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Relaxed error control in shape optimization that utilizes remeshing

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Abstract

Shape optimization strategies based on error indicators usually require strict error control for every computed design during the optimization run. The strict error control serves two purposes. Firstly, it allows for the accurate computation of the structural response used to define the shape optimization problem itself. Secondly, it reduces the discretization error, which in turn reduces the size of the step discontinuities in the objective function that result from remeshing in the first place. These discontinuities may trap conventional optimization algorithms, which rely on both function and gradient evaluations, in local minima. This has the drawback that multiple analyses and error computations are often required per design to control the error. In this study we propose a methodology that relaxes the requirements for strict error control for each design. Instead, we rather control the error as the iterations progress. Our approach only requires a single analysis and error computation per design. Consequently, large discontinuities may initially be accommodated; their intensities reduce as the iterations progress. To circumvent the difficulties associated with local minima due to remeshing, we rely on gradient-only optimization algorithms, which have previously been shown to be able to robustly overcome these discontinuities.