Hw3 Theory

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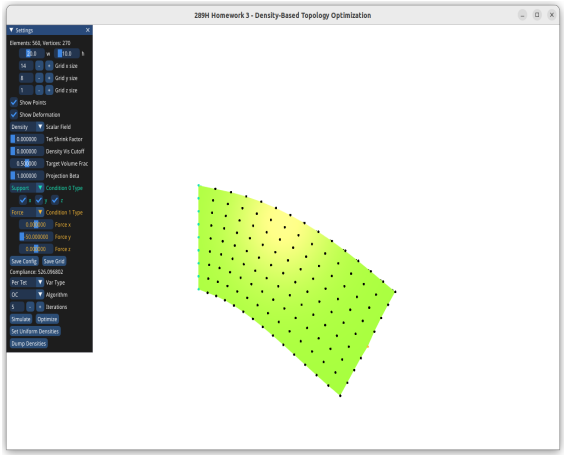
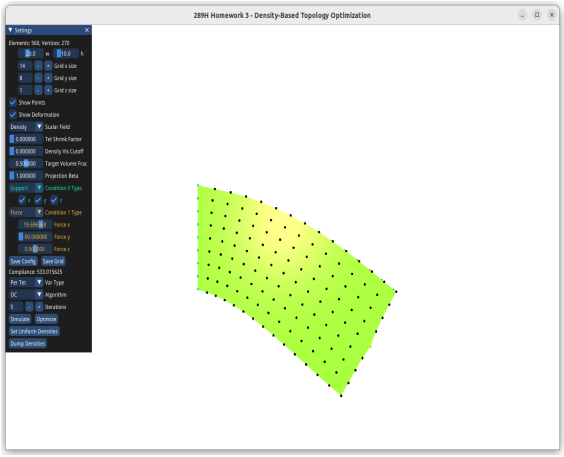
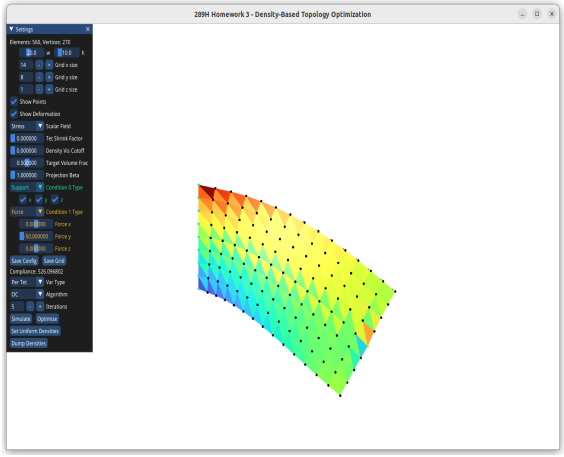
1 Uniform Density design



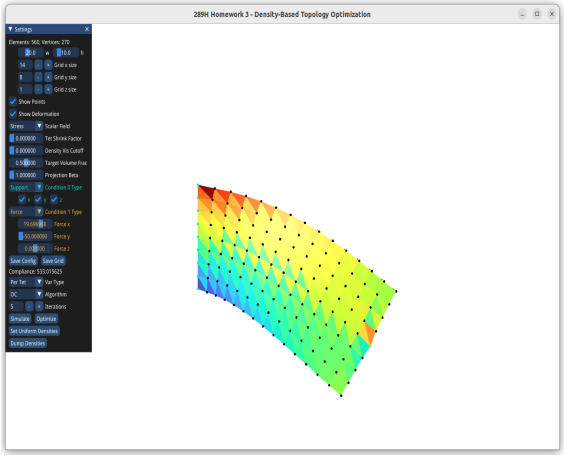
(a) -y direction force; compliance: 526.09



(b) -y and x direction force; compliance: 533.01



(c) stress field of (a)

