

Geodesic Horn Antenna for Ultra-Wideband Applications

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Advances in communication systems have driven the need for wider bandwidths, exceeding the limits of traditional frequency bands. This has motivated the shift towards higher frequency bands to support 5G and 6G networks [1]. At these frequency bands antennas are required to not only support ultra-wideband operation but also ensure efficient performance, provide high gain, and maintain consistent radiation characteristics across the entire bandwidth. Lens antennas, which are theoretically non-limited in bandwidth, have shown to be a suitable solution in the millimeter-wave band [2].

Graded-index lenses can focus and direct electromagnetic waves, so they can be used as an antenna to generate a directive beam in the desired direction. However, this type of lenses suffer from significant losses due to the use of dielectric materials. In contrast, geodesic lenses present a promising alternative by replicating graded refractive indices through equivalent physical paths [3]. This way, fully-metallic configurations can be implemented in a parallel plate waveguide (PPW), effectively avoiding the material losses mentioned before. Although geodesic lenses are inherently wideband, their implementation is mainly constrained by their feed design [4].

This work presents the design and fabrication of an ultra-wideband feed system that is integrated to a geodesic horn [5]. The feed incorporates a ridge-to-PPW transition operating in the 10-40 GHz frequency range. The profile of the lens is optimized using an in-house ray-tracing model in one direction [5]. An array of radiating flares is placed at the opposite side of the lens to enhance the gain in the E -plane. The design is adapted for monolithic additive manufacturing, which avoids potential leakage and misalignment-related losses [6]. This approach demonstrates the suitability of geodesic antennas for ultra-wideband point-to-point communications.

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