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Maxwell's equations in periodic structures. (English) Zbl 07413426

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This book aims to expose advanced undergraduate students, graduate students, as well as researchers to the mathematical theory of Maxwell's equations in periodic structures, especially related to diffractive optics. There is both introductory material to serve beginners to the area as well as quite up to date references in the field for experienced researchers. There is both a focus on analytical methods (e.g. variational formulations of diffraction grating problems) as well as numerical methods (e.g. finite element methods for bi-periodic structures).

The first two chapters are more introductory material, addressing the fundamental aspects of the Maxwell equations as well as basic diffraction grating theory. Then, variational formulations of 1D and 2D diffraction grating problems are considered. Adaptive finite element methods are then discussed for these (boundary value) problems. Next, inverse diffraction grating problems are addressed, where both uniqueness theorems and some numerical methods are presented. Then, a framework for reconstructing grating surfaces with super-resolution is presented in the context of near-field imaging problems in diffraction optics. Finally, the last part of the book is devoted to related results in diffractive optics, including the method of boundary integral equations, time domain problems, nonlinear gratings, and optimal design problems.

Overall, the book is quite interdisciplinary in nature and provides a balance between analytical and numerical methods. Plenty of references are provided as well.

Reviewer: Eric Stachura (Marietta)

MSC:

35-01	Introductory exposition (textbooks, tutorial papers, etc.) pertaining to partial differential equations
35Q61	Maxwell equations
78Axx	General topics in optics and electromagnetic theory
78Mxx	Basic methods for problems in optics and electromagnetic theory
65M60	Finite element, Rayleigh-Ritz and Galerkin methods for initial value and initial-boundary value problems involving PDEs

Keywords:

Maxwell equations; diffractive optics; bi-periodic structures; finite element methods; near-field imaging

Full Text: DOI