3D Printed Magneto-Electric Phased Array Antenna with Integrated Analog Beamforming for sub-6 GHz Frequency Band

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A dual linear polarized 3D printed magneto-electric phased array antenna for the sub-6 GHz frequency band of the 5G spectrum is proposed and its beam steering performance is investigated. The magneto-electric radiating element exhibits well defined stable pattern quality, low variation in the impedance over a wider bandwidth and high port to port isolation in a dual polarization configuration. The conventional method of fabrication using metal stamping of magneto-electric antenna is challenging and expensive [B. Q. Wu and K. M. Luk, IEEE Antennas and Wireless Propagation Letters, vol. 8, 2009, pp. 60-63]. Such complex structures can be easily fabricated using 3D printing process [A. Castro, B. Babakhani, and S. K. Sharma, IET Microwaves, Antennas & Propagation, vol. 11, 2017, pp. 1977-1984].

The single radiating element is a dual linear polarized magneto electric dipole that operates between 4-6 GHz with a unidirectional stable radiation patterns. This also provides good polarization isolation to support half duplex transmit and receive communication. ABS plastic material with finite surface roughness and finite conductivity of the conductive ink is taken into consideration while modeling the antenna in Ansys HFSS. Next, a 3D printed 4×4 phased array aperture for the Sub 6 GHz spectrum is studied. The array provides high front to back ratio and low cross polarization. The simulated array will be 3D printed and coated with silver ink as its conductive coating.

The analog beamforming network (BFN) of the array is also investigated. The BFN is designed in the receive mode in a 4×4 planar configuration using conventional PCB techniques. Each section of the BFN is connected to a Low noise amplifier (LNA) and phase Shifter, which is fed to a Wilkinson power divider. The HMC392ALC4 from Analog Devices is the selected LNA operating from 3.5 – 8 GHz. The MAPS-010165 from MACOM is a 6-bit digital phase shifter operating from 3.5 – 6 GHz.

The fabricated board will be combined with the 3D printed array aperture for experimental verification of the scan performance. Additional simulated and measured results on the 3D printed array and beamforming board will be presented during the symposium.