

Next-Generation Low-Cost Wideband Phased Array Apertures

John T. Logan^{*1}, Rick W. Kindt², and Marinos N. Vouvakis¹

¹UMass Amherst, ECE Dept., Amherst, MA 01002

²Naval Research Laboratory, Radar Division, Wash., D.C. 20375

In an age of information and network-centric warfare, the development of electronically scanned arrays (ESA) with ultra-wideband (UWB) wide-scan and agile polarization radiation remains essential for servicing multifunctional RF front-ends. However, the realization of UWB-ESA apertures continues to be a major challenge due to stringent system requirements, manufacturing costs, and more diverse servicing bands from HF all the way to THz.

Attaining bandwidths greater than 6:1, even around X-band, poses a significant design challenge as various antenna figures-of-merit tend to degrade unacceptably. For instance, Vivaldi arrays exhibit high polarization purity degradation when scanning off-axis in the non-principal planes (R. Kindt and D. Taylor, Proc. IEEE Antennas Propag. Soc. Int. Symp., pp. 1961-1964, Jul. 2011). Planar arrays generally exert reduced efficiencies due to lossy R-cards and materials required to suppress impedance-disrupting ground plane resonances that would otherwise result in poor matching (W.F. Croswell et al., Chapter 12 in Modern Antenna Handbook edited by C.A. Balanis, 2008), whereas reduced-profile vertically-integrated BAVA arrays have been proposed with higher input mismatch losses (M.W. Elsallal and J.C. Mather, Proc. IEEE Antennas Propag. Soc. Int. Symp., pp. 1980-1983, Jul. 2011).

This work aims to explore research towards UWB-ESA apertures that simultaneously tackle cost/complexity concerns and bandwidth maximization ($>6:1$) without performance drawbacks. Primary focus will be placed upon the evolution of Planar Ultrawideband Modular Antenna (PUMA) arrays that incorporate a fully planar, low-cost fabrication process and modular assembly while still supplying efficient UWB performance, such as those in Fig. 1. The presentation will traverse not only the immediate challenges, but it will also delve into future directions towards decade-bandwidth low-cost, low cross-polarization UWB-ESAs capable of deployment at diverse frequency bands.

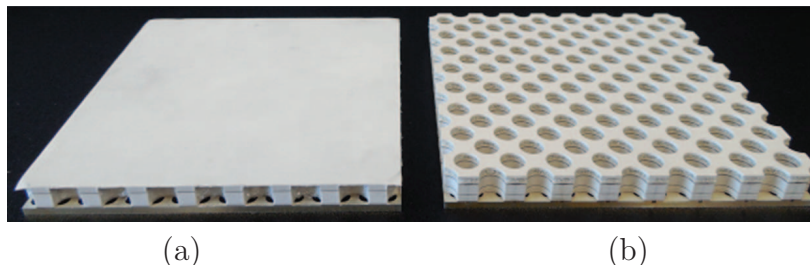


Figure 1: Two dual-polarized low-cost Planar Ultrawideband Modular Antenna (PUMA) prototypes. (a) 3:1 PUMA; (b) 6:1 PUMA.