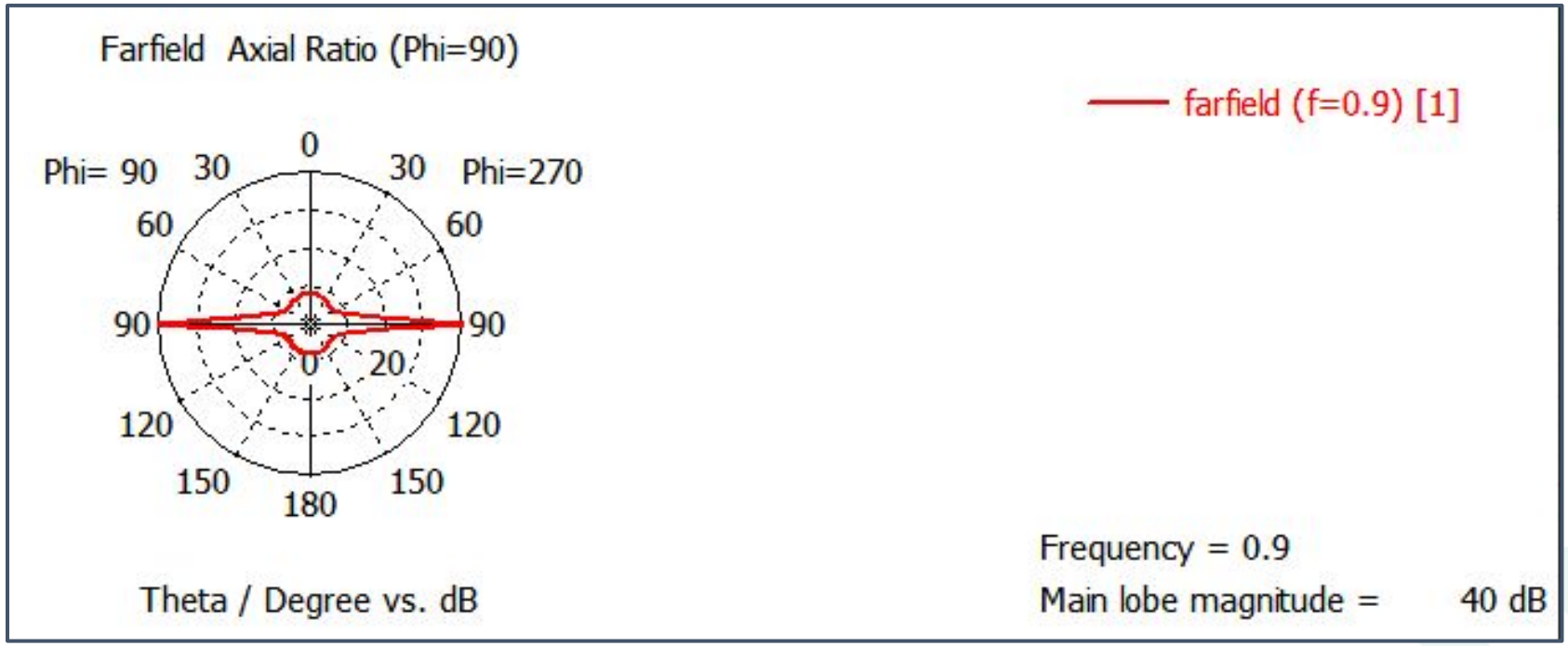
Simulation Results - 2D Radiation Pattern



