

Conformal Leaky-Wave Antenna Fed by a Quasi-Optical System

Michael Dittman and Mauro Ettorre

Michigan State University, East Lansing, United States, dittmanm@msu.edu

Conformal antennas allow for seamless integration into mobile platforms, supporting a variety of applications, including communications, sensing, and radar systems (Johnson, R.C. (1993) *Antenna Engineering Handbook*, 3rd Edition, MGH, New York, NY). Leaky-wave antennas (LWAs) have been explored for use as conformal antennas, with various research teams demonstrating the manipulation of the complex propagation constant of the leaky-wave mode to compensate for the conformal aperture (A. Foroozesh, R. Paknys, D. R. Jackson and J. -J. Laurin, "Beam Focusing Using Backward-Radiating Waves on Conformal Leaky-Wave Antennas Based on a Metal Strip Grating," *IEEE Transactions on Antennas and Propagation*, vol. 63, no. 11, pp. 4667-4677, Nov. 2015). This work presents a tapered conformal leaky-wave antenna (CLWA) fed by a quasi-optical system (QOS), allowing for the simultaneous and independent control of radiation pattern along the principal planes of the antenna.

A dual-layer pillbox is designed to feed a tapered CLWA to achieve a focused beam at broadside utilizing a QOS developed for planar technology. (M. Ettorre, R. Sauleau, and L. Le Coq, "Multi-Beam Multi-Layer Leaky-Wave SIW Pillbox Antenna for Millimeter-Wave Applications," *IEEE Transactions on Antennas and Propagation*, vol. 59, no. 4, pp. 1093-1100, April 2011). The antenna system consists of a feeding horn, a parabolic reflecting mirror, a coupling slot, and a tapered CLWA shown schematically in Fig. 1 (a). The feed horn in the bottom substrate layer excites a quasi-transverse electromagnetic (quasi-TEM) wave with a cylindrical phase front. The quasi-TEM wave propagates toward the parabolic reflector where the cylindrical phase front is converted to a planar one and coupled into the top layer via the coupling slot. In the top substrate, the CLWA radiates the energy from the quasi-TEM wave to free space. The CLWA is tapered to compensate for distortion due to the circular arc to achieve a focused beam at broadside in the E-plane (yz-plane in Fig. 1 (a)). Radiation patterns from full-wave simulations are shown in Fig. 1 (b) for a feeding horn at the focus of the parabolic mirror. The main beam of the antenna points at about -1° with a maximum gain of 23.63dB at 24.15 GHz. The H-plane presents a side lobe level lower than -18dB, and is mainly controlled by the QOS.

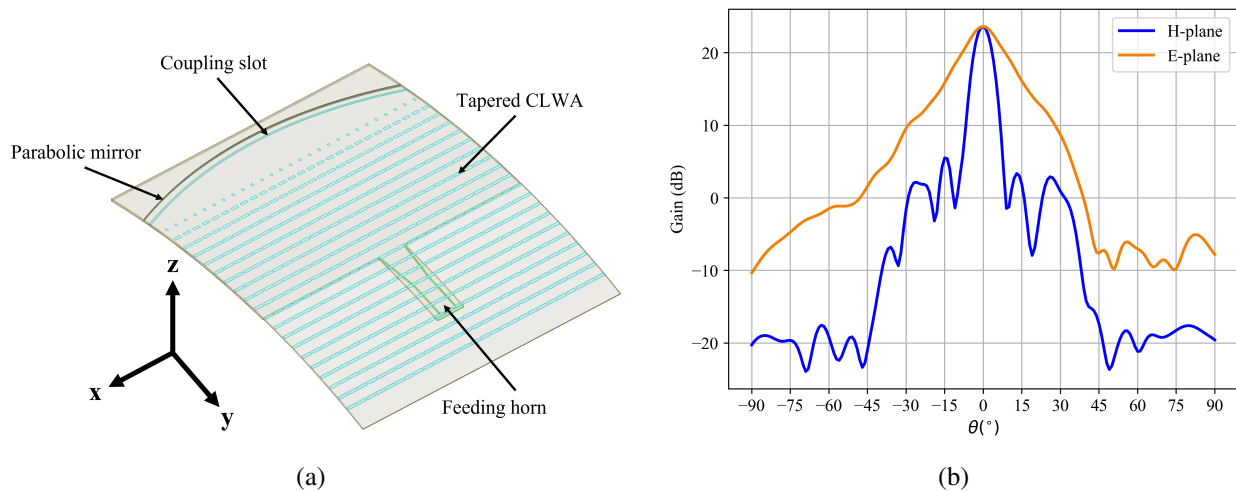


Figure 1: (a) View of a CLWA fed by a quasi-optical system and (b) simulated gain pattern along H- and E-plane at $f = 24.15$ GHz.