3rd URSI AT-AP-RASC, Gran Canaria, 29 May – 3 June 2022

Design and Fabrication of a Novel Non-Uniform Stackable Luneburg Lens Using Additive Manufacturing for Microwave Applications

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Owing to its many advantages, such as rapid prototyping, additive manufacturing has a growing demand in many applications, including electronics [1] and microwave components [2]. This technique allows the fabrication of a customizable part from a digital 3D model while providing a variety of materials to choose from. Many of those materials are commercially available which makes them easily accessible, however in order to enable their use for electromagnetic applications, it is necessary to characterize their dielectric properties. The complex dielectric constant of samples printed using two techniques, namely Fused Deposition Modeling (FDM) and Stereolithography (SLA), has been identified. For FDM, the chosen filaments characterized are: Poly Lactic Acid (PLA), Thermoplastic polyurethane (TPU), Conductive PLA (Proto-Pasta) and Electrifi conductive filament (Multi3D), and for SLA, the selected material is Acrylonitrile Butadiene Styrene (ABS). A sample print was fabricated from each of these materials with the same dimensions and printing setup. The permittivity and the tangent losses of the samples were determined through broadband characterization using DAK-TL2 measurement system between 200 MHz to 2.8 GHz ensuring repeatability and accuracy of the measurements. It was found that the ABS sample fabricated using SLA technology, which presented a dielectric constant of 3.07 at 1.5 GHz, had the most promising results because it produced finer details and therefore it was considered more reliable for the presented lens design (micro-level accuracy and quality of the non-uniform lenses). According to these results, the lens was successfully designed, manufactured, and tested. An example of a fabricated and simulated lens is presented in Figure 1.

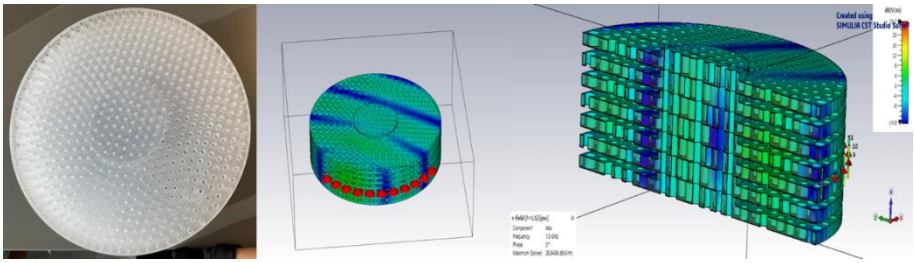

Figure 1: From left to right: example of fabricated lens prototype and its simulation in CST.

During the presentation, measurements and simulations of a novel non-uniform stackable Luneburg lens for microwave multi-band angle-of-arrival applications using additive manufacturing will be detailed.

1. Y. Yu, J. Lu, J. Liu, “3D printing for functional electronics by injection and package of liquid metals into channels of mechanical structures”, Materials & Design, Volume 122, 2017, Pages 80-89, ISSN 0264-1275, https://doi.org/10.1016/j.matdes.2017.03.005.

2. F. Pizarro, R. Salazar, E. Rajo-Iglesias, M. Rodríguez, S. Fingerhuth and G. Hermosilla, "Parametric Study of 3D Additive Printing Parameters Using Conductive Filaments on Microwave Topologies," in IEEE Access, vol. 7, pp. 106814-106823, 2019, doi: 10.1109/ACCESS.2019.2932912.