Reconfigurable Band Rejection and Band-Pass Frequency Selective Structures

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Traditional frequency selective surfaces employ planar arrangements, and typically exhibit poor filtering responses similar to single-stage filters. Because of this, recent literature has explored "thicker" frequency selective structures (FSSs) to design rejection filters with sharp roll-offs. A class of thick FSSs was recently considered to add inductance and capacitance to the unit cell and provide design flexibility and frequency control for the FSS. In effect, these designs realize a higher-order multi-stage filter to achieve sharper roll-offs (versus single-stage filtering in planar designs). However, these thick FSSs still lack tuning capability for practical application. (B. Munk, *Frequency Selective Surfaces: Theory and Design*, 2000; B. Li and Z. Shen, *IEEE Trans. Microwave Theory Techniques*, 61, 3578-3589, 2013.)

In this work, we expand upon the thick FSS concept to design a new class of reconfigurable FSSs that operates across a wide band of frequencies. To do so, we introduce a novel printed FSS unit cell that provides frequency response control in the same manner as a multi-band filter. This is done by dynamically adjusting the geometry of the FSS elements using switches. This dynamic frequency reconfiguration is achieved using a printed microstrip element that can take several forms depending on whether suitably placed switches are open or closed. Tuning is achieved by controlling which of the switches are open or closed. The structure also displays desirable properties, including increased selectivity (relative to previous work) for narrowband designs.

Performance stability (with respect to both incident angle and polarization) presents a major challenge for these selective structures. Our most recent design considerations achieve stability for incident angles through 45 degrees, focusing primarily on symmetric and ellipse-based element designs. This presentation will explore these and other various element geometries to implement reconfigurable FSSs with emphasis on frequency and bandwidth control.

This presentation will explore thick FSS structures for both band rejection and band-pass applications, and an ultimate goal is to employ these multi-band filters as reconfigurable cover layers over broadband antennas. Our current designs can be fabricated from readily-available off-the-shelf materials, demonstrating a final design produced at a low cost. Measurements and comparisons to analyses will be presented at the meeting.