Related problems to shape optimization in fluid mechanics

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1. INTRODUCTION

Among the disciplines of computer sciences, CAD/CAM/CAE is one of the most useful in the engineering due to its possibility to create simulations of the behaviour of a object under certain conditions without the complication of materialize it.

One of the advantages of CAD packages is the possibility to emulate fluid flow conditions in an object. This information can be used to change the shape of it under a optimally criteria.

2. PROBLEM

- **Given:** A incompressible Newtonian fluid in R^2, which presents constant density ρ and viscosity μ, steady laminar flow with streamlines parallel to X axis and velocity V_∞. A rectangular segmented object in R^2 placed with its normal vector perpendicular to XY plane and the smallest dimension perpendicular to the streamlines of the fluid flow.

- **Goal:** To obtain a optimal shape of the object such that the change of direction in the velocity vectors is minimal.

3. RELATED WORKS

3.1 Flow Complex

The goal of this algorithm is to reconstruct a surface from a given a set of points, but they are constrained to lie on the surface of some solid [1].

3.2 Isogeometric shape optimization in fluid mechanics

This work uses isogeometric shape optimization to implement it in many applications, like body with uniform pressure, minimal drag or pipes with minimal pressure drop. The goal is thus to minimize the cost function, which depends on the velocity u, pressure p, and boundary domain Γ'.[2].

The method has two phases: Initialization and Optimization.

- **Initialization:** In the initialization phase, the algorithm uses B-spline a and NURBS for the geometry and parametrization of the body. In the flow analysis the Navier-Stokes equation and the incompressibility condition are solved.

- **Optimization:** In the optimization phase an iterative, gradient-based, non-linear optimizer is employed to reduce the cost function.

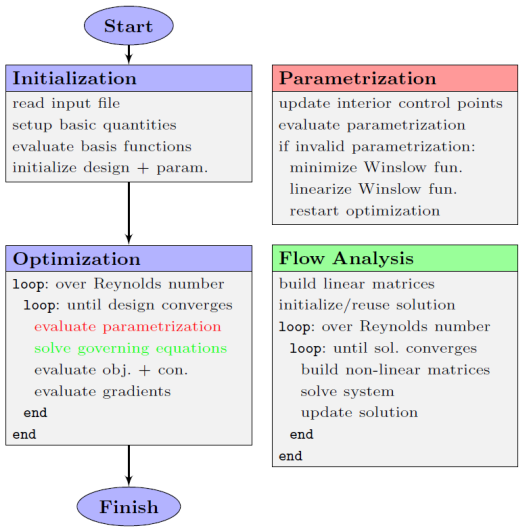

Figure 1: Flow chart for the optimization process (left) with details of the parametrization and analysis procedures (right) [2].

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4. REFERENCES

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