

Continuous Transverse Stub Array Integrating Artificial Dielectric Layers

Luca Del Biondo and Mauro Ettore
Michigan State University, MI 48824, USA

The ongoing growth of the satellite communication industry necessitates the development of innovative solutions for compact, high-gain antennas capable of wide-angle scanning. Ideally, these antennas should have a low-profile design to ensure easy integration into mobile platforms for efficient deployment. Furthermore, there is an increasing demand for a wider operational bandwidth to support high data rate transmissions in civilian and military applications. In this context, phased arrays are becoming the preferred technology due to their agility, while wideband arrays based on connected arrays are being actively considered.

Continuous Transverse Stub (CTS) arrays present a viable solution to current challenges in the context of connected arrays and wideband arrays. These arrays achieve stable matching across wide bandwidths and maintain consistent performance over a wide field of view. Additionally, they are suited to cost-effective Printed Circuit Board (PCB) technology. Extensive analysis and experimental validation of such structures have been conducted in the literature (M. Ettore, F. F. Manzillo, M. Casaletti, R. Sauleau, L. Le Coq, and N. Capet titled “Continuous Transverse Stub Array for Ka-Band Applications,” *IEEE Transactions on Antennas and Propagation*, vol. 63, no. 11, pp. 4792-4800, November 2015). The wideband operation of the array is generally achieved by feeding it with a corporate feeding network using parallel plate waveguide technology. Such a corporate network places several constraints on the fabrication process to avoid blind or buried vias.

In this work, we explore the possibility of introducing artificial dielectric layers (ADLs) above the array of slots to preserve the wideband operation and field of view (D. Cavallo, W. H. Syed and A. Neto, “Closed-Form Analysis of Artificial Dielectric Layers—Part I: Properties of a Single Layer Under Plane-Wave Incidence,” in *IEEE Transactions on Antennas and Propagation*, vol. 62, no. 12, pp. 6256-6264, Dec. 2014) while reducing the complexity of the beam-forming network. A Mode Matching (MM) approach is proposed for the analysis of the unit cell of the array in an infinite array environment to derive its performance in matching and field of view. In particular, we present a CTS array unit cell with only two ADLs operating in 7:1 bandwidth over a field of view of 45° in elevation in all azimuthal planes (Fig. 1). The proposed solution is compared to classical CTS solutions, describing the benefits of future developments and possible evolutions.

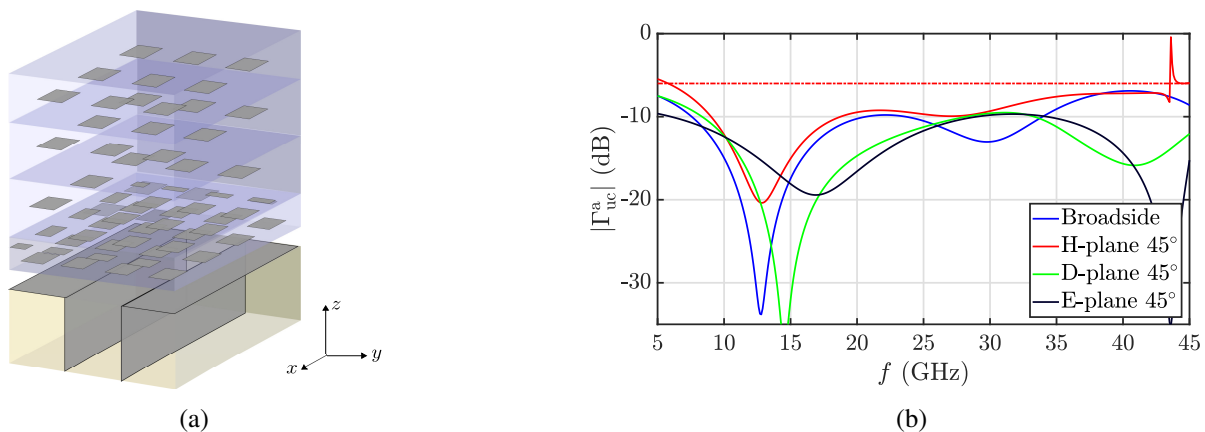


Figure 1: (a) CTS array unit cell with two ADLs and (b) active input reflection coefficient of the unit cell for 45° scan angle in various azimuthal planes.