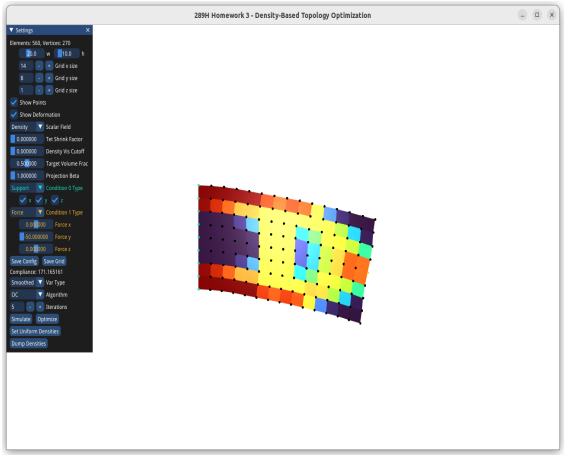


(d) stress field of (b)

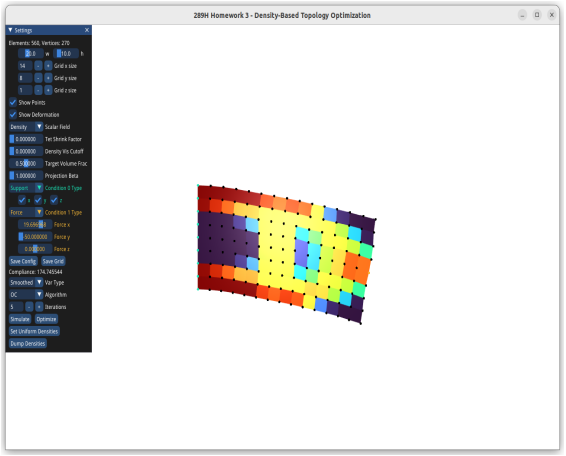
Figure 1: Simulation on uniform-density design

Uniform-density design withstands simulation of both y and x-direction forces. The elements move toward the direction of load. Through (c) and (d) we can see that the upper support elements bear higher stress while the lower support elements has smaller stress.

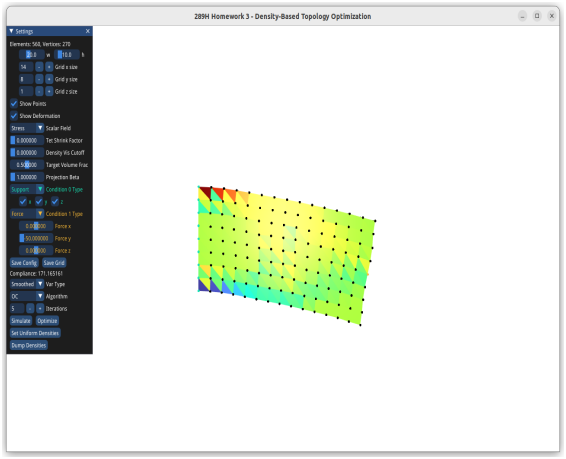
2 Density-optimized Design (with smooth filter)



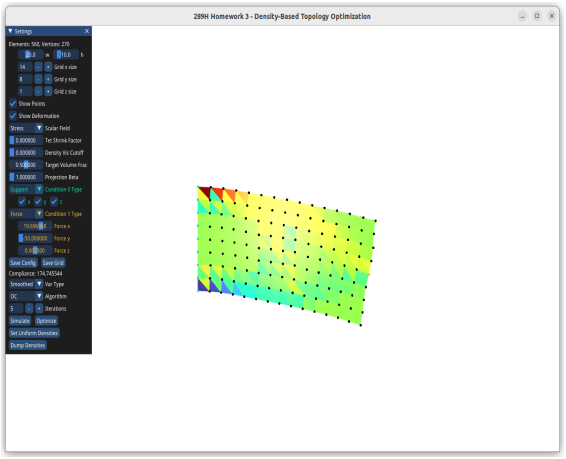
(a) -y direction force; compliance: 171.16



(b) -y and x direction force; compliance: 174.74



(c) stress field of (a)



(d) stress field of (b)

Figure 2: Simulation on optimal density design (with smoothed variables)

After optimizing the densities under -y direction load, the simulation shows much lower compliance than uniform-density design under same load. This optimization design also withstands perturbation along other directions. The stress field shows smaller stress difference of the upper and lower support elements than uniform-density design.

3 Discussion

Density-based optimization of elastic object handles perturbations better than area-optimization of truss, as the latter structure "breaks" when simulated with perturbation and compliance soars.