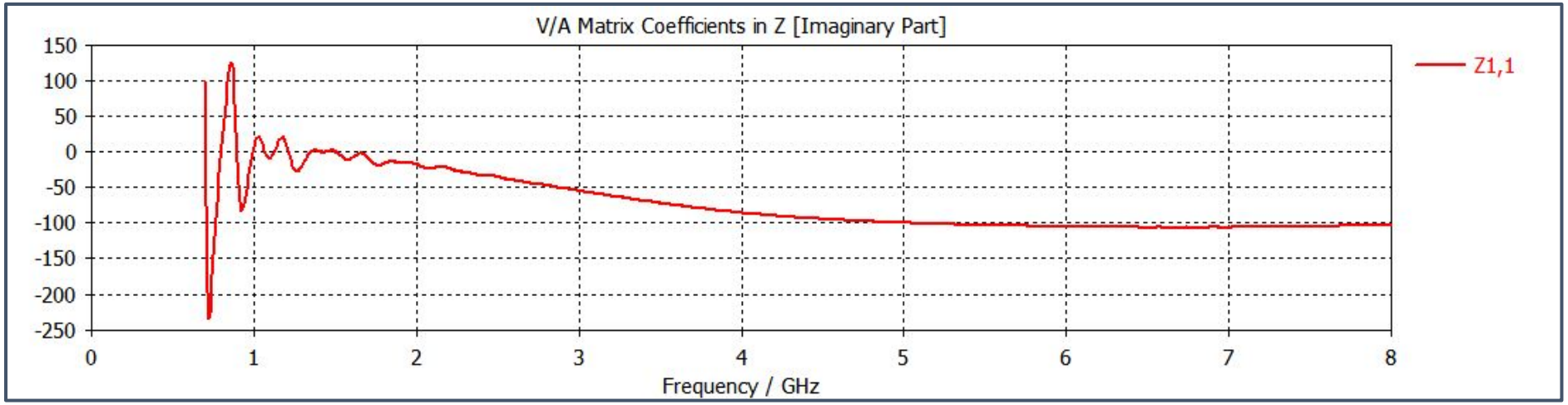
Simulation Results - 3D Radiation Pattern



