Mapping the Beam of a Low Frequency Antenna using Satellite Signals

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An accurate mathematical model for the beam shape of the low frequency array element is an important ingredient of high-quality image processing. Although modern electromagnetic simulators work quite well in calculating a beam profile, it is difficult, in practice, to obtain empirical validation of this model, even at a single frequency. Low frequency antennas can be quite large and it becomes impractical to mount them on the movable platform in the far field region of an antenna test range. In most cases, it is more desirable to understand the *in situ* behavior of the antenna, where it is subjected to localized scattering from nearby structures, including other antennas within the array.

We are developing an *in situ* antenna power pattern measurement system that makes use the 137.5 MHz signals received from approximately thirty low-earth-orbiting satellites of the Orbcomm constellation. The antenna under test is connected to a heterodyne receiver and PC-based data acquisition system. The total power of the satellite signals are measured every 200 ms. These data are tagged with positional information obtained from orbital analysis software and then stored on the PC. Data validation, calibration, and beam mapping are performed in post processing. Enough information is acquired over the course of three or four days to yield a useful beam map.

Details of our measurement system will be presented along with a few preliminary results. In the total power mode, a high dynamic range beam map of a reference dipole was measured and compared with that obtained through simulations. In the differential mode, data from a pair of dipoles showed clear evidence of scattering by nearby objects. Improvements to this measurement system are currently underway. Applications to PAPER and FASR will be discussed.