Team Name: W. C.U.B.E.

Wideband Circular-lens Utilizing Beamforming Electronics

List of team members (5 maximum): Maxine Tan, Luke Strachan, Dylan Matthews, Lindsay Falk, and Zack Tyler

Brief Project Description:

Problem: Many phased arrays used in communication systems consume too much power and have trouble dissipating heat due to a high density of electronics (phase shifters) associated with each antenna in the array. This resists their use case to expensive cell towers, radar systems, and expensive satellite communications. To help solve this issue Professor Chisum has developed a method of spacing antennas further apart in an array by using an optimization algorithm and gradient index lens to compensate. However, this has yet to be demonstrated physically with a controller for a prototype.

This project aims to build a controller for a phased array of antennas operating onboard a satellite. This will consist of 8 patch antennas in a linear array that can be individually controlled using beamformer ICs. This phased array will utilize Professor Chisum's gradient index lens and particle swarm algorithms to maximize gains in an arbitrary direction to receive signals similar to a radar. The final controller and lens will be able to fit in a 2U CubeSat bus being constructed by the IrishSat design team. The final result will be a phased array that can beamscan to find a target signal being transmitted and lock on it for the eventual use in communications or as a sensor instrument.

Features demonstrate on Demo Day:

List the **top 5** features that you are planning on demonstrating at the end of next semester.

- MCU that runs Prof. Chisum's algorithm
- Successful beamforming using multiple beams
    - Compare gain of target signal from either a simulated model without optimized algorithm or switching modes to a traditional phased array
- Show net improvement between sidelobes from single beam and phased array superposition
- Search for and identify an object, potentially on an x-y mapped display
- Successful integration into IrishSat's CLOVERSat

Technology Analysis:

There will likely be several technologies that will be necessary to complete your project. List any key technologies and show that they are available, affordable, and accessible. Note that each team's budget will be on the order of $500 (depending on the final number of teams, team size, etc.). By accessible, I want you to show that you can reasonably incorporate the technology into your design.

Main Bill of Materials

- Gradient Index Lens (free provided by Prof Chisum's contact at 3D printing company)
- 12 small patch antennas
- 12 low noise amplifiers
- 1 beamforming IC
- 2 ADC's
- ESP32 processor
- All associated components for building a power path taking power from cubesat bus
- Deployment components for cubesat will be provided by IrishSat