Scattering and resonances of thin dielectric structures*

In this work we consider both wave scattering and the computation of resonance values of a thin structure with large refraction index. The Helmholtz equation with a variable coefficient models the wave phenomena. The scatterer is assumed to have a high (possibly periodic) index of refraction while at the same time it is very small in one of the dimensions. We show that if the index scales as $O(1/h)$, where h is the thickness of the scatterer, then approximate solutions, based on perturbation analysis can be obtained. For the scattering problem the approximate solution consists of a leading order term plus a corrector, each of which solves an integral equation in two dimensions for a three dimensional problem. We provide error analysis on the approximation. The approximate method can be viewed as an efficient computational approach since it can potentially greatly simplify scattering calculations. For the resonance problem, we examine the perturbation approach as a means to calculate resonance modes. Applications in mind are for the modeling and optimal design of photonic bad gap materials.

* joint work with J. Gopalakrishnan, F. Santosa, and J. Zhang