

Additive Manufacturing of Millimeter Wave Absorbers

Additive Manufacturing has emerged as a groundbreaking technology for precisely fabricating complex structures using various plastics and additives. When mixed with a base plastic like Polylactic Acid (PLA), additives like carbon black can enhance the conductive properties of the final plastic filaments. These improved properties will increase the final permittivity of the plastic, making it suitable for the manufacture of millimeter wave absorbers.

The Bambu Lab H2D 3D printer combined with the AMS 2 Pro and AMS HT units, enable the ability to seamlessly switch between two materials due to the dual nozzle toolhead on the printer. Combining carbon black infused PLA with Polycarbonate, an efficient millimeter wave absorber can be fabricated.

Using printed calibration plates in both the aforementioned PLA and Polycarbonate, the permittivity is tested using a *Compass Microeave Focused Beam System* in both Ka (4-40 GHz) and U (40-67 GHz) frequency bands. The permittivity data gathered is then fit to a *Debye* curve to determine the optimal volume fraction (fill density) to make the millimeter wave absorbers.

A MATLAB script is used to generate the g-code to print a millimeter wave absorber. The script tailors the structure based on the raw permittivity data measured from the Focused Beam System that has varied volume fractions on different layers based on the material.

In conclusion, additive manufacturing offers a highly precise method for producing millimeter wave absorbers with composite plastics. With a dual-material 3D printing setup, it is possible to manufacture absorbers based on measured permittivity data with optimal electromagnetic performance.