

Casting constraints in structural optimization via a level-set method

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ABSTRACT

Shape and topology optimization via a level-set method [2, 5] has started attracting the interest of an increasing number of researchers and industrial designers over the last years. Beyond its flexibility to perform changes in the topology of the shape, its independence on the objective function to be minimized expands significantly its range of applicability.

Industrial applications frequently impose strong constraints on the geometry of the optimized structure. A significant category of such structures is cast parts, i.e. parts intended to be constructed by casting. In this case, liquid metal is poured into a cavity (die) and the final structure is obtained after the cooling of the metal and removing the dies. Thus, the shape of the cast part should allow the removal of the dies (molding constraint) [4].

In this work, we propose a general method for handling the molding constraint. Based on the signed-distance function, we formulate a molding constraint that guarantees the feasibility of the optimized structure. A simple projection method for the velocity field [4] is applied in a first step. Once the optimized shape violates thickness constraints [1] imposed on the cast part, this projection method is no longer sufficient and the molding constraint is applied at the same time with thickness control. We apply a penalization method to impose the constraints and compute a shape derivative [3] for the objective function. We show examples in 3-d.

References

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