An Investigation of Ground Plane Resonators in the Design of a Frequency Reconfigurable Electrically Steerable Parasitic Array Radiator (ESPAR)

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ESPAR antennas can direct radiation and steer nulls by using variable passive elements like varactors, avoiding the cost and complexity of devices like phase shifters. Past attempts to design a frequency reconfigurable ESPAR have often lead to either superimposing multiple separate designs, or introducing switches and other components, leading to a larger bias network. To avoid this added size and intricacy, ground plane parasitic resonators may be used to accommodate multiple frequency operation. As the resonator is simply a design etched into the ground plane, it is an inexpensive way to modify the ESPAR design. Additionally, coupling ground plane resonators with capacitive patches and shorting pins may be able to reduce the size of the design, as well as the resonance frequency. Equivalent circuit models of these resonators help facilitate the design process (C.-J. Wang, C.-H. Lin and Y.-C. Tsai, IET Microwaves, Antennas & Propagation, 4, 1199-1207, 2010).

This study investigates the effects of parasitic ground plane resonators on low-profile frequency reconfigurable arrays. By using ground plane resonators to control the current distribution on the antenna array's ground plane, the design can appear electrically larger or smaller for different operating frequencies. The corresponding shifts in resonances can be used to optimize the design for multiband use. In addition, the array factor and its relationship with the antenna pattern vary with frequency. These effects are studied through simulation and measurement.

These experiments help further develop a principled method of designing frequency reconfigurable ESPARS. Since stationary base station antennas can afford to be larger and more complex, these low-profile and inexpensive antennas can find use in femtocells for mobile ad-hoc networks and other portable devices.