Measurement of Radio Array Antenna Patterns Using Unmanned Aerial Vehicles and Software Defined Radios

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Antenna pattern measurement often necessitates placing systems within an anechoic chamber. These measurements can be costly for sensor development and can place the antennas in an artificial scenario which may not be a realistic operational situation. Nevertheless, antenna pattern information is required to confirm that the sensor will operate as intended. Recently, a confluence in the development of two technologies, software defined radios (SDRs) and unmanned aerial vehicles (UAVs), have brought about a less expensive solution for this type of measurement.

MIT Haystack Observatory has developed a method to measure an antenna pattern using a combination UAV and SDR technique. This method will be used in the near future for testing of a new geoscience array radar being built at the Observatory, and will allow researchers to confirm simulations of antenna patterns in the field. The UAV carries an SDR and a small computer to record RF data along with metadata for the position and velocity of the platform. Data is then processed to determine the antenna pattern using the required near-field to far-field transformations.

We will describe the data acquisition and processing, including hardware, software and algorithms. The acquisition and processing has been developed from readily available open source software. We intend to make this package available as well to the open source community in a timely manner. We will also present final analysis results of this pattern measurement method using a number of different antennas to demonstrate its validity. Results will also include statistical uncertainties of the measurements derived from first principle signal processing and electro-magnetics.