Nanophotonic Modeling
Lecture 4.22: Summary & Conclusions for Unit 4

Prof. Peter Bermel
Photonic Cavity Lasing
Finite Element Method

- In general, we want to apply Galerkin method with trial functions $\eta_j$:
  \[ \int_0^L dx \, \eta_j(x) r_B(x, t) = 0 \]
- Analogy: stuff balloon into box, with each trial function as a single ‘finger’
- FAESOR Modeling Toolbox:
  http://hogwarts.ucsd.edu/~pkrysl/faesor/faesor_publish.html
Thermal Transport Mechanisms

- Convection: heat transfer by surface contact with gas or fluid molecules
  \[ Q = h(T_1 - T_2) \]

- Conduction: volumetric heat transfer by propagation of phonons
  \[ \frac{\partial u}{\partial t} - Q = \alpha \nabla^2 u \]

- Radiative thermal transfer: emission of thermal photons from source to receiver
  \[ \frac{dQ}{d\lambda} = \frac{2\pi hc^2 \varepsilon(\lambda)}{\lambda^5 \left[ e^{hc/\lambda kT} - 1 \right]} \]
FEM Modeling Steps: Thermal Conduction

\[ c_v \frac{\partial T}{\partial t} - \nabla \cdot [\kappa (\nabla T)^T] - Q = 0 \]

1) Define material constants and system parameters
2) Define geometry and initiate `targe2_mesh`er
3) Create material objects (blocks of cells)
4) Apply initial conditions and generate system matrices
5) Solve for heat field and iterate over time

* http://hogwarts.ucsd.edu/~pkrysl/faesor/
Selective Thermal Radiation Enabled by 2D Photonic Crystals

Optimizing Thermal Emission with Integrated Filters


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