

## Moreau-Yosida Regularization in Shape Optimization with Geometric Constraints

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In the context of shape optimization with geometric constraints we employ the method of mappings (perturbation of identity) to obtain an optimal control problem with a nonlinear state equation on a fixed reference domain. The Lagrange multiplier associated with the geometric shape constraint has a low regularity (similar to state constrained problems), which we circumvent by penalization and continuation scheme. We employ a Moreau-Yosida-type regularization and assume a second-order condition to hold. The regularized problems can then be solved with a semismooth Newton method and we study the properties of the regularized solutions and the rate of convergence towards a solution of the original problem. A model for the value function in the spirit of Hintermüller and Kunisch is introduced and used in an update strategy for the regularization parameter. The theoretic findings are supported by numerical tests.