**Analysis of Photonic Crystal Wave Containment**

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*Periodic dielectric structures may be used to direct and contain electromagnetic waves. The ability of a crystal to affect wave behavior depends on the several factors, including the shape, scale and distribution of dielectrics as well as the relative wavelength of an incident wave. Simulation techniques such as FDTD may be used to model periodic dielectric structures and their response to different wavelengths in order test suitability of a given structure for a particular application. We present an analysis of three structures, their resonant frequencies, and software modifications to enable efficient simulation of such structures.*

The Finite Difference Time Domain method is a popular, robust method to simulate and analyze the propagation of electromagnetic waves within different media and geometries. While typically applied to non-periodic structures such as dielectric slabs and complex circuits, the algorithm may also be used to simulate periodic structures.

For this document, the existing GoLightly simulator was modified to facilitate periodic structures. The goals of such modifications include:

1. Unity3D FDTD implementation
2. Unit cell-based simulation definitions.
3. Tiling of image-based crystal unit cells.
4. Mathematically-defined periodic structures
5. Multi-resolution simulation
6. Source wavelength sweep
7. Interactive monitor charting and analysis
8. Summary data export

These modifications are detailed in the following sections.

Unity3D Implementation

The most-recent GoLightly implementation, created in 2015, utilized a combination of C++, NVIDIA CUDA and OpenGL. While effective at the time it was created, several factors indicated that a reimplementation was required for this project.

**References**

**1**Pollock, C. R., and Michal Lipson. *Integrated Photonics* . Boston: Kluwer Academic , 2003. Print.