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Multiscale structural topology optimization

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Abstract

This work develops firstly a nonlinear framework for concurrent topology optimization of material and structure. It has been shown that though linear models are assumed at both scales, the structural equilibrium is in general nonlinear due to the adaptation of local material microstructures. Secondly, the new regime of nonlinearity due to material optimization is approximated by a precomputed database model. As a result of this off-line step, the effective strain-energy and stress-strain relations required for the concurrent design are provided in a numerically explicit manner, which significantly reduces computational cost and enables design of larger-scale problems.

Keywords: model reduction; homogenization; multiscale analysis; topology optimization.