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Limiting Descent Directions in p-Harmonic Shape Optimization

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Shape optimization constrained to partial differential equations is a vibrant field of research with high relevance for industrial-grade applications. Recent developments suggest that using a p-harmonic approach to determine descent directions is superior to classical Hilbert space methods. This applies in particular to the representation of kinks and corners in occurring shapes. However, the approach requires the solution of a vector-valued p-Laplace problem with a boundary force for each descent direction. We present an algorithm to solve these problems for finite p efficiently and discuss extensions to the limit setting. A key challenge in this regard is that the Lipschitz deformations obtained as solutions in limit setting are in general non-unique. Thus, we focus on solutions which are in a sense limits to solutions for finite p and aim to preserve mesh quality throughout the optimization.

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