Fabrication Challenges of Bio-Matched Antennas

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The aim of this work is to identify key issues in fabrication and evaluate the reproducibility of Bio-Matched Antennas (BMAs)[1]. BMAs are a new class of broadband, high gain antennas for into-body radiation (J. Blauert and A. Kiourti, IEEE Trans. On Antennas and Prop., 68, 2040-2049, 2020). The antennas operate with an engineered dielectric, a periodic combination of plastic and hydrogel, that creates a better match for transmission through biological tissues. This innovative design offers many new opportunities at the intersection of electromagnetics and medicine.

Fabrication, however, remains the primary obstacle for the development of robust BMAs for use in long-term applications. Hydrogel is the fundamental material used to create anisotropy within the dielectric. This hydrogel leaks from the BMA over time which decreases antenna performance and structural integrity. The conducting flares of the BMA are made from copper tape, which loses its adhesive properties over time, further contributing to hydrogel leakage. The resolution of the 3D printer is inconsistent which can clog the holes in the plastic where the hydrogel resides. Further, the connection between the copper tape conducting flares and the SMA connector is not reliable. Soldering the SMA connector is difficult because the plastic structure cannot melt, and alternative methods to attach the SMA impact overall performance of the BMA.

In this research, we investigate the current limitations of BMA fabrication. Three BMAs of the very same design are manufactured using identical processes. Inconsistencies with the initial fabrication are discussed. The BMAs are then evaluated to observe performance loss due to time. Preliminary results demonstrating significant issues with fabrication are reported. This study is intended to determine fundamental problems so that a more robust BMA can be designed and fabricated in the future. A BMA that is resistant to performance loss for extended periods may be used for medical radiometry and telemetry in imaging applications, core temperature monitoring, and more.

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