

Figure 8: Optimized shape of the hole using the proposed bi-fidelity algorithms. Initial shape is shown using a dashed line. Note that, two-fold symmetry is assumed here.

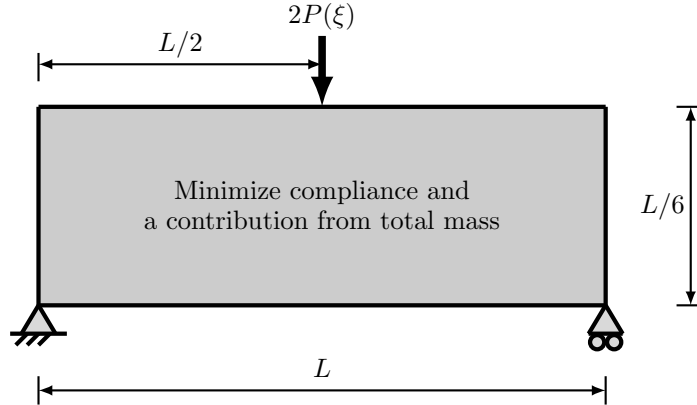


Figure 9: Schematic of the beam problem of Example III (a) (design domain is shown as the shaded region).

optimization problem, and use some parts of the widely-used 99 line topology optimization code in [92]. In SIMP, the material properties are interpolated by a power-law model in terms of the density ρ of a fictitious porous material, *e.g.*,

$$E(\rho_i) = \rho_i^{\beta_P} E_0; \quad 0 < \rho_i \leq 1; \quad i = 1, 2, \dots, N_e, \quad (35)$$

where β_P is a penalization parameter and E_0 is the bulk material's elastic modulus. For the formulation of the optimization problem considered here and $\beta_P > 1$, intermediate densities are penalized as compared to densities closer to zero or one. We use $\beta_P = 3$ in the present work. To avoid a checker-board design, we use filtered values of the design variables θ to define the material density ρ [94–97]. This density filter is applied to the e th element as follows

$$\rho_e = \frac{1}{\sum_{i=1}^{N_e} H_i} \sum_{i=1}^{N_e} H_i \theta_i, \quad (36)$$