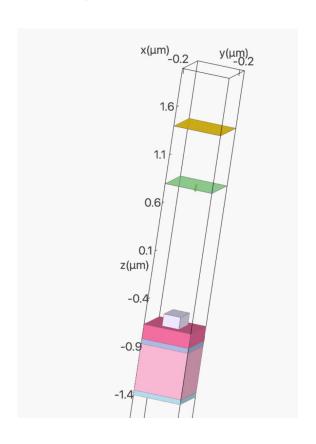
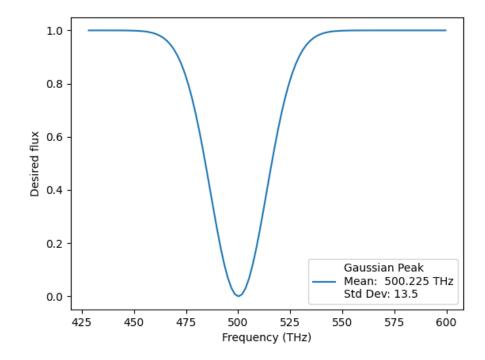
Week 05 Design Summary

Jax version

Objective

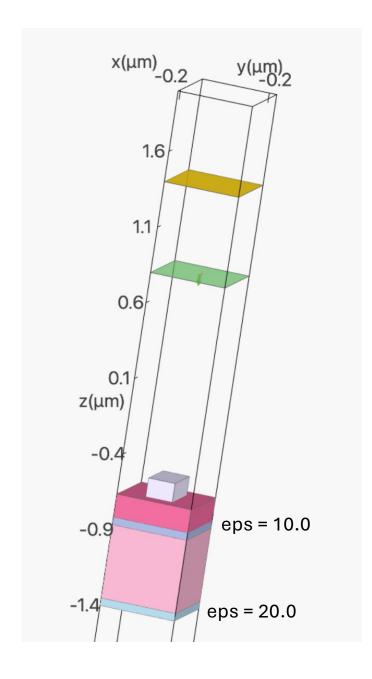




Methodology

- Simulation parameters
 - Simulated range: [0.5 um, 0.7 um], [428 THz, 600 THz]
 - Center: 0.6 um, ~500 THz
 - Metals replaced with fixed size (t = 50 nm) high-k dielectric slabs
 - Shut off: 1e-6 (by default 1e-5)
- Evaluation function

$$e = \sum_{k=0}^{n-1} (D[k] - G[k])^2$$



Methodology

Optimization range of design parameters

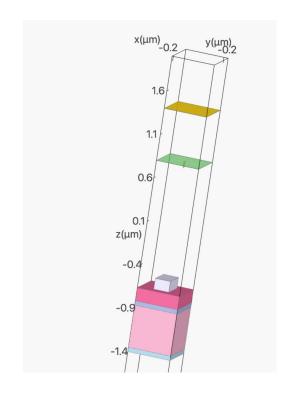
Substrate 1	Substrate 2		Cuboid width	Cuboid height
[0.05, 0.5] um		[0.1, 0.5] um		

Optimization loop

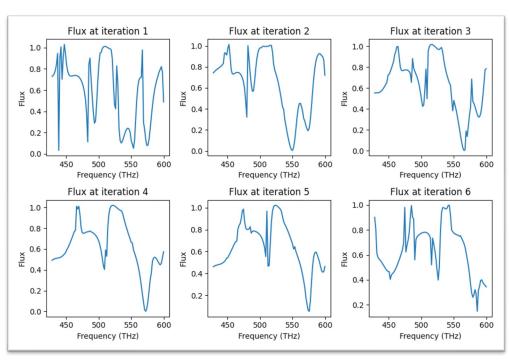
• Number of iterations: 6

• Step size: 0.1

• Starting point: slightly below the mid point



Results: silica (eps = 3.9)

