Optimizing Multilayer Photonic Structures

Francis Afzal

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Mentor: Dr. Georgios Veronis
Graduate Student: Christopher Granier
Motivation

- Multilayer photonic structures have applications in light absorption and emission
- Primary motivation is for improving efficiency of solar thermo-photovoltaics
- Secondary motivation is to make these structures work as light emitters
Implementation

- Want to design a structure with high absorptivity at a narrow angular range
Structure

- Made of alternating layers of silicon and silica on top of a tungsten substrate
- Layer lengths are not required to be periodic
We calculate the absorptivity and emissivity of our structures at various wavelengths by using the matrix transfer method.
Method Cont'd

- We use a genetic algorithm to generate and evaluate structures.
- After N generations, the “most fit” structure survives and its absorbing properties are plotted.
Results

- Have analyzed structures optimized for one wavelength at a larger range of wavelengths.
- Have recently modified the code to be able to optimize structures by looking at absorptivity profiles over multiple wavelengths.
Optimized 8 Layer Structure
Optimized 16 Layer Structure
Optimized 32 Layer Structure
Conclusions

- Now necessary to optimize over multiple wavelengths.
- May need to test different material combinations.
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Questions?