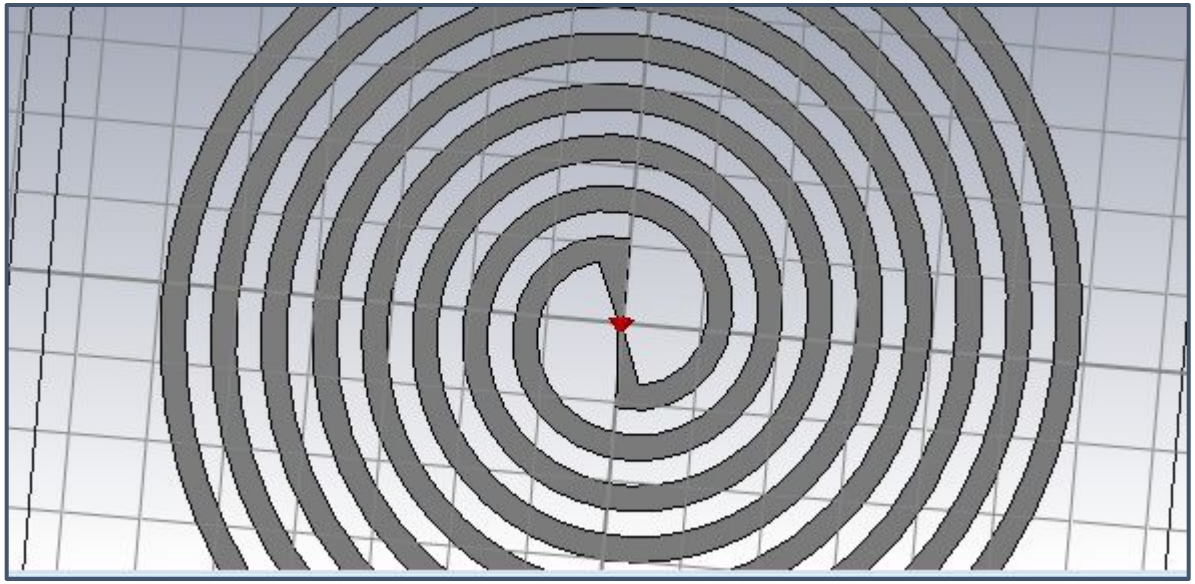
Simulation Results - Axial Ratio



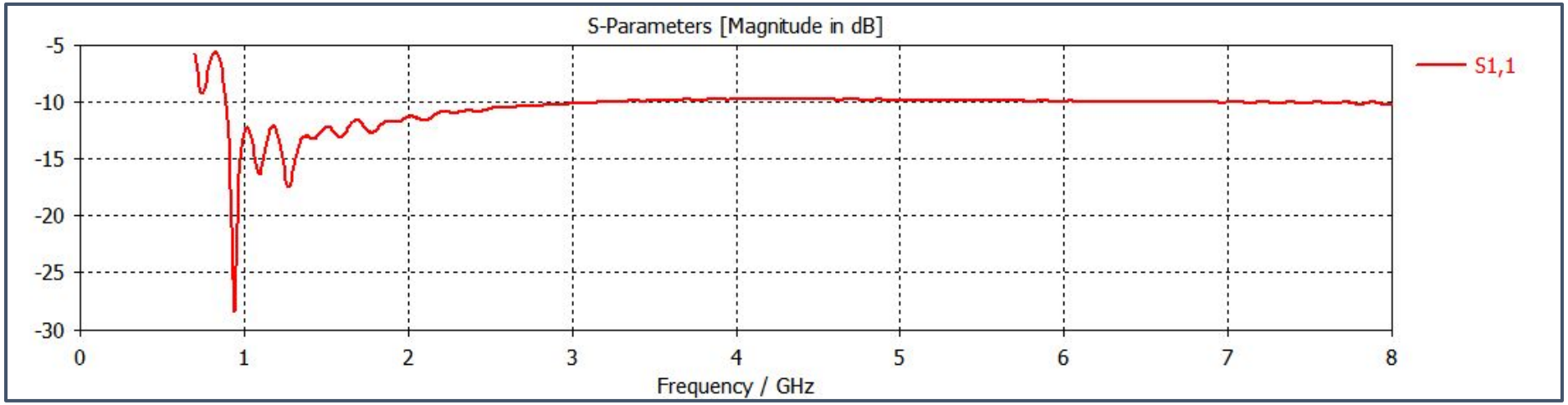
Simulation Results - Z [Imaginary]



