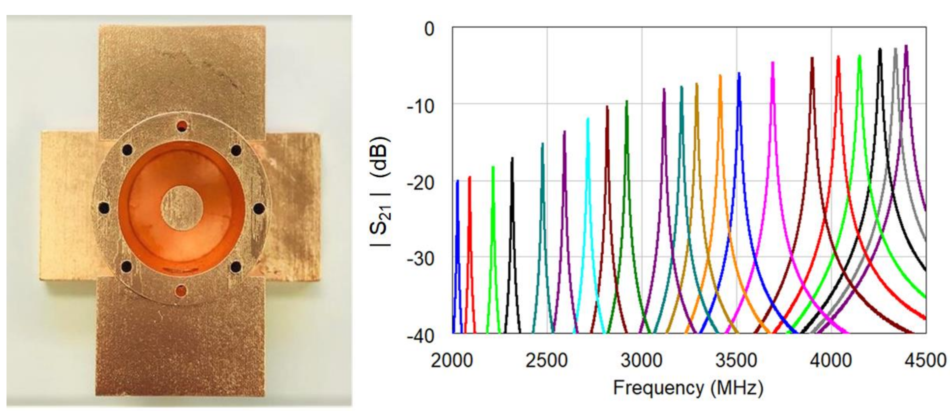
RF Characterization of 3D-Printed Coaxial Cavity Resonators

Kshitij S. Sadasivan*[(1)], Dimitra Psychogiou [(1)]
(1) Department of Electrical, Computer, & Energy Engineering University of Colorado Boulder, Boulder, CO 80309

Wireless communication and radar systems with multi-band capabilities are increasingly calling for low-cost and reconfigurable RF hardware able to support them. They are needed to expand their operability to a wide range of bands as well as to reduce their size. Tunable RF/microwave filters are key enabling elements of reconfigurable RF front-ends due to their ability to select the band of interest whilst suppressing interference and noise. Among all of the alternative adaptive filter concepts that have been discussed in the open technical literature, RF filters using coaxial-cavity resonators show great potential in terms of wide tuning (one octave) and low insertion loss (quality factor, $Q > 300$). However, their practical development relies on expensive manufacturing of CNC-machined or PCB-based blocks. In an effort to reduce costs and weight of bulky waveguide-based components, additive manufacturing such as fused-deposition modeling (FDM) and stereolithographic (SLA) have been recently explored. Important demonstrations of these technologies include, 3D printed horn antennas, ridge-waveguide transmission lines and couplers. Taking into consideration the large number of RF applications that could benefit from low cost tunable RF filters in the L-band (1-2 GHz), S-band (2-4 GHz) and C-band (4-8 GHz), this manuscript explores the RF design and experimental testing of frequency reconfigurable coaxial cavity resonators. They are based on SLA-based 3D printed parts that are metalized through a commercially-available copper platting process. Alternative resonator sizes with operating frequencies between 1-8 GHz have been tested in order to evaluate RF performance trade-offs including Q, Q/volume and tuning range in L-, S- C-band. Resonators with $Q > 500$ and tuning range> 2:1 were demonstrated as for example the one in Fig. 1. Further details on their design, practical development and tuning method will be discussed at the conference.



(a) (b)

Figure 1: (a) Manufactured prototype of the 3D-printed coaxial cavity resonator. (b) RF-measured response in terms of power transmission response.