# INVESTIGATION OF LEAKY-WAVE ANTENNAS MADE FROM METAMATERIALS

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One of the interesting uses of metamaterials is in the development of high-gain leaky-wave antennas (LWAs). LWAs have the inherent advantage of a high directivity that is typically achievable with a rather simple structure, since the guiding structure itself provides the radiation mechanism while a simple source is often used to launch the leaky wave. LWAs may be constructed in various ways, with the focus here being on planar structures composed of planar dielectric and/or metallic layers. A simple source such as an electric or magnetic dipole may be used to launch a cylindrical leaky wave that propagates outward on such a structure, producing a radiation pattern that is either conical at some scan angle, or a pencil beam at broadside. A line source excitation may be used if a fan beam is desired.

In the past, planar LWAs have been constructed using dielectric layers, in which a high-permittivity superstrate layer is placed over a substrate layer. More recently, planar LWAs have also been constructed from periodic metallic patch or slot arrays that form a partially reflecting surface (PRS) that is placed over a substrate layer. Although the PRS was constructed from a periodic structure, these previous LWAs did not use a metamaterial substrate.

With the advent of recent interest in metamaterials, it has been observed that high-directivity antennas using a metamaterial layer, e.g., a layer with a relative permittivity near zero, may be realized. Although not initially appreciated, it will be shown that such novel antennas are in fact LWAs by nature, and hence a comparison with other planar LWAs is warranted. The properties of such metamaterial LWAs will be explored, and comparisons will be made with LWAs realized with conventional substrates. The use of a wire medium to obtain a quasi-homogeneous artificial low-permittivity layer will be explored, and results will be presented to show that LWAs based on such a medium behave as expected from the homogeneous-layer analysis. The possible use of other artificial metamaterial layers will also be examined, including metamaterial layers with both low and high values of permittivities and permeabilities.

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2. B - Fields and Waves

3. (a) S-B1

4. C - Contributed Paper

5. No special instructions