Multi-Beam Antennas Using Planar Lenses Fed With Focal Plane Arrays

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Over the past few decades, a significant amount of research has been conducted in the area of microwave and millimeter-wave lenses. Such lenses are used in a wide range of applications including imaging, radar systems, and high-gain phased array antennas. Many types of microwave lenses have been presented in the literature. These include dielectric lenses, which were among the first microwave lenses investigated. Such lenses are generally heavy and bulky and suffer from internal reflection losses. Planar microwave lenses have addressed many of the shortcomings of the traditional dielectric lenses at low RF and microwave frequencies. Traditional planar lenses composed of arrays of transmitting and receiving antennas were among the first planar lenses studied. However, these lenses generally suffer from poor scanning performance due to large element spacing. Another major problem with conventional planar lenses is the large spacing between the feed point and the lens aperture. This may not be desired in applications where the lens is to be illuminated with a feed antenna to achieve a high gain aperture. In such cases, the large spacing between the feed antenna and the lens' aperture can result in a large overall profile of the antenna, which is not desirable. Therefore, a new feeding technique that does not need a large separation between the lens and its associated feed network is desired.

In this presentation, we report a multi-beam zoned microwave lens fed with a planar feed network to achieve a multi-beam, low-profile, high gain antenna aperture. The proposed structure has a low profile with an overall thickness of $1.5\lambda_0$ including planar feed network and achieves a scanning performance in a field view of $\pm 45°$ when it used in a beam-scanning antenna system. Furthermore, a novel method for design and optimization of these planar lenses is proposed. The proposed technique relies on using the effective medium approach to characterize the response of each of the lens' spatial phase shifter. Detailed design process as well as measurement and simulation results of the proposed antenna will be presented and discussed at the symposium.