Surface Waves in Medium-Sized, Tightly-Coupled Planar Arrays

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We extend previous research in tightly-coupled planar arrays by evaluating alternative element shapes and their transitional properties. We present a concise review of the literature on tightly coupled arrays to address the focus of our research. Investigations of tightly coupled arrays focused first on infinite arrays, then finite by infinite. Alternatively, Capolino applied hybrid asymptotic techniques, combining Floquet wave techniques and edge diffraction, to analyze a large, tightly-coupled array. Nearly all past work relies on an assumption of a large array and uses arrays of dipoles or slots. This excludes a fundamental understanding of the impact of element shape on the array performance.

We present an investigation of tightly-coupled planar arrays of medium size and varying element shape. It is commonly understood that the center elements of a large square array can be approximated by an infinite array solution. While several options are available to control the array guided surface wave, we consider source impedance, metallic loss, and radiation. With these as our loss mechanisms for the array guided surface wave, we investigate the size requirements of the array. Such an understanding is needed for an entire class of medium-sized planar arrays.

Evolving from the dipole and the foursquare element, we present current distributions of linear and square tightly-coupled planar arrays. This illustrates the presence and disruption of surface currents due to array-guided surface waves at low frequencies. These currents are Fourier transformed to confirm and evaluate the surface waves by their phase velocities. The current decompositions indicate differences in the expected performance, such as bandwidth or impedance distortions across frequency, of different element shapes.