Deployable Ultra-Wideband Tightly Coupled Dipole Textile Array

Matthew W. Nichols*, Alexander D. Johnson, Elias A. Alwan, and John L. Volakis
RF Communication Laboratory, Electrical and Computer Engineering Dept.
Florida International University, Miami, Florida, 33174
Email: mnich036@fiu.edu

Ultra-wideband (UWB) antennas are of great interest for software radios as they can seamlessly integrate several narrowband antennas into a single multi-functional aperture. Recently developed ultra-wideband (UWB) phased arrays employed tightly coupled dipole elements to achieve extremely wide bandwidths >30:1(J. Zhong, et. al, "Ultra-Wideband Tightly Coupled Dipole Array with FSS R-Card," IEEE APS/URSI 2018). These arrays have also been shown to demonstrate wide angle scanning (70º or more) using frequency selective superstrates (E. Yetisir, et. al, "Ultra-wideband Array with 70° Scanning using FSS Superstrate", IEEE AWPL, 2016.). Such capabilities make these arrays the best candidates for beamforming applications. Importantly, they are low profile and can be inconspicuously mounted on any surface. As such, fabrication of low profile UWB arrays with small footprints offer notable reduction in power, cost, and space for the radio, communication, and sensor systems. These attractive features make low profile wideband antenna array a key component in high data rate communications and high resolution radar.

The wide bandwidth performance of the tightly coupled dipole arrays (TCDAs) is largely due to the balun feeding network which serves as a higher order impedance matching network. TCDAs have been shown to operate across large bandwidths of 14:1 and greater, and are scalable with demonstrated operation from 200 MHz (UHF) up to 90 GHz (W-band). As would be expected, TCDAs have been realized using standard printed circuit board (PCB) processes. PCB structures are, of course, not flexible and can also lose electrical connection under stress. In addition, as the array size grows, these traditional arrays become expensive and bulky, requiring much larger stowage. The aforementioned issues can be mitigated using flexible and durable substrates for antenna array fabrication. Fabrication of TCDAs on textiles instead of PCBs allows for foldable, packable, deployable, and even compressible/stretchable versions of TCDAs under load while still being able to operate effectively.

In this paper, we propose a deployable tightly coupled dipole version using a textile, origami-type, construction process. The operation of interest is at the L and S bands. In addition to realizing a textile and package version (accordion type) of the antenna and substrate as well as substrate structure, a key challenge to this realization is the feeding network using conductive threads and fabrics. Preliminarily simulations show a high correlation with the PCB counterpart of the developed 'all textile' TCDA. At the conference, we will demonstrate the design and feeding structure of the 'all textile' TCDA along with an examination of its associated environmental and deployable cycles.