From the wave to the HOLOGRAM

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OVERVIEW

MEEP (MIT Electromagnetic Equation Propagation) simulation software package was used to **simulate** a basic component of a new theory for **hologram display technology**.

QUESTION

To what extent does the simulation of this basic component align with **numerical/analytical precedent**, and how does this inform related **future** computer simulation-based **research**?

METHODOLOGY

The Python programming language and MEEP were used to create the simulation and run it on an M1 MacBook Air in the following layout (Figure 1).

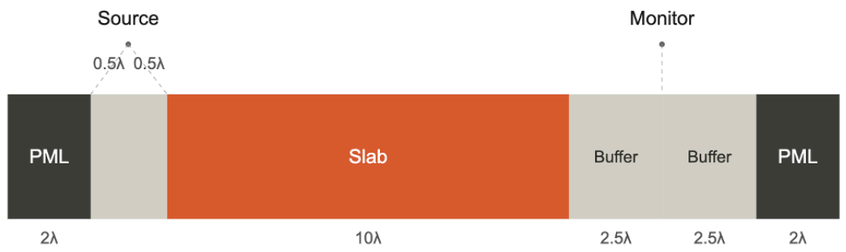


Figure 1: Layout of the 1 Dimensional MEEP simulation domain, established in accordance with best practices for accurate simulation

The wave was emitted from the source and **entered** the slab with **refractive index n** (where $1.1 \leq n \leq 2.0$). At a **temporal boundary** (a boundary in time rather than space), n was instantaneously **changed to 1 (a vacuum)**. This caused the wave to accelerate, increasing the frequency of the wave whilst the wavelength remained the same; the light seen by the monitor was therefore '**blueshifted**'.

RESULTS & CONCLUSION

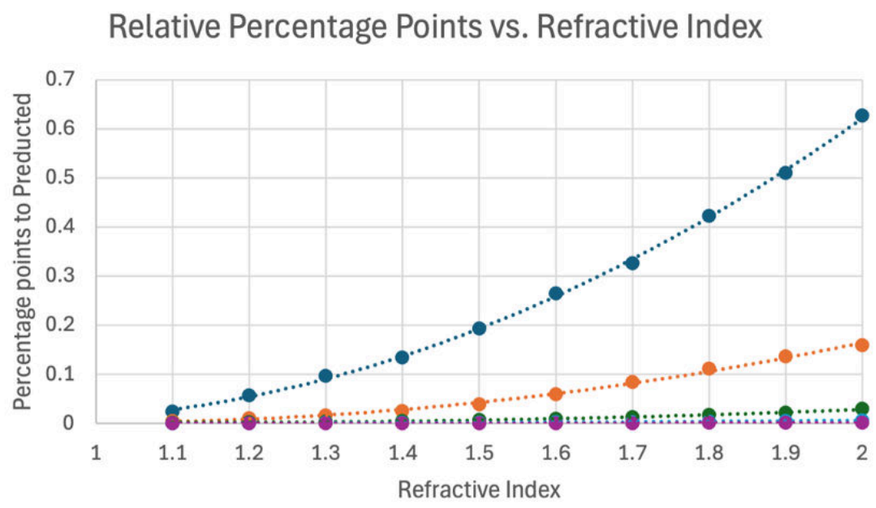


Figure 2: The percentage point increase in positive wavelength relative to the initial refractive index of the transmission medium, plotted for all 5 MEEP resolutions

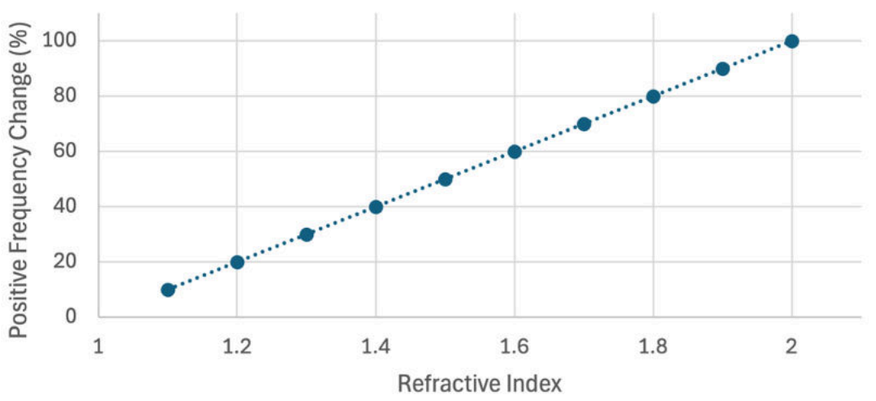
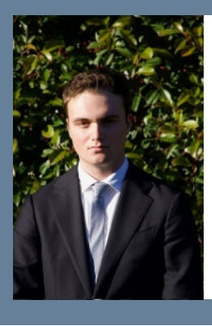


Figure 3: The positive percentage increase in Electroagnetic wave frequency relative to the initial refractive index of the transmission medium at the maximum MEEP frequency of 206.45

The first graph (Figure 2) indicates that varying the simulation resolution caused the results to **converge** to the numerically **predicted outcomes**. The second graph (Figure 3) shows a **strong positive linear correlation (r = 1)** between the initial **refractive index** and the positive **frequency shift**. These results are promising for continued related research.

Image above from Star Wars: Episode I – The Phantom Menace, courtesy of Lucasfilm Ltd. and 20th Century Studios



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