

RADIATION AND BEAM-STEERING OF A W-BAND TROUGH WAVEGUIDE ANTENNA USING MEMS PERTURBATIONS

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The trough waveguide has been investigated for many applications, ranging from a source for microwave heating to sustained plasma generation, which make use of both its open structure and the wide bandwidth provided by the dominant guided TE mode [W. Rotman and A. Maestri, IRE Int. Convention Record, 8, Mar. 1960, pp. 67-83]. In the initial stages of development, the trough waveguide made use of mechanically controlled perturbations within the waveguide as a means to facilitate radiation and beam-steering from the open structure. Although these techniques proved very effective, the cam and gear methods available at the time of development were mechanically limited and somewhat cumbersome. Making use of micromachining techniques, this structure is revisited here with the goal of developing a radiating structure for highly integrated radar and communication systems.

In this work, radiation from the trough waveguide is facilitated through electro-mechanical cantilever-type perturbations which are hinged across the bottom of the center fin on both sides of the guiding structure. This design separates itself from previous work on this type of antenna, as the actuated cantilevers are used primarily to provide the desired phase and amplitude distribution across the effective aperture instead of significantly altering the guided wavelength. This effect has been observed in field plots of the waveguide for different actuation schemes. Using the cantilevers, the traveling wave encounters the antipodal asymmetry periodically every distance a , which is where the electric field of the TEM mode on the aperture experiences a peak value. Since the design does not significantly alter the guided wavelength, the characteristic impedance of the guide is not adversely affected and the use of symmetrical tuning elements is not needed as they were in many previous designs that placed solid perturbations the guide. In addition to facilitating radiation, the cantilevers can be actuated in such a manner that they provide amplitude tapering along the effective aperture (open end of the guide). To achieve this tapering - with minimal effect on the guided wavelength - the degree of actuation (angle) of the cantilever can be properly set to convert a given amount of energy into the radiating TEM mode. Discussion of this traveling wave antenna will include a W-band design intended for micromachined actuators and an S-band design for laboratory investigation, along with the feed structures used to excite the trough waveguide and the possible electromechanical perturbations that can operate in the guide.

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