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Isogeometric shape design optimization of elastic structures using boundary integral equation

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Abstract

This paper presents the configuration design sensitivity analysis (DSA) method for two-dimensional elastic structures using an isogeometric method for the boundary integral equations. The shape variation of a domain naturally occurs in both shape and orientation, so-called configuration variation in a boundary integral equation method (BIEM). In the isogeometric approach, the NURBS basis functions used in CAD system are directly utilized in the response analysis, which enables a seamless incorporation of exact geometry and higher continuity into the computational framework. Furthermore, the boundary integration method (BEM) is more suitable in isogeometric concept without additional domain parameterization and thus CAD friendly. To enhance accurate configuration sensitivity, CAD-based exact geometric model and higher-order geometric information such as normal and tangent vectors are exactly embedded over the whole design space. The necessary configuration velocity fields is analytically decomposed into CAD-based exact shape and orientation velocity fields point- wisely, which leads to accurate analytical sensitivity analyses and a precise optimization result. Through the numerical verification, it is demonstrated that the consideration of orientation variation and higher-order geometric information provides accurate configuration sensitivity. Also, it turns out that the proposed method works very well in optimization problems.