Ultra-Wideband Tightly Coupled Dipole Array with FSS R-Card

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Future mobile and stationary communication platforms are expected to operate across large bandwidths. This implies that a single aperture must operate at multiple frequencies and concurrently provide links at different directions. In addition, as the size and weight of mobile systems is reduced, small, compact, and lightweight antennas are required. In the past several years, tightly coupled dipole arrays (TCDA) have been shown to deliver wideband performance using a compact form factor. When compared to traditional broadband arrays, such as Vivaldis, TCDAs have very low profile and are highly cost efficient. TCDAs have also been shown to exhibit more than 7:1 operational bandwidth along with a much-improved scanning capability.

Larger bandwidth can be achieved by cancelling the ground plane effects. Specifically, the ground plane leads to severe radiation disturbance when its separation is multiples of $\lambda/2$ from the array surface. In the past, adding resistive card (R-Card) between tightly coupled dipoles and the ground plane proved successful in mitigating ground plane reflections. Versions of such designs achieved 14:1 bandwidth. In other words, the R-Card with uniform impedance is able to disturb ground planes effect to improve radiation.

In an effort to achieve as much as 30:1 bandwidth using a single TCDA aperture, we propose a frequency selective surface (FSS) R-card material placed between the array and ground plane. These FSS R-Cards are designed and optimized to produce periodic amplitude attenuation of the reflected ground plane waves. They serve to reduce ground plane effects at frequencies when the separation between the ground plane and array is multiples of $\lambda/2$. The proposed TCDA with inserted FSS R-Card operates from 0.2 GHz to 6 GHz, *viz*. 30:1 bandwidth. The array is dual linear and can scan down to 45^{o} in all directions. We note that the array and FSS R-Cards are co-optimized to achieve an average radiation efficiency of more than 75% across the 30:1 bandwidth. In addition, the traditional dielectric superstrate is replaced by an FSS superstrate for easier fabrication and lighter weight.