The Department of Electrical and Computer Engineering

Michigan State University

Ph.D. Dissertation Defense

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In Person: Room 2219 Engineering Building

Zoom: Email sandra@msu.edu for Zoom information

TITLE: ANTENNAS IMPLEMENTED ON CERAMIC AND THERMO-SENSITIVE SUBSTRATES FOR RADIO FREQUENCY IDENTIFICATION, CELLULAR, AND CELLULAR VEHICLE TO EVERYTHING COMMUNICATIONS, USING LITHOGRAPHY AND ADDITIVE MANUFACTURING TECHNIQUES

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ABSTRACT: This dissertation demonstrates the implementation methods and performance of antennas on different substrates using the traditional lithography method and Additive Manufacturing (AM) techniques. The developed devices are used for biomedical applications and vehicular communications. The effectiveness of using photonic curing and reactive silver ink to develop 3D printed antennas on thermo-sensitive substrates is investigated. Intense Pulsed Light (IPL) is used to cure silver nano-particle ink on the automotive Acrylonitrile Butadiene Styrene (ABS) and the vero-white polymer. Different curing profiles of IPL are tested on the ABS and the vero-white to identify the optimal one. Development of antennas using lithography, Aerosol Jet Printer (AJP) combined with thermal curing, AJP combined with photonic curing, and AJP combined with reactive ink is investigated and their overall performance is compared.

The first step of this dissertation is to explore the antenna design that is optimal for biomedical, Radio Frequency Identification (RFID) applications, operating inside human muscle and in free space. The next step is the development of a dual-band, planar antenna for automotive applications using lithography on a flexible, lightweight substrate and AM techniques on ABS. The antenna performance is tested on a real vehicle and the effects of the ground on the antenna radiation pattern are identified. Co-Planar Waveguide (CPW) lines are developed using the same procedure to identify the losses due to silver conductivity. Thereafter, an Electrically Small Antenna (ESA) is developed on a 3D printed hemisphere for vehicular communications. Prototypes of this antenna are tested on a real vehicle and a ground plane inside a near field system. The effect of the vehicle body on the antenna performance is evaluated.