

# Parametric shape optimization using FreeFEM

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The objective of this work is to study the shapes which minimize certain functionals which are computed via a partial differential equation or an optimization problem to the given geometry. Many such questions arise when working on theoretical problems in shape optimization and numerical computations may give valuable insight regarding the geometry of the optimal shapes. Given an explicit parametrization of the shape, FreeFEM is used to generate the associated mesh (2D, surface and 3D), compute the objective function and modify the shape in order to improve the objective function.

The usage of the support function in order to model numerically constraints like convexity, constant width or diameter will be illustrated for functionals obtained by solving some PDEs. These constraints will be handled with the IPOPT library in FreeFEM.

The usage of a radial parametrization will also be illustrated when dealing with 2D, surface and 3D meshes in FreeFEM, for maximizing the length of the minimal perimeter partitions. The library Nlopt LBFGS will be used in order to compute the functional to be optimized.