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Continuation methods for higher-order density-based topology optimization

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We aim to solve a topology optimization problem where the distribution of material in the design domain is represented by a density function. To obtain candidates for local minima, we want to solve the first order optimality system via Newton's method. This requires the initial guess to be sufficiently close to the a priori unknown solution. Introducing a stepsize rule often allows for less restrictions on the initial guess while still preserving convergence. In topology optimization one typically encounters nonconvex problems where this approach might fail. We therefore opt for a homotopy (continuation) approach which was first introduced in the 1980s and is based on solving a sequence of parameterized problems to approach the solution of the original problem. The arising Newton-type method also allows for employing deflation techniques for finding multiple distinct solutions as well as for efficiently tracing Pareto optimal points in multi-objective optimization problems.
We show numerical results for the design optimization of an electric machine.

Author: WINKLER, Michael (RICAM)

Co-author: GANGL, Peter (Johann Radon Institute for Computational and Applied Mathematics (RICAM), Austrian Academy of Sciences)

Presenter: WINKLER, Michael (RICAM)

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