APPLICATION OF LUNEBURG LENS ANTENNA TO AUTOMOTIVE RADAR IN SUBMILLIMETER- AND MILLIMETER-WAVE FREQUENCY

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In automotive radar applications, a multiple beam antenna is very important for the wide coverage of the vehicles. In this paper, a new parallel-plate Luneburg lens antenna which can support a absolutely wide scan angle is presented for the automotive application in millimeter- and submillimeter-wave frequencies. The antenna is composed of multiple primary feeds, a parallel-plate Luneburg lens with a metallic artificial dielectric, and a pair of corrugated flares. For a primary feed, here two types are investigated. First, an open-ended waveguide is used. Second, a tapered slot antenna (TSA) is presented. Especially, the TSA makes the antenna integrated with an entire RF system. A rotationally symmetric parallel-plate Luneburg lens requires a specific refraction index in order to focus the wave of the primary feed at the lens aperture. Here, a periodic, regular metal post structure which acts as a metallic artificial isotropic dielectric is used. Using transmission line theory and transverse resonance condition, the relation between the required refraction index and the metal post dimension is derived. To improve a half power beam width (HPBW) and side love level in the vertical plane (in elevation), a pair of corrugated flares is applied.

To predict the far-field pattern of the entire antenna, geometrical optics (GO) and aperture integration method are used. In particular, in order to simulate the influence of the post dimension and arrangement on the pattern, several antennas with an open-end waveguide as a primary feed and different metal post shapes are simulated with the help of Ansoft HFSS.

For verification of the simulation and theory, a prototype antenna is fabricated and measured. The measurement is in good agreement with the simulation and theory. Also it proves that the antenna has such good advantages as definitely wide coverage with multiple primary feeds and very low lost, especially compared to the current commercial antennas. Also the complete antenna is made of metal and then can be cheaply and massively produced using such as a precise casting method. In the presentation, antenna design procedure and measurement will be shown.