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PDE-Driven Shape Optimization via a Fixed-Domain Method: Analysis and Numerical Results

A fixed-domain approach for the solution of shape optimization problems governed by elliptic partial differential state equations with Dirichlet boundary conditions is presented. The method involves extending the state equation to a larger domain using regularization, and encoding the unknown shape domain via a controlled shape function. Results include the convergence of the method as well as differentiability of the control-to-state operator. An algorithm for the numerical implementation is provided as well as corresponding numerical results.