A Short Focal Lens with Phased Array Antenna for 5G Application

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Recently, the millimeter wave have been received a huge attention for realizing of next generation (5G) among numerous candidates. The reasons for this, we can obtain dramatically high gain, wide bandwidth, small size, and wide coverage by utilizing the phased array antenna system. However, a lot of companies and research groups effort for the higher specifications to maintain a stable service from the unexpected losses. The lens such as a transmit-array, a reflectarray, and a meta-surface can be possible approach. In order to enhance the antenna gain, the area of the projected E-field to the lens should be larger than the aperture size of the antenna. Because the array antenna already has a high gain and narrow beamwidth, the long distance between antenna and lens is required for obtaining a large area of the projected E-field on the lens. Because of this, the overall structure becomes bulky.

In this paper, the short focal lens based on the phased array antenna is presented. To maximizing the area of the projected E-field on lens in very short distance, efficient two methods are proposed.

The first method is dual lens system. The first lens, second lens and array antenna are assembled in this system. The first lens is closed to the array antenna and, it change the narrow beam pattern of the array antenna to a broad beam pattern. Then second lens received the broad beam pattern from the first lens. From this method, the area of the projected E-field on the second lens can be maximized. Therefore, the original beam of the array antenna is converted in twice and then the enhanced gain pattern is completed. The procedure of the beam converting will be presented in detail, and then the design of the first lens and second lens will proposed. Finally simulation results of the lens will be compared.

The second method is to use a beam synthesis of the array antenna. Indeed, the phased array antenna can make some broad beamwidth pattern or multi beam pattern as well as a conventional pencil beam. We usually have used the pencil beam for getting high gain form the array antenna. However, the broad beam or multi-beam is more useful in the lens because the area of projected E-field on the lens can be larger, and then the antenna gain is enhanced in short distance. The changed area of the projected E-field on the lens will be addressed versus beam shaping. It will demonstrated that the co-relation between the area of the projected E-field and antenna gain. Finally, simulation results and measured results are compared in presentation