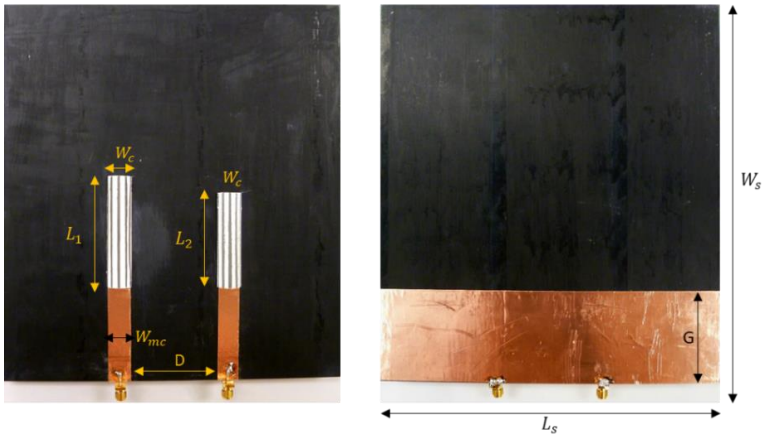
Microstrip Near-Field Cloaking Prototype Using 3-D Elliptical Metasurface Cloaks

Gitansh Gulati[(1)], Kevin Morris[(1)], Min Liang[(1)], Alexander B. Yakovlev[(2)], and Hao Xin*[(1)]
(1) Electrical and Computer Engineering Department, University of Arizona, Tucson, AZ 85721, USA
(2) Department of Electrical Engineering, University of Mississippi, University, MS 38677-1848, USA

Modern densely-packed electromagnetic environments used in airborne and wireless communications demand low interference in receive/transmit antennas with high performance, reliability, compactness and lightweight. In this regard, a novel design based on the concept of mantle cloaking to reduce the electromagnetic interaction between microstrip antennas has been proposed (H. M. Bernety and A. B Yakovlev, "Decoupling antennas in printed technology using elliptical metasurface cloaks," J. Appl. Phys. 119, 014904, 2016).

To convey the idea, this work focuses on the development of a 3-D elliptical metasurface cloaking prototype to suppress the near-field coupling in planar microstrip antennas at microwave frequencies. Figure 1 demonstrates the fabricated prototype consisting of two-microstrip-fed monopole antennas resonating at 0.89 GHz and 1.03 GHz, covered with confocal elliptically shaped metasurface cloaks which are partially embedded in the substrate. The elliptical metasurface cloaks with strip inclusions are prepared in two steps: (a) semi-elliptical dielectric shells ($\varepsilon_r = 5$) are fabricated using a mixture of strontium titanate ($SrTiO_3$) powder and UV curable resin cured in several layers and (b) conductive strip inclusions are developed over cured semi-elliptical dielectric-shell samples using highly conductive nickel spray coating. Semi-elliptical teflon mold holds the semi-fluid mixture which is cured using high intensity UV lamp (100 Watts). Thin semi-elliptical shells (0.5 mm thick) were designed and 3D printed (polymer jetting) to ensure accurate spray coating. Further, low-permittivity ($\varepsilon_r = 2.7$) substrate with semi-elliptical shaped exclusions for inserting cloaks is also 3D printed. Finally, monopole antennas and partial ground plane are implementeed using 1.4 mil thick copper tape to ease the process. Testing and measurement to study the effect of cloaking on radiation pattern and total efficiency is currently under progress and will be reported at the conference.



Length of Substrate	L_s	18.9 cm
Width of Substrate	W_s	21 cm
Width of GND plane	G	5.1 cm
Distance b/w antennas	D	4.8 cm
Length of Cloak 1	L_1	6.075 cm
Length of Cloak 2	L_2	5.195 cm
Width of Cloaks	W_c	1.32 cm
Width of microstrip	W_{mc}	1.2 cm

Figure 1. Top view (left) depicting microstrip-fed monolpole antennas surrounded by elliptical metasurface cloaks and bottom view (right) depicting partial ground plane of the fabricated prototype.

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