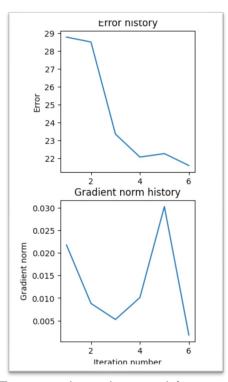


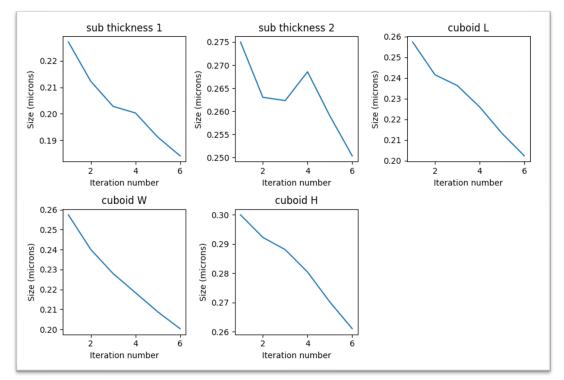
Iteration 1 Iteration 2 Iteration 3 1.0 1.0 0.5 0.5 0.5 Residue error 9.0 9.0 Residue error Residue error 0.0 0.0 0.0 -0.5 -0.5 -1.0-1.0-1.0450 500 450 600 500 600 Frequency (THz) Frequency (THz) Frequency (THz) Iteration 4 Iteration 5 Iteration 6 0.5 Residue error 0.0 0.0 Residue error Residue error 0.0 0.0 -0.5-1.0-1.0500 500 550 450 550 600 600 500 550 Frequency (THz) Frequency (THz) Frequency (THz)

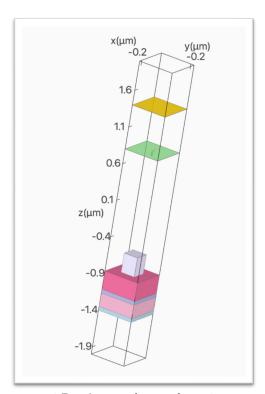
Flux history

Residue error history

Results: silica (eps = 3.9)





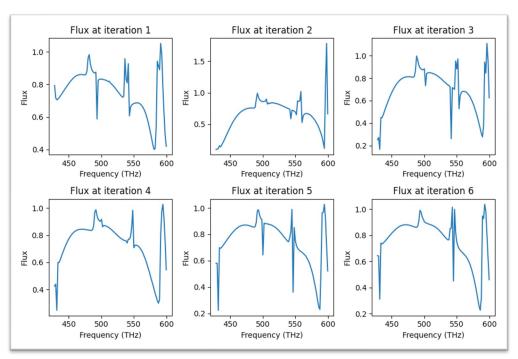


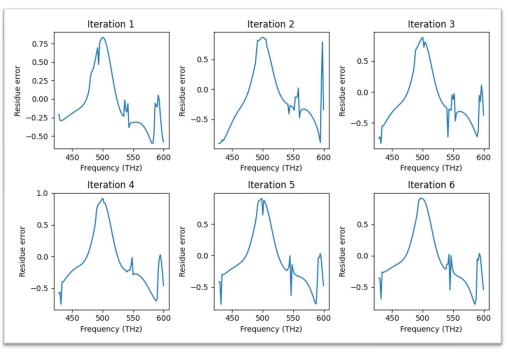
Error and grad norm history

Design history

3D plot at iteration 6

Results: TiO_2 (eps = 2.25)

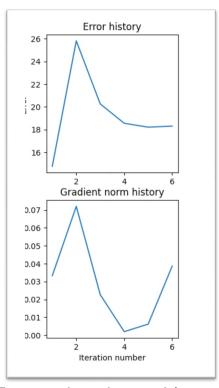


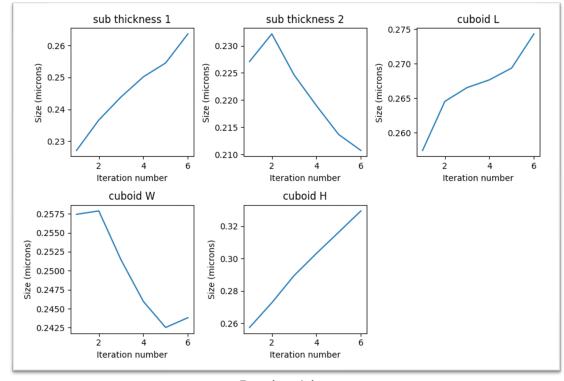


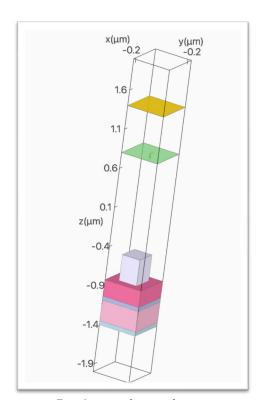
Flux history

Residue error history

Results: TiO_2 (eps = 2.25)







Error and grad norm history

Design history

3D plot at iteration 6

Some reflections

- Time consuming
 - Not sure of autograd's speed, but tidy3d+jax requires ~15 min per iteration for this application, depending on materials.
- Shut-off value plays an important role
- Off peak?
 - Target at 500 THz but peaked at other frequencies and got stable.