AMLAS (AERO 689) Assignment #1

Topology Optimization for Structures

Objective We want to perform topology optimization for a load bearing cantilever. The initial workspace will be a rectangular bar as shown in the figure below. We are interested in determining the optimal topology of the structure

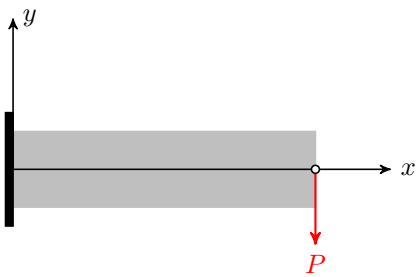

Figure 1: Cantilever beam with load P applied at the end. The length of the cantilever is L and the thickness is w.

that can carry a load of P.

Representation

1. Discretize the structure with a fine rectangular grid of points. These will define the nodes. These nodes will be equally spaced with constant dx and dy. Values of dx and dy will define how fine the mesh is.

2. Only those nodes that are attached to the left fixture will have reaction forces acting on them. All other nodes will be free and not have any reaction force acting on them.

3. The members will be defined using nearest neighbor algorithm. A given node will be connected to nodes that are within $\sqrt{dx^2 + dy^2}$ distance. The connectivity matrix will be generated using this information. Make sure you do not have duplicate members.

4.

5. Solve the optimization problem for the minimum mass. Prove that the structure's mass is equivalent to weighted 1-norm of the force densities.

For this assignment, only consider equilibrium condition. Therefore, you problem will be very similar to the problem solved in class, except the const function.

6. Choose a material of choice, and compute the minimum radius of each member from the yield stress (tensile members) and buckling stress (compressive members). Compute the mass of the total structure from this information.

Your answer should look similar to the following image, for the dimensions chosen. Good luck!