Numerical results for the radiation by a line source in the presence of a slotted metallic plane covered by DPS and DNG elliptical lenses

Brook Feyissa*, T. Negishi, D. Erricolo
University of Illinois at Chicago
Department of Electrical and Computer Engineering,
851 South Morgan Street, Chicago, IL 606067, USA

The geometry of this two-dimensional problem consists of a slot in a perfectly electric conducting ground plane. The slot is covered with two confocal elliptical lenses of equal size, located on opposite sides of the hole. The slot is the focal segment for the elliptical lenses. Both lenses are made of lossless materials. One lens is made of a double-positive (DPS) medium characterized by a real positive electric permittivity and a real positive magnetic permeability. The other lens is made of a double-negative (DNG) metamaterial characterized by a real negative permittivity and a real negative permeability.

The semi-infinite space surrounding the structure on either side of the conducting plane is such that the DPS lens is isorefractive to the surrounding space, while the DNG lens is anti-isorefractive to the surrounding space, and the two lenses are anti-isorefractive to each other. This system is illuminated by an electric line source.

The analysis is conducted in the phasor domain with time-dependence factor $\exp(i\ \omega\ t)$. This work is related to the analytical solution, without any numerical results, described in (D. Erricolo, P.L.E. Uslenghi, "Radiation by a Dipole Antenna on the Axis of a Circular Hole in a Metallic Plane Covered by DPS and DNG Oblate Spheroidal Lenses," International Conference on Electromagnetics in Advanced Applications (ICEAA), Torino, Italy, Sept. 9-13, 2013)

The numerical solution consists on the evaluation of the exact analytical solution to the boundary-value problem obtained in terms of infinite series of products of radial and angular Mathieu functions. The modal expansion coefficients are determined analytically by imposing the boundary conditions on the metallic plane and at the interfaces between penetrable materials, and the radiation condition at infinity.