A 360^0 Scanning Lens Design
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Recent developments in civilian radar sensors and communication systems has contributed significantly to the growing interest in smart antennas that can dynamically scan multiple beams. There are many radar and communication systems that require the generation of a set of multiple beams from a single antenna aperture. A variety of technologies exists to enable this. For instance, a linear array fed by a Butler matrix or network of phase shifters. Butler matrices have the disadvantage of requiring many couplers and crossovers, while phase shifters can be expensive.

A useful alternative is to use a Rotman lens, which is a parallel-plate Multiple Input – Multiple Output structure. The Rotman lens is attractive because of its simple design, compact size and broadband characteristics. Many different Rotman lenses have already been developed, using microstrip, waveguide, and substrate integrated waveguide techniques. Since its invention, much effort was made to optimize the design formulations based on optical phase tracing methods to solve for the receiving contour and a set of delay lines from three perfect focal beam ports. This approach implies that any non-focal beam ports residing between the perfect focal points may generate some phase error. A drawback of the Rotman lens is its limited scanning range due to the geometric configuration of the beam ports and the inherent constrains of linear arrays.

In this paper, we propose a novel design for the microwave lens that has full 360^0 coverage in the azimuthal plane. The proposed lens has a polygon shape that encompasses a symmetric optimized contour with the least phase error. The optimization provides a solution for a possible contour that satisfies a set of input parameters and constraints including the total dimension, minimum gain coverage, and the phased array size.