Wideband Low-Profile Canted Antennas for Array Applications

J. T. Bernhard*, B. Herting, P. Mayes, N. Chen, and E. Michielssen
Electromagnetics Laboratory and Center for Computational Electromagnetics
Department of Electrical and Computer Engineering
University of Illinois at Urbana-Champaign, Urbana, IL 61801
jbernhar@uiuc.edu

Planar microstrip antennas revolutionized phased array technology decades ago. To enable the next levels of array functionality, however, new array elements with expanded capabilities and appropriate array strategies are required to operate over wide frequency bands. While patch antennas have many desirable characteristics, their narrow impedance bandwidths make them unsuitable for wideband applications. Common wideband antennas, on the other hand, promise increased bandwidth, but at the expense of greater physical size and/or reduced gain. This situation captures a fundamental physical limitation analogous to the gain-bandwidth tradeoff in electrical networks. In the case of antennas, this limitation is defined by gain-bandwidth and size. Therefore, in order to increase significantly the bandwidth of low-profile antennas, the effective volume occupied by the antenna structure must be increased. There are two alternatives: (a) increase the height, or (b) increase the lateral dimensions. These choices have implications not only for antenna design but also attainable array performance.

A number of groups are pursuing wideband and ultra-wideband antenna arrays. The motivation for this research is the ability to use one antenna aperture for a number of applications across a large frequency spectrum, reducing the number of antennas on platforms such as satellites, vehicles, and ships. Most often, variants of TEM horns or Vivaldi tapered slot antennas are implemented and do provide very wide band operation. However, these antennas are not applicable in many scenarios due to their large thickness, complicated and labor-intensive feed networks, and considerable weight.

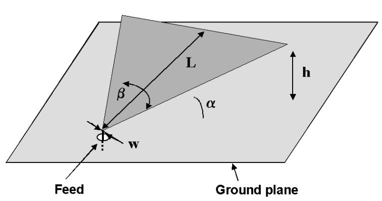

Figure 1: Non-resonant canted sector antenna.

In this presentation, we will describe experimental and simulation results on a family of low-profile antennas (non-resonant canted sectors – a single element is depicted in Figure 1) intended for wideband applications where traditional periodic patch antenna arrays severely limit performance. The results will illustrate compromises between the total height of the antenna above the ground plane, achievable impedance bandwidth, and radiation characteristics. Current designs show promise with over 40% instantaneous bandwidths that maintain useful broadside radiation performance. Simulation strategies, solutions for fabrication of these low-profile structures (similar to those described in J.-C. Langer et al., *IEEE Microwave and Wireless Components Letters*, **3**, 2003) and the development of related structures that ameliorate the poor broadside radiation characteristics as frequency increases will also be discussed.