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SENSITIVITY ANALYSIS AND SHAPE OPTIMIZATION USING ISOGEOMETRIC BOUNDARY ELEMENT METHODS

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Isogeometric analysis (IGA) was firstly proposed by Hughes et al. [1] to integrate the numerical analysis and Computer Aided Design (CAD). IGA takes advantage of the basis functions initially used to generate geometric model to approximate the unknown fields during analysis. An immediate advantage is that mesh generation is circumvented and the exact geometry is kept at all stages of analysis.

However, IGA needs a domain discretization but CAD only constructs the surface of the geometry. This confliction can be solved naturally by isogeometric boundary element methods (IGABEM). IGABEM is a combination of boundary integral equation and CAD, and only requires quantities pertaining to the boundary of the problem for analysis. The method has been applied using NURBS for 2D linear elasticity [7] and for shape optimisation in 3D [2]. More recently, a BEM T-spline discretisation strategy has been applied in 3D linear elasticity [4].

The present paper applied IGABEM to sensitivity analysis and shape optimization. Shape optimization is an iterative process and the geometry needs to be updated. A remeshing procedure in traditional analysis can be extremely time consuming. In contrast, IGABEM is without the need of remeshing and exhibits huge advantages in efficiency. Furthermore, IGABEM satisfies the high requirement of geometry accuracy for shape sensitivity analysis. In the present paper, we use T-splines as basis functions for IGABEM, which produce water-tight geometries and allow local refinement compared to NURBS. The optimization solver is gradient based, and a sensitivity analysis is conducted using implicit differentiation and a regularised form of the boundary integral equation [3]. Through the three dimensional benchmarks in linear elastostatic problems, we show that accurate results can be obtained with the efficiency of analysis.

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