**Project Summary**

The CSU Antenna Test Range or 'ATR' is a project that began in 2008 as a multi-disciplinary project which has since been worked on by multiple senior design teams. The ATR is nearing completion, and in its final form, will be an automated antenna characterization system that will have both modeling and measurement capabilities for near and far fields. The main instrument utilizes an anechoic chamber inside the Colorado State University Electromagnetics Lab. This system integrates disciplines from electromagnetic waves and radiation, computer science, control systems, power systems, and basic circuit theory.

**ATR Overview**

The ATR’s functionality can be summed into three primary scanning modes:
- Spherical (Far Field Characterization)
- Cylindrical (Near Field Characterization)
- Planar (Chamber Characterization)

Currently, spherical and cylindrical modes are in operation.

Different antennas may also be hot swapped for rapid testing, and the fully automated range allows users to start a scan and walk away as the scan progresses. Data collected may then be extracted and plotted in 3 dimensions as shown in the sample spherical plot below.

**Antenna Test Range**

**Team Members**

**Computer Engineering**
- Jason Kiehlbauch (left)

**Electrical Engineering**
- Colin Hice (right)

**Work Completed**

Work completed this year primarily consisted of bug fixing, documentation, and getting all of the axes up to working order and taking several demo scans. We managed to get all of the axes except for the horizontal working and calibrated. Accurate scans can be made on these axes.

After beginning where the last team was forced to abruptly leave due to Covid, we found a lot of axes did not work. A lot of troubleshooting was performed, which culminated in the replacement of a lot of old electronics. In addition, the control cooling was overhauled with added airflow systems being installed to allow for longer uninterrupted operation.

**Future Work**

The first focus of the next team is to get the horizontal axis working, and identifying potential issues with the rotary stage and rectify them. After this, the wiring on the Arduino side should be cleaned up, and all three primary scans (see Overview) should be performed in a single sitting without modifying the range. Long term goals include LIDAR positioning, and implementing near-field to far-field conversion which would allow for accurate signal characterization to be performed in the MHz range. This would vastly improve the functionality of the range, after which point, the range will have reached completion according to our vision.

**Budget and Constraints**

Initial Budget: $3351
Final Budget: $2936

New hardware must be sourced within reasonable time (due to Covid), and must be compatible with established systems.

**Results**

Below is a summary of all the successful scans completed during the year. Annotated next to each scan is the axis (or axes) that where involved, and the resolution (increments) used. All models shown were taken for the horn antennas (depicted under project summary) at a frequency of 8 GHz.

**Acknowledgements**

We would like to thank Dr. Branislav Notaros for his guidance and opportunity to work on this project. We would also like to thank our industry engineering mentor, Joe Bakel, for his continuous technical guidance and offer of support for next year’s team. Also, a special thanks to Thomas Wilkinson and Keenan Mallory who, as previous senior design students, aided us in becoming familiar with the ATR and its systems.

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