Advanced Manufacturing Technology Center

Research to optimally design and develop functional RF devices, systems, and structures that cannot be fully realized using conventional manufacturing but can be using AM technologies such as multi-material and conformal AM

Conformal Printing
- Enables direct write techniques to be utilized on extreme topologies such as doubly curved surfaces
- Realized using 6-axis machine (nScrypt 3Dx-700)
- Offers the ability to produce electromagnetic devices on arbitrary surfaces which may feature multiple layers

Conformal Holographic Antenna
Goals
- Develop direct write methods to physically realize a conformal Voronoi Metasurface
- Improve upon current manufacturing methods that are tedious and time consuming
- Demonstrate feasibility of methods developed
- Verify the engineered electromagnetic properties through physical characterization
Antenna Design
- Leaky wave antenna design at Australia’s Defence and Technology (DST) Group
- 30 degrees forward directional pencil beam operating at 10GHz
- Substrate designed to conformally adhere to UAS

Current Manufacturing Method
- Laser profile etching of copper foil negative coupled with hand removal, placement and alignment
- Time consuming process
- Two-dimensional plane cannot map to extreme arbitrarily doubly curved surfaces without deformation

Developed Method of Aerosol Jetting and Electroless Plating
- Aerosol jetting head coupled with 6-Axis Nscrypt to conformally pattern substrates with nano particle conductive ink (UT DOTS)
- Post processing electroless plating step employed to improve RF conductivity of patches and realize desired RF properties

Measurement Results
- Sufficient gain patterns realized using platted aerosol method
- Reduction in manufacturing time realized

Bulk RF Conductivity Characterization
Goals
- Develop a test method for consistent bulk conductivity characterization of direct write inks up to 26.5 GHz
- Print microstrip with nScrypt micro dispensing or IDS aerosol jetting systems
- Measure microstrip with the Anritsu UTF Test Fixture over 2.0 GHz to 26.5 GHz band
- Characterize print thickness, surface roughness and resolution with Keyence Laser Microscope

Test Setup
- Two Custom PCBs were designed to maximize repeatability and accuracy of measurements
- Multiple inks were deposited then characterized using the Anritsu test bed and a network analyzer

Characterization Results
- A copper baseline microstrip was used to confirm the accuracy of the system
- The resulting conductivities can be used to determine which inks are best suited for a specific RF application

Direct Write Methods Explored
Aerosol Jetting Head
(Integrated Deposition Systems)