

Diffraction of plane electromagnetic waves by a gradient dielectric cylinder

V.V. Kotlyar^{1,2}, M.A. Lichmanov²

¹ Image Processing Systems Institute of RAS

² Samara State Aerospace University

Abstract

The authors have developed a method for analyzing the diffraction of a plane electromagnetic wave by a gradient dielectric cylinder. This method is used as the basis for the calculation of diffraction patterns on transverse gradient cylindrical lenses: an inner Luneburg lens, a generalized Luneburg lens, and an Eaton-Lipman lens. It is shown by numerical examples that these lenses, with the dependences of the refractive index on the radial coordinate obtained in the framework of geometric (ray) optics, perform the functions of focusing (for Luneburg lenses) and reflecting (for Eaton-Lipman lenses), even if the lens radius is equal to the wavelength of light.

Keywords: electromagnetic wave, dielectric cylinder, inner Luneburg lens, generalized Luneburg lens, Eaton-Lipman lens, geometric optics, ray optics, focusing, reflecting.

Citation: Kotlyar VV, Lichmanov MA. Diffraction of plane electromagnetic waves by a gradient dielectric cylinder. *Computer Optics* 2003; 25: 11-15.

[Access full text \(in Russian\)](#)

References

- [1] Luneburg RK. *Mathematical theory of optics*. Providence, RI: Brown U Press; 1944.
- [2] Gordon JM. Spherical gradient-index lenses as perfect imaging and maximum power transfer devices. *Appl Opt* 2000; 39(22): 3825-3832.
- [3] Flores JR. Gradient-index with spherical symmetry. *J Mod Opt* 1999; 46(11): 1513-1525.
- [4] Kotlyar VV, Melekhin AS. Abel transform in the problems of design of gradient optical elements. *Computer Optics* 2001; 22: 29-36.
- [5] Zelkin EG, Petrova RA. *Lens antennas*. Moscow: "Sovetskoe Radio" Publisher; 1971.
- [6] Kotlyar VV, Lichmanov MA. Analysis of light diffraction by micro-optics using finite elements method. *Optical Memory and Neural Networks* 2001; 10(4): 257-265.
- [7] Kotlyar VV, Lichmanov MA. Diffraction of a plane electromagnetic wave on a gradient optical element with transverse cylindrical symmetry. *Physics of wave processes and radio engineering systems* 2002; 5(4): 37-43.