

Integrated Solar Panel Antenna

Andrew Best, Daniel Graves, Jeremy Proch, George Chiporikov
Mentor: Stefan Matalia, President of Innovative RF Solutions Inc.
School of Electrical, Computer, and Energy Engineering



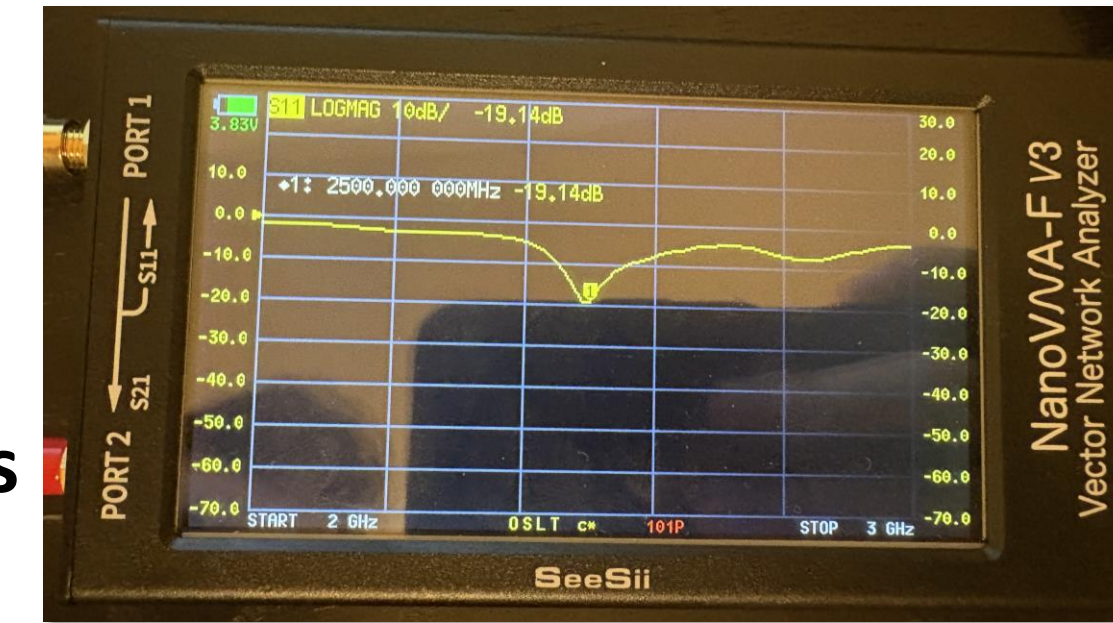
Introduction

This project was focused on solving the space-constraint faced by many small satellites also known as CubeSats. These satellites have most of their surface area dedicated to solar panels for power generation which leads to a tradeoff with communication hardware. Our project aims to solve this by integrating an antenna directly onto a solar panel. By meshing the antenna and ground plane, along with the use of a glass dielectric, we demonstrate how the placement of an antenna can have a minimal impact on power efficiency. This enables a dual functionality without compromising efficiency.



