Ultrawideband Substrate-Loaded Tightly Coupled Array with Integrated Feed Strucutre

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Ultrawideband (UWB) phased arrays are a critical component in many emerging defense and civil communication systems. Multifunctional apertures, advanced radars, Electronic Warfare (EW) systems, and radio telescopes all demand wideband beamforming front ends, sometimes demanding bandwidths well in excess of a decade. Further, some of these applications demand low-profile apertures, for integration on mobile platforms such as aircraft or spacecraft. To address the need for extremely wideband low-profile arrays, the authors developed a substrate-loaded tightly coupled array (Moulder, et. al., Trans. on Ant. and Prop., Sept. 2012). This design uses a resistive element in the substrate to enhance to bandwidth of a low-profile tightly coupled array (to up to 21:1, for VSWR<3). In order to avoid severe losses from the loading, a synergistically designed superstrate is employed, allowing the design to provide radiation efficiency greater than 73% across the 21:1 band.

While this substrate-loaded array shows great promise for the aforementioned UWB applications, a major technical challenge in its implementation is feeding. The array element requires balanced feeding. Transformation to often-required unbalanced excitation over such wide bandwidths is a major challenge. Furthermore, the nominal impedance of the element is roughly 100-200Ω. Transforming the element's input impedance to 50Ω for integration with array electronics is another requirement of the feed.

In this paper, a substrate-loaded array with an integrated feed structure is presented. The design allows excitation of the infinite array unit cell over a 14.2:1 bandwidth (using a stricter matching criterion of VSWR<2.4). Further, it scans to 45^0 in the E-, H-, and D-planes without major degradation in performance. The operational principles of the design will be discussed at the conference, as well as experimental validation of the array-feed combination.