

Near field Electromagnetic Cloaking of Monopole Antennas for Mutual Coupling Reduction using 3-D Confocal Elliptical Meta-Surface Cloaks

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With rapid mobile technology enhancement and densely packed frequency spectrum, modern communication systems have closely packed antennas and give rise to interference problems. As a potential solution, a novel technique of mantle cloaking using 3D frequency selective surface is used which effectively reduces the electromagnetic coupling between closely spaced antennas [(H. M. Bernety and A. B Yakovlev, "Decoupling antennas in printed technology using elliptical metasurface cloaks," J. Appl. Phys. 119, 014904, 2016)].

To demonstrate the idea of mantle cloak for near field antennas, two planar monopole antennas, covered with confocal elliptical cloaks (fabricated in layers) are placed in proximity ($0.147\lambda_1$) of each other on the same substrate. Elliptical dielectric shells are fabricated using strontium titanate ($SrTiO_3$) and cured (layer by layer) by UV light [(G. Gulati, K. Morris, M. Liang, A. B. Yakovlev and H. Xin, "Microstrip Near-Field Cloaking Prototype Using 3-D Elliptical Metasurface Cloaks", 2018 IEEE International Symposium on Antennas and Propagation and USNC-URSI Radio Science Meeting, July 8-13, 2018, Boston, Massachusetts, USA)]. Strips are printed on the cloaking shell using nickel spray. There is partial ground at the back for micro-strip line feed to the monopole antennas. The two adjacent antennas have resonant frequency of 930 MHz and 1030 MHz, respectively. Placing cloaks on the antennas reduces mutual coupling between antennas as shown in Figure 1 below. It can be clearly observed that the mutual coupling is reduced for the targeted frequencies in both measurement and simulation. This technique also improves the radiation pattern of antennas while reducing the coupling between them.

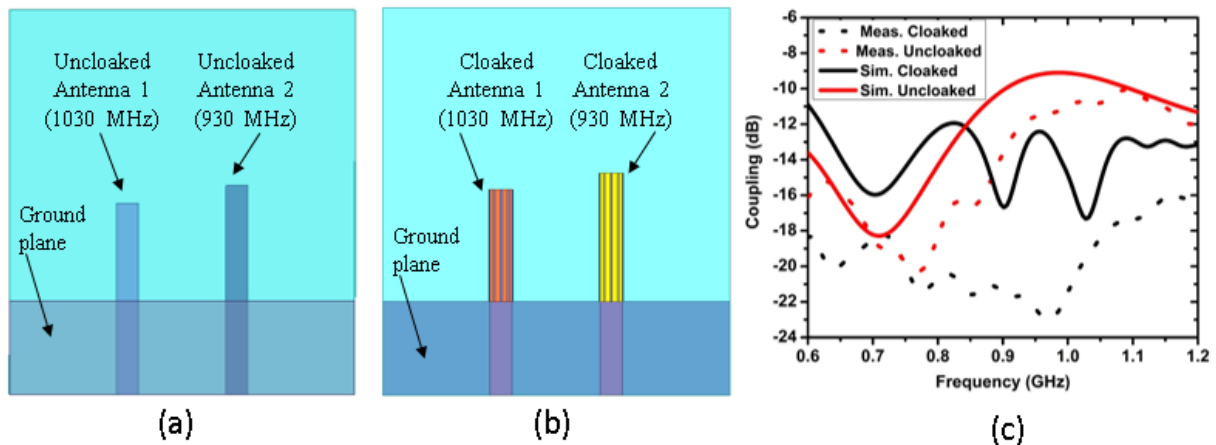


Figure 1. (a) Uncloaked case with monopole antennas fed using microstrip line (b) Cloaked case with confocal elliptical cloaks covering the monopole antennas and partial elliptical cloaks embedded in the substrate (c) Simulated and measured S21 characteristic results comparison for uncloaked and cloaked cases.

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