**Title**:

Microwave Materials Characterization of High Performance Concrete with Electromagnetic Interference Mitigation Properties.

**Abstract**:

Advanced concrete mix designs are of interest as it relates to improved performance (electromagnetic interference mitigation, structural, weight, etc.) of the material. Such high performance concrete (HPC) include additives such as graphene or steel fibers to achieve advanced performance. As such and focusing on electromagnetic interference mitigation in particular, the electromagnetic (dielectric) properties of such materials are of interest. Generally speaking, dielectric properties represent the ability of a material to store (permittivity) and absorb (loss factor) electromagnetic energy. These properties are also related to important chemical, electrical, and physical properties such as compressive strength and electromagnetic interference mitigation. To this end, a set of HPC samples with 0% (control sample), 1%, and 2% steel fibers (by volume) were cast and their complex reflection properties measured with a calibrated Vector Network Analyzer (VNA). Two frequency bands were used, R-band (1.7 – 2.6 GHz) and Ku-band (12.4 – 18 GHz), in order to compare performance across a wider bandwidth. These measurements were conducted using a one-port open-ended rectangular waveguide technique. As the steel fiber content may not be evenly distributed throughout the sample volume, measurements were made with different interrogating polarizations and at different locations across the sample face to study this effect. These measurements were used to calculate the permittivity and loss factor (e.g., complex dielectric properties). These properties were used as inputs to a full wave high frequency simulation model of the materials in order to calculate the shielding effectiveness, SE. SE is related to the amount of energy absorbed and reflected by a given structure (e.g., a slab, wall thickness, etc.). As such, SE is an ideal comparative metric in this case as it quantifies how well a material or structure protects against external electromagnetic interference. The results indicate that fiber distribution has a stronger effect at higher frequencies, and the SE is also greater for the same. To this end, the best-performing mixture can be determined which may be further refined with additional additives, etc. in the future.

**Mini-Abstract:**

Microwave materials characterization was used to characterize electromagnetic interference mitigation performance of 3 high performance concrete (HPC) designs with different amounts of steel fiber (by volume). The results show that the electromagnetic interference mitigation performance increases as frequency increases.

**Biography**

Jack Hishon is a graduate student in the Dept. of Electrical and Computer Engineering at Missouri University of Science and Technology (Missouri S&T) and has been a member of the Microwave Sensing (*µ*Sense) Laboratory since 2022. Jack’s research focus includes high frequency simulations and microwave materials characterization for solid, granular, and liquid materials. As an undergraduate, Jack was nominated for and received in two consecutive semesters the Dean’s Undergraduate Research Scholarship in the College of Engineering and Computing at Missouri S&T.