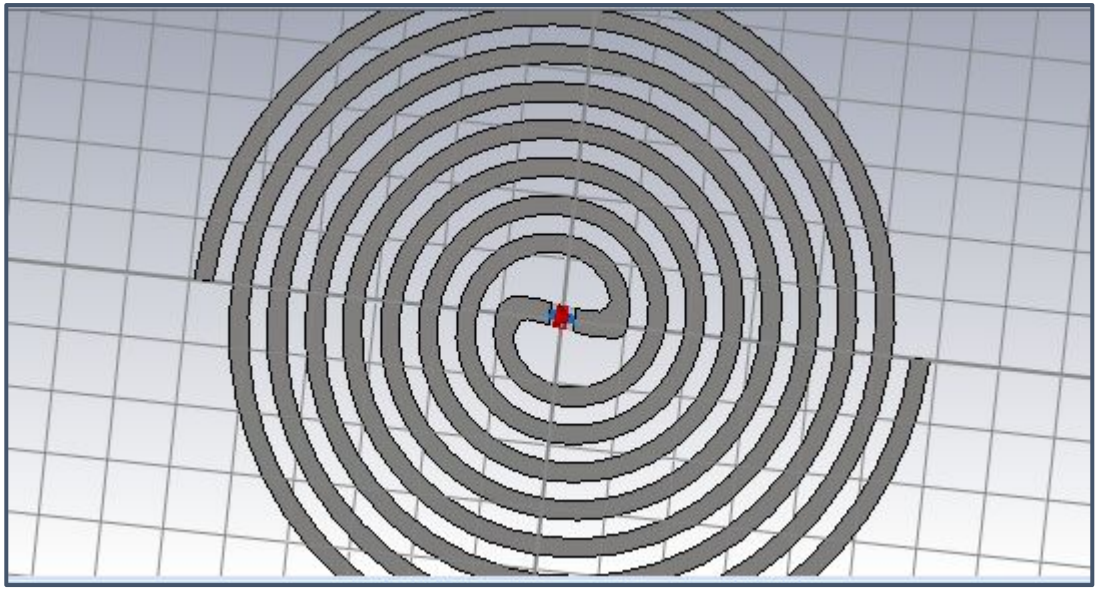
Analysis - Design 2



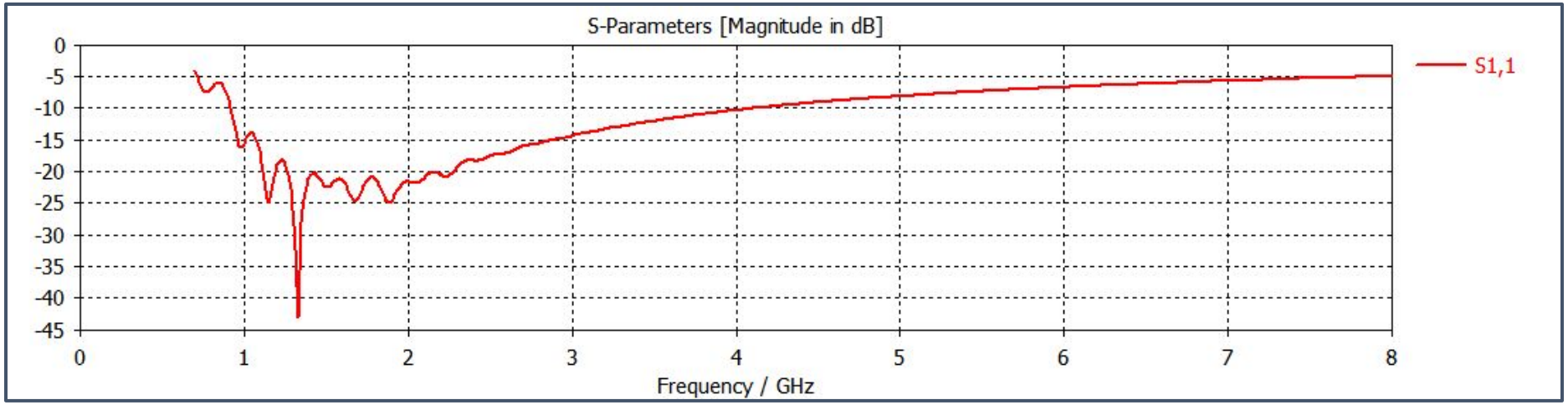
Analysis - S11 of Design 2



Analysis - Design 3

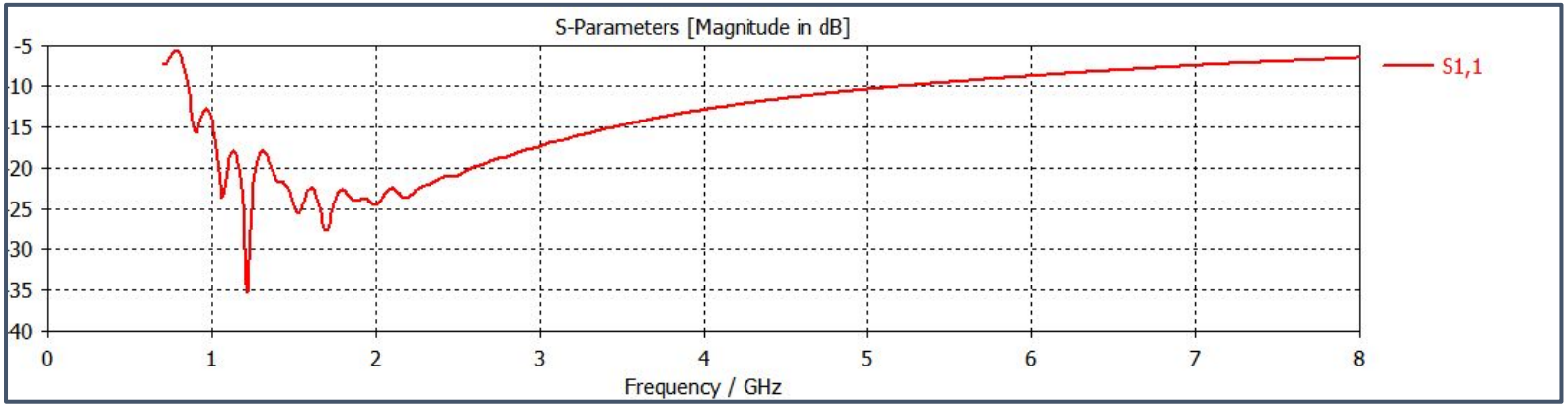


Analysis - S11 of Design 3

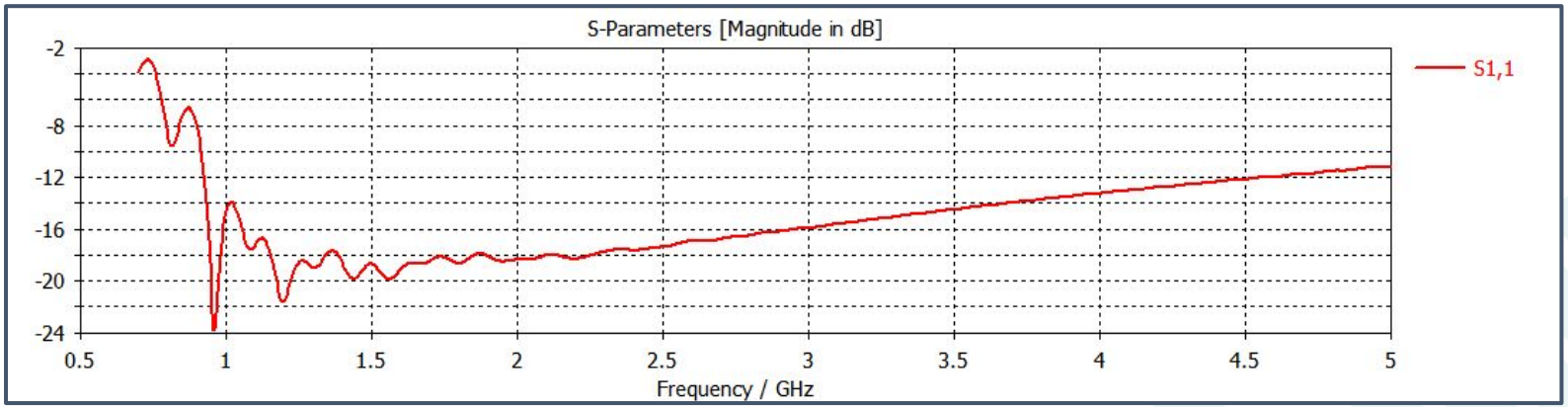


Analysis - S11 v/s No. of Turns

N = 3.5

