Modeling and Measurement of 3D Printed λ/30 Spherical Spiral Dipoles

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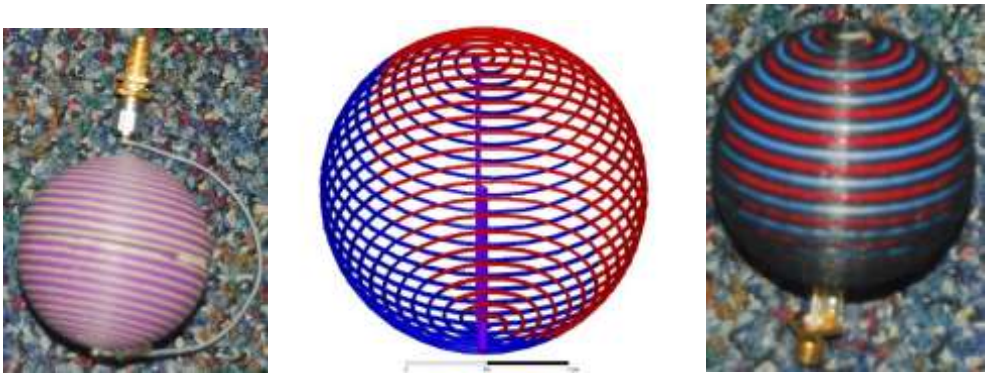
The modeling and measurement for a pair of 2" diameter 3D printed (λ/30) spherical spiral dipoles (SSD) will be presented. The measured and simulated data for the two spherical spiral dipoles are compared for validation of the simulations with experiential data.

The purpose of the work was to investigate this unique antenna design through simulations and then with measurements after building this electrically small antenna utilizing our in-house 3D additive manufacturing capabilities. An additional challenge, pertaining to the measurements, was our ability to measure that antenna in our tapered chamber at 185MHz (λ ~ 64") when the lower limit of our 40' x 20' x 20' tapered chamber is ~180MHz.

A comparison of return loss, realized gain, and patterns will be presented. Finite Element Method (FEM) modeling in ANSYS's High Frequency Structure Simulator (HFSS) proved easy to optimize to accommodate the manufacturing and measurement capability goals. The simulated and measured data show good agreement between one another, for the most part. Differences between modeled and measured data will be discussed on account of printed conductive ink versus wound gauge wire, two different dielectric spherical cores which the approximate dielectric constant is known, and RF cable attachments to the 2" diameter 3D printed λ/30 spherical spiral dipoles in the tapered chamber versus the HFSS simulations. Further investigation showed another two resonances at ~70 MHz and ~140 MHz on our network analyzer for each of the two manufactured spherical spiral dipoles. This resulted in additional simulations being run in HFSS around these frequency locations for conformation of agreement between simulation models and real world measurements. These additional resonances did appear in the simulations, but are too far below our in-house chamber's trustworthiness.



Figures: SSD's with conductive ink, HFSS simulation, and Cu wire (left to right)