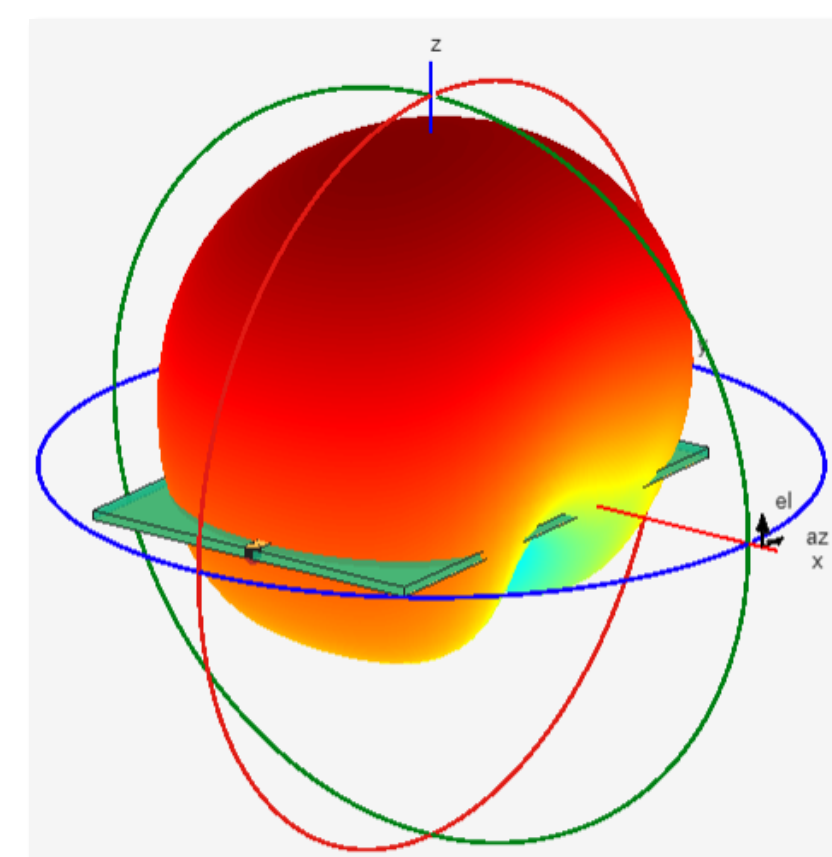
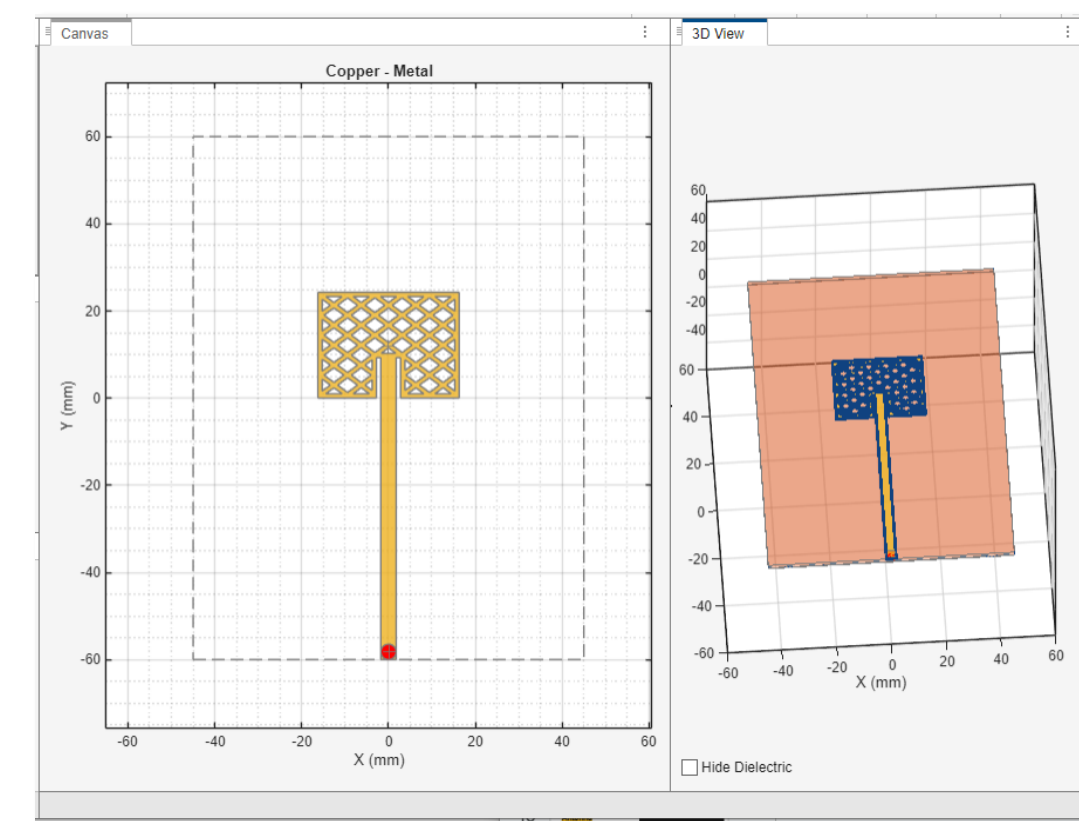
Design Steps

- Research on Antenna Designs was done to find what would work for Frequency.
- Research on how to decrease the covered surface area was done.
- Meshed ground plane and antenna allowed how a higher transparency
- Simulations ran on Sol Supercomputer using MATLAB were used to optimize parameters.
- Multiple Iterations of antenna made to satisfy design parameters
- Vector network analyzer used to measure RF characteristics of antenna.
- Testing done to determine effect of antenna on Solar Panel.