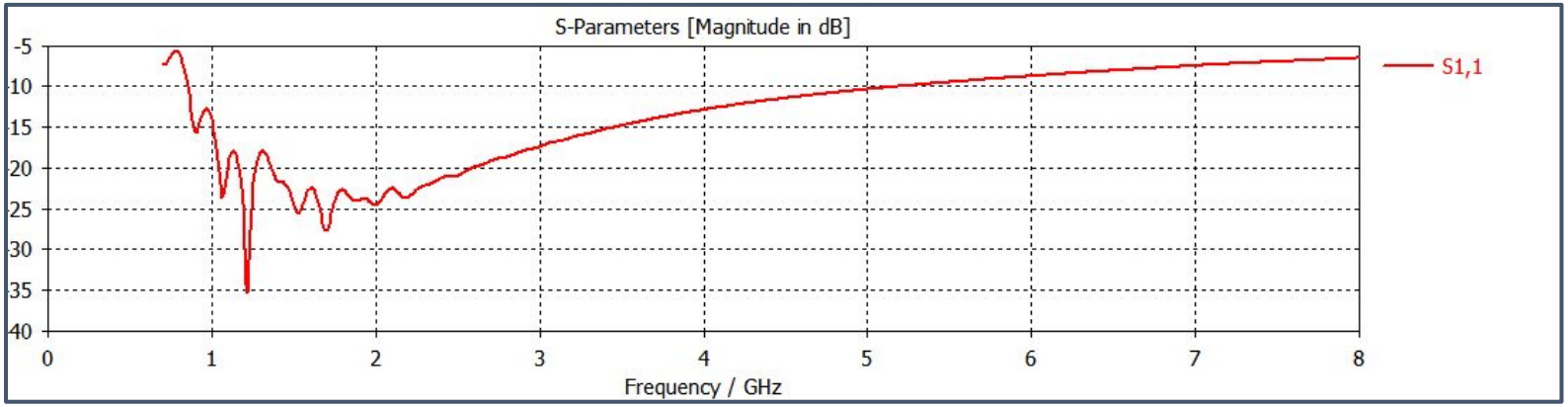


N = 5

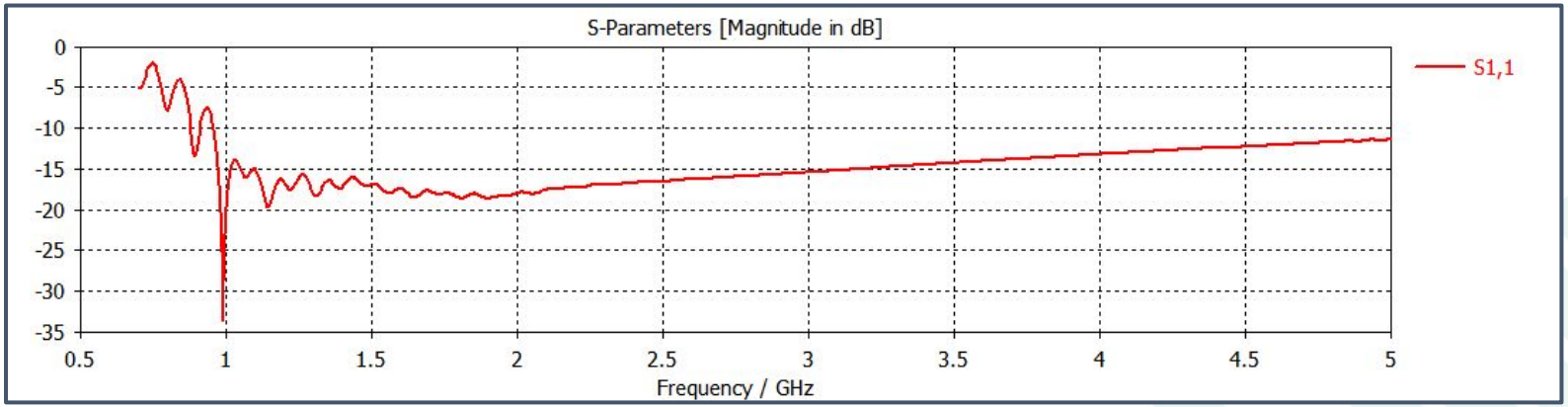


Analysis - S11 v/s No. of Turns

N = 3.5



N = 8



Future Work

- Fabrication
- Comparing simulation results with that of the actual antenna

Acknowledgement & References

Acknowledgement

- Instructor **Dr. Shobha Sundar Ram** for her continuous involvement in the project, right from conceptualisation to execution
- TA **Ms. Guntaas Kaur** for her assistance in CST simulation

References

- Antenna Theory, Analysis and Design by *Constantine A. Balanis*
- http://www.antenna-theory.com/
- Modern Antenna Design by Thomas A Milligan, 2005, p.541

Thank you!

Questions?