LEAKY-WAVE ANTENNA FEATURING 360° COVERAGE AND LOW CROSS-POLARIZATION

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Abstract – A leaky-wave antenna (LWA) is presented in the study, featuring 360° coverage in the elevation plane and low cross-polarization in radiation. In practice, antennas providing both omnidirectional radiation patterns in the azimuth plane and beam-steering functions in the elevation plane are attractive for the radio system, tracking equipment, and other communication applications. In addition, a sensing system with full coverage in the azimuth plane and scanned beams in the elevation plane is preferred to eliminate blind spots for imaging and collision avoidance. LWAs could be a prospective candidate if they can offer omnidirectional radiation patterns and steered beams simultaneously, but the typical fan-shaped beams are not capable of full coverage in the azimuth plane [1] [2]. Antenna arrays can be formed to radiate omnidirectionally at the cost of compactness, but an extra feeding network undoubtedly contributes to the complexity of designing and fabrication [3]. The proposed quasi-uniform LWA has a compact configuration, which is based on a dielectric-filled rectangular waveguide (RWG) and fed by a higher order mode. In the frequency band of interest, the TM_{11} mode performs as a fast wave in the proposed quasi-uniform LWA, radiating via the transverse slots etched on the walls, and this higher order mode is excited via a mode convertor from an inline coaxial line to the dielectric-filled RWG. For the reduction of sidelobe levels at high frequencies, -25 dB Taylor amplitude distribution is applied to the etched slots, and the effective attenuation constant is calculated by using the ABCD matrix [4]. The dielectric-filled LWA with the inline coaxial feeding is fabricated and measured. In Fig. 1, the simulated and measured radiation patterns in the elevation plane are plotted and compared at several frequencies. It can be observed that the measured main beam is scanned from 36° at 14.7 GHz to 58° at 16.2 GHz. The measurement is consistent with the simulation, showing frequency-driven beam-scanning capability with low cross-polarization in the elevation plane. Simulated and measured radiation patterns in the azimuth plane illustrate the omnidirectional radiation patterns and thus confirm the radiating performance of the TM_{11} mode in the proposed LWA. The advantages of the scanned beams and omnidirectional radiations are promising for radar systems.

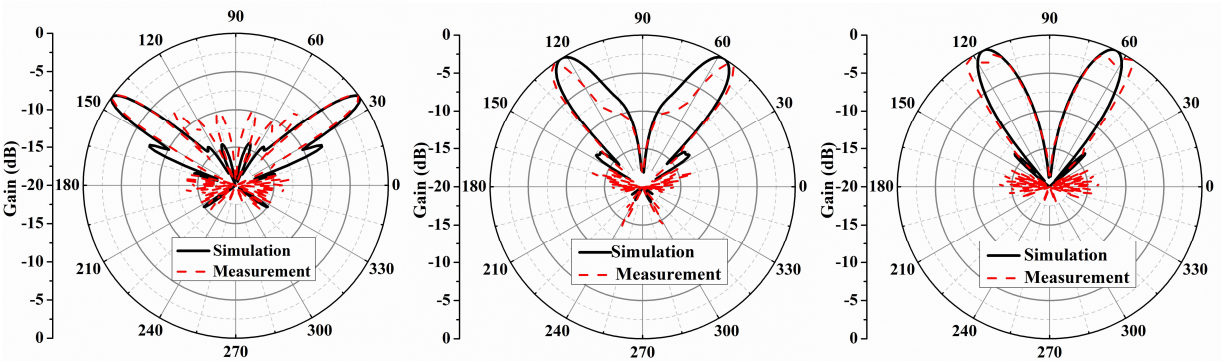

Fig. 1: Simulated and measured radiation patterns of the fabrication LWA in the elevation plane at different frequencies: (a) 14.7 GHz, (b) 15.8 GHz and (c) 16.2 GHz.

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