

ABSTRACT

With the advancement of technology, highly directive communication with excellent beam scanning capability is a necessary requirement. Leaky wave antennas (LWAs) are a class of guided traveling wave antennas that possess directive beam scanning properties. The non-linear relation of the scanning angle with the operating frequency is used for suitably positioning the beam towards the desired direction. Among various methods of generating leaky wave transmission, a planar conductor-backed multi-layered dielectric structure with an embedded current source is a popular option. However, the leaky wave radiation analysis of such a structure is a challenging task due to complex and lengthy mathematical formulations. This thesis aims to address the issue by deriving simplified analytic expressions for computing the leaky wave poles in a planar stratified medium with either a horizontal electric or magnetic dipole source. The proposed formulations are generalized for any number of layers and any desired frequency. Later, deep learning inspired techniques are explored for the inverse design of leaky-wave antennas in a planar multilayered medium. In the inverse problem, the antenna parameters can be predicted from the antenna directivity, thus optimizing the antenna performance. Lastly, some potential applications of the planar LWAs have been investigated in the context of beam scanning and secure communication perspective.

Keywords: Leaky wave antennas, Planar multi-layered medium, Pole computation, Inverse design, Deep learning, Beam scanning, Secure communication.