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Shape optimization of fluid-structure interface based on spline finite element method

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In this study, a shape optimization based on spline finite element (FEM) method with trimmed surface analysis (TSA) is applied to the design of fluid-structure interface which is a multi-physics interface. At the fluid-structure interface, interactions between the fluid and the structure occurs actively. In the optimization based on spline FEM, boundaries of the shape are represented neatly and smoothly by using spline shape functions without any additional efforts. Hence, design-dependent loads can be treated with ease. Also another issue in the conventional cell-based optimization considering a fluid-structure interaction is large mesh distortions of fluid meshes around the structure due to the huge difference in stiffness between the fluid and the structure. The problem can be solved with using TSA in which only trimming curves are moving on the fixed background NURBS surface. These features make TSA suitable for the optimizations considering a fluid-structure interaction.

Keywords: Shape optimization, Spline finite element method, Fluid-structure interaction, Design-dependent load