# A LENS DESIGN USING THE HOLOGRAPHIC PRINCIPLE

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High gain antennas have been vital components in various communication systems, where antennas such as lenses and reflectors have been widely employed. In a conventional design, antenna beam-forming characteristics have been achieved by applying Fermat's principle through geometrical constraint. For a system that requires multi-focal points, for multi-beam applications from a shared aperture, this can be a very challenging problem. A design based on the holographic principle is a promising alternative method, which can overcome this problem.

A zone plate has been recognized as a simple hologram (W. E. Kock, Microwaves, pp. 46-54, November 1968). The equivalence was demonstrated by a simple hologram of a pin hole using laser light and a photographic plate. A volume-type holographic antenna has also been reported in the literature (K. Iizuka, et al, IEEE Trans. Antennas Propagat., vol. AP-23, pp.807-810, November 1975). The holographic antenna was constructed from circular arcs of metal strips as a crude representation of a hologram. The antenna functions in a similar way to a traveling wave type where the beam scans with frequency. In this paper, a flat lens design using the holographic principle is presented. A method for efficiency enhancement will also be discussed. The proposed antenna should be attractive for millimeter-wave applications due to its low loss nature.

The proposed antenna configuration consists of a number of short dipoles arranged in a concentric ring pattern. The locations of the short dipoles are determined by applying the holographic principle. The two waves used to produce a hologram consist of a spherical wave from the feed and a plane wave propagating in the boresight direction, the desired direction of the antenna beam in this investigation. The location of the spherical wave is the focal point of the lens. For a single layer lens, the antenna produces two symmetrically beams located at the front and back. However, the back lobe radiation can be suppressed by using a multilayer configuration. Preliminary results of a two-layered lens achieve a gain increase of close to 6 dB with a significant reduction of the back lobe. The number of layers serves as a design parameter for antenna efficiency enhancement in addition to proper feed selection criteria. This investigation is confined to the boresight beam. However, the concept can be easily applied to the design of a lens with a tilted beam. Details of the study and a discussion will be presented at the conference.