Ultra-Low Profile Wideband Tightly Coupled Dipole Array

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Low profile wideband antennas and arrays are critical in a number of advanced defense and commercial communications systems. Particularly, a special focus has been given to multi-purpose conformal apertures, implying wide bandwidths when placed over a ground plane. The low profile of these arrays allow for conformal mounting, promoting the minimization and integration of electronics on mobile platforms. However, the design of low cost phased array apertures that are both broadband and low-profile ($< \lambda_{high}/2$) has been a continuing challenge. Ground plane effects are a natural limiter of bandwidth, with the aperture height dependent on the ratio of the wavelength of the highest frequency of operation. Wideband arrays have therefore typically been realized using "feed-organizers" with bulky external baluns located below the ground plane. This significantly increases the total size, weight, and cost of the array.

Among UWB arrays, the Tightly Coupled Dipole Antenna (TCDA) arrays have been shown to deliver low profile arrays characterized by their significant space, weight, and power (SWaP) savings. In past works, a wideband integrated Marchand balun was introduced into the TCDA feed circuit (J. Doane, et. al, "A Wideband, Wide Scanning Tightly Coupled Dipole Array with Integrated Balun (TCDA-IB)", IEE AWPL, 2013). Other iterations have impedance bandwidths exceeding 14:1 (J. Moulder, et. al, "Superstrate-Enhanced Ultra-wideband Tightly Coupled Array with Resistive FSS," IEEE APT, 2012) and scanning performance greater than 70° in all directions (E. Yetisir, et. al, "Ultra-wideband Array with 70° Scanning using FSS Superstrate", IEEE AWPL, 2016.). TCDAs have been designed and measured from 0.3 GHz up to 90 GHz with VSWR < 3.

In this paper, an ultra-low profile TCDA is presented, with a height $h < \lambda_{high}/4$. Generally, the upper bound of the operational band is set for a conformal array with a height, $h= \lambda_{high}/2$. This limitation creates a significant challenge in creating a wideband dual polarized antenna array with 6:1 impedance bandwidth. The proposed antenna array is a low cost conformal solution, utilizing low cost material standard PCB processes. This array achieves full diversity through linear V and H ports, with scanning capability down to 45°. A prototype has been built and tested to verify the array's performance. Results will be presented in the conference