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Band gap calculations of photonic crystals by singular boundary method

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Abstract

This paper applies the singular boundary method (SBM) to compute band gap structures of two-dimensional (2D) photonic crystals. By using the fundamental solutions, a linear eigenvalue equation is established to describe the relationship between the Block wave and frequency. For given frequencies, the solution of the equation yields the related Block wave vectors. The convergence, accuracy and efficiency are carefully examined through several benchmark cases.

Keywords: Photonic crystals, band gap, band structures, meshless, singular boundary method

1. Introduction

Photonic crystals [1-3] are artificial periodic structures on the scale of light wavelength. The existence of band gap is an important property of photonic crystals. Electromagnetic (EM) waves corresponding to a frequency in a band gap cannot propagate through the crystals in any direction. In the past decades, photonic crystals have attracted great attention in a variety of scientific and engineering fields.

Some numerical methods have been used to calculate the band structures of photonic