Analysis of Super Imaging Properties of Spherical Geodesic Waveguide Using COMSOL Multyphisics

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Abstract

Negative Refractive Lens (NRL) has shown that an optical system can produce images with details below the classic Abbe diffraction limit. This optical system transmits the electromagnetic fields, emitted by an object plane, towards an image plane producing the same field distribution in both planes. Recently, two devices with positive refraction, the Maxwell Fish Eye lens (MFE) (Leonhardt et al. 2000) and the Spherical Geodesic Waveguide (SGW) (Minano et al. 2011) have been claimed to break the diffraction limit using positive refraction with a different meaning. In these cases, it has been considered the power transmission from a point source to a point receptor, which falls drastically when the receptor is displaced from the focus by a distance much smaller than the wavelength. Although these systems can detect displacements up to lambda/500, they cannot be compared to the NRL, since the SGW deals only with point source and drain. Here, it is presented a COMSOL analysis of the SGW with defined object and image surfaces which are both conical sections of the sphere (Figure 1). The analysis is done for TE modes depending only on the angular spherical coordinates. The calculus shows that a Dirac delta electric field in the object surface produces an image below the diffraction limit in the image surface, if the image surface is a perfect absorber.

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Figures used in the abstract

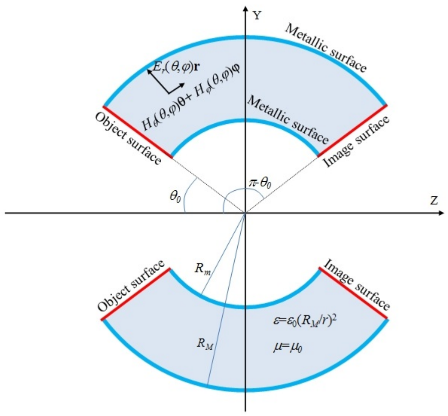

Figure 1: Spherical Geodesic Waveguide.