RE: Why Form 1 converges much slower than Form 1P on this problem?

Dear all,

Currently I am trying to solve a very simple 2D electromagnetic problem with GetDP, which is the transmission of plane wave through a dielectric slab.

My simulation configuration is shown as Figure 1.

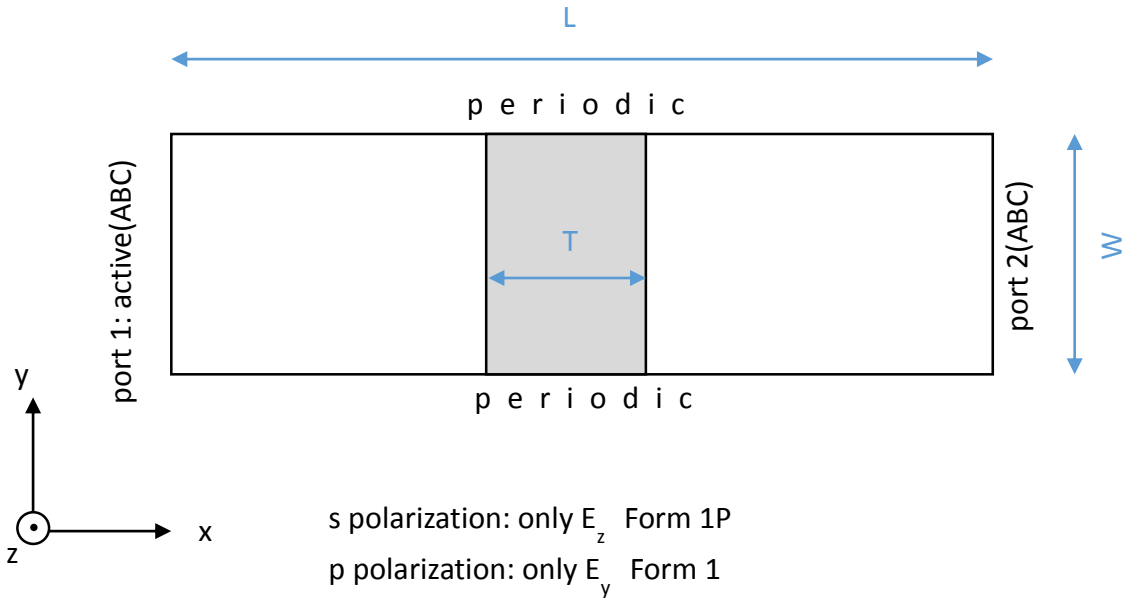

Figure 1 A schematic of simulation configuration

It is a slight modification from the waveguide example on OneLab website. A high index slab (n=3.5) with thickness T is inserted in the middle of the simulation region. The upper and lower boundaries are changed from PEC to periodic to represent the infinity slab structure. The mode on port 1 is changed to plane wave. I simulated this structure to get the transmission spectra (S21) in two different ways with different polarizations:

1. s-polarization: the electric field is perpendicular to the 2D plane (E_z). The simulation is in Form 1P.
2. p-polarization: the electric field is parallel to the 2D plane (E_y). The simulation is in Form 1.

In principle, these two approaches represent the same configuration, which is the infinitely extended slab with the normal incident light. However, Form 1P converges much better than the Form 1. The result is shown as Figure 2. The analytical result from transfer-matrix method is also shown for reference. For s-polarization and Form 1P, all curves with different resolutions are overlap with each other and match well with the analytical result even with only 3 grid points per wavelength. However, for p-polarization and Form 1, there is a systematic shift to the higher frequency (lower wavelength) when the resolution is reduced. Even with 7 grids per wavelength, there is a large discrepancy to the analytical result.

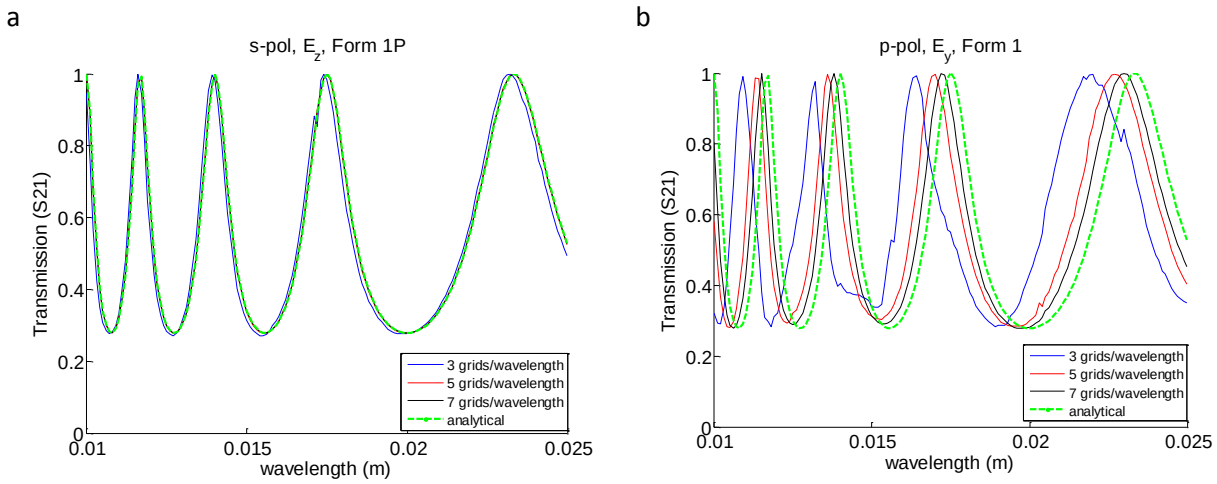

Figure 2 Transmission spectra with differennt resolutions (a) Form 1P (b) Form 1

I wonder why there is a huge difference between Form 1P and Form 1 and whether I can modify my code in Form 1 to have the similar accuracy as Form 1P. It would be nice that I have similar accuracy with Form 1. My final goal is to simulate 3D structures (in Form 1P) and this shift is also observed in my 3D simulations.

Here is some thoughts from my intuition. The blue shift of the spectra can be caused by the effectively thinning of the high index material. I suspect that I missed defining the proper basis for the surface such that the grid at the interface is not considered as the high index material. The lower the resolution, the larger the surface grid, thus the thinner the effective slab thickness.

I attached my code for both Form 1 and Form 1P with this mail and matlab (octave) scripts to run the batch simulation and plot the result. I appreciate any kind of comments. I really want to know whether this is the bug in my (OneLab) code, or bug in GetDP or just fundamental limitation in the finite-element method.

Regards,

Peter