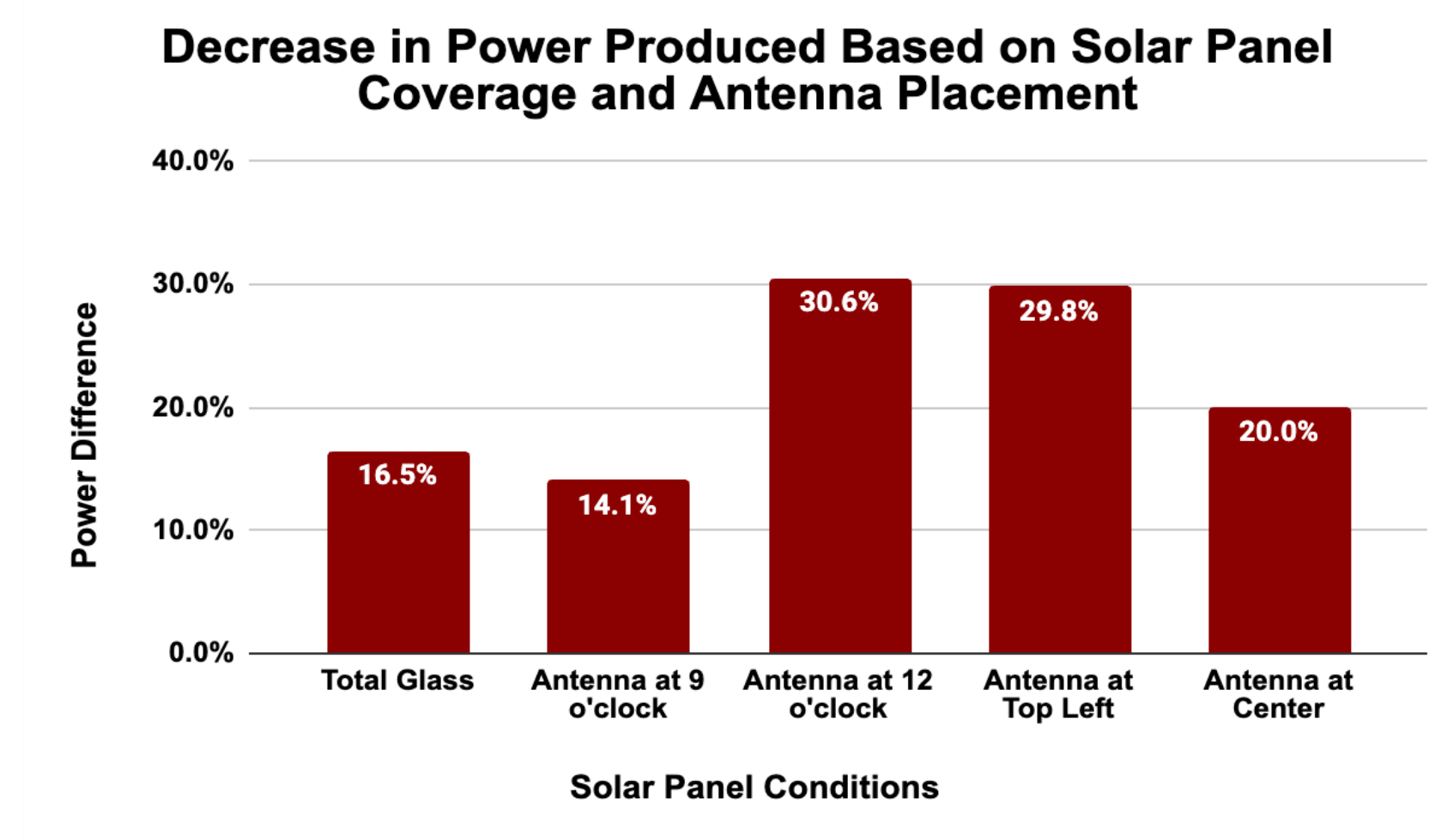


Glass Substrate PCB Meshed Patch Antenna

- PCB design allowed for rapid and cost-effective design iteration.
- Transparent materials and meshed conductors maximize light transmittance.
- Patch-type antenna allows for extension of design to phased array to further increase gain and enable beam steering.
- Design utilizes unlicensed 2.4GHz ISM band.
- Antenna fabrication achieved using laser printing and chemical etching techniques.
- Measured return loss of up to 19dB in certain iterations, and 3dB bandwidth of 60MHz.
- 50Ω input impedance and SMA connector allow for compatibility with common RF equipment. Ωs



Power Efficiency of Solar



Future Work

Future advancements of this project can focus on phased array implementations, clear conductors, and potentially etching an antenna to the solar panel.

Fabrication

A laser printer was used to print a toner antenna pattern onto copper tape which would serve as a resist for the etching process. After attaching the tape onto the glass substrate, a solution of ferric chloride was used to etch the remaining copper.

