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TRANSFER MATRIX METHOD FOR ONE-DIMENSIONAL PHOTONIC CRYSTALS

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Dedicated to Prof. K. Srinivasa Rao on his 75^{th} ***Birth Anniversary***

Abstract: Theory of photonic crystals includes an extensive study of electromagnetism and optics in conjunction with solid state physics. Many things have been known for over a century and I want to explore how the calculation on photonic crystal emanates from the theories of electromagnetic waves, basic material optics and some concepts from the field of solid state physics. The electromagnetic wave interacts at the interfaces of the building blocks in the photonic crystals. Maxwells equations can be used to predict the photonic behavior of light propagating in the structure in terms of Bloch functions, band structures and band gaps with the application of transfer matrix method.

Keywords and Phrases: Reflection and Transmission spectra, photonic crystals, transfer matrix method.

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1. Introduction

The band structure of photonic crystals (PCs) can be calculated in mainly three fashions: either by a Plane Wave (PW) method [1], with a Finite Difference Time Domain (FDTD) method [2] or with a Transfer Matrix Method (TMM) [3].

All of these methods calculate with high efficiency and accuracy and are in good agreement with experimental results. These methods are chosen according to the problem tackled. The PW method is a straight-forward method, which assumes a linear combination of plane waves as a solution for Maxwell's equation on a defined lattice. It is very easy to implement and obtain the band structure when the direction is specified. The codes give all the propagating/evanescent energies for that direction. A defect in the infinite photonic crystal will be treated using a supercell. Many results have been obtained with this method [4-5]. The limitation of the