Near 4π Coverage of Mono-Static Radar Cross Section at 200 GHz Using a Spherical Antenna Measurement System

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To support antenna applications above 110 GHz, researchers in the Electromagnetics Division at NIST have designed and implemented a high-frequency antenna measurement system. At the heart of the positioning system lies a 6-axis robot capable of performing a multitude of scan geometries around a central point. Our current goals are to provide spherical, planar, and extrapolation antenna measurements on par with other NIST antenna facilities from 50-110 GHz and to extend the range of those measurements to 220 GHz and ultimately to 500 GHz. The robot provides off-the-shelf repeatability of 70 microns. Real-time tracking with a high-speed laser tracker gives the of antenna position to within 20 microns, or λ/20 at 500 GHz, which will be used to with position correction algorithms. We have worked to minimize RF drift and optimize measurement performance from 200-500 GHz with LO stabilization, accurate calibrations, and checks of drift against canonical scatterers.

We will use this new antenna measurement system to perform near 4-π, mono-static RCS using a spherical scan geometry. We show results in the WR-05 band (140-220 GHz) and cover -115° to 115° from the zenith and have -360° to 360° in azimuthal coverage. We will present results of two different reference spheres to validate both the RF measurement stability and the accuracy of the scanning process. We will then present results of RCS on a small object and examine the statistical variations of the RCS relative to the orientation with the observer. We hope to provide insight into requirements needed to detect and accurately identify objects in these frequency ranges.