

Investigation of binary lenses in the frame of electromagnetic theory

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Abstract

The paper presents the results of numerical simulation of binary diffractive lenses operation within the framework of a rigorous electromagnetic theory. It investigates the efficiency of binary lenses for the cases when the aperture radius is only a few wavelengths, and the focal length is comparable to the radius. The results of the rigorous electromagnetic theory and the scalar Kirchhoff approximation are compared. The limits of the scalar theory applicability in the calculation of binary lenses are estimated.

Keywords: binary diffractive lenses, aperture radius, electromagnetic theory, scalar Kirchhoff approximation

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References

- [1] Sheng Y, Feng D, Larochelle S. Analysis and synthesis of circular diffractive lens with linear grating model and rigorous coupled-wave theory. *J Opt Soc Am A* 1997; 14(7): 1562-1568.
- [2] Soifer VA, ed. *Methods of computer optics*. Moscow: "Fizmatlit" Publisher; 2000.
- [3] Shi S, Prather DW. Electromagnetic analysis of axially symmetric diffractive optical elements illuminated by oblique incident plane waves. *J Opt Soc Am A* 2001; 18(11): 2901-2907.
- [4] Mirotznik MS, Prather DW, Mait JN, Beck WA, Shi S, Gao X. Three-dimensional analysis of subwavelength diffractive optical elements with the finite-difference time-domain method. *Appl Opt* 2000; 39(17): 2871-2880.
- [5] Soifer VA, ed. *Methods for computer design of diffractive optical elements*. New York: John Willey & Sons Inc; 2002.
- [6] Peng S, Morris GM. Efficient implementation of rigorous coupled-wave analysis for surface-relief gratings. *J Opt Soc Am A* 1995; 12(5): 1087-1096.
- [7] Moharam MG, Grann EB, Pommet DA. Formulation for stable and efficient implementation of the rigorous coupled-wave analysis of binary gratings. *J Opt Soc Am A* 1995; 12(5): 1068-1076.
- [8] Moharam MG, Grann EB, Pommet DA, Gaylord TK. Stable implementation of the rigorous coupled-wave analysis for surface-relief gratings: enhanced transmittance matrix approach. *J Opt Soc Am A* 1995; 12(5): 1077-1086.
- [9] Silberstein E, Lalanne P, Hugonin J, Cao Q. Use of grating theories in integrating optics. *J Opt Soc Am A* 2001; 18(11): 2865-2875.
- [10] Berenger J-P. A perfectly matched layer for the absorption of electromagnetic waves. *J Comput Phys* 1994; 114: 185-199.
- [11] Gedney SD. An anisotropic perfectly matched layer-absorbing medium for the truncation of FDTD lattices. *IEEE Trans Antennas Propag* 1996; 44(12): 1630-1639.