Adjoint-Based Optimization Under Uncertainties on FSI Systems for Applications in Hemodynamics.

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Kurzgefasst

- Numerical Investigation and Robust Optimization of Hemodynamic Applications

The project is part of the ”SENSUS” (Simulationsbasierte Entwurfsoptimierung Dynamischer Systeme unter Unsicherheit) research training centre at the interface between applied mathematics and computational engineering. The research involves 6 teams from mathematics as well as fluid dynamics and structural engineering from three Hamburg universities and is funded by a Landesexzellenzinitiative of Hamburg. The training centre was established in July 2020 for a period of 3,5 years.

The present proposal targets to advance adjoint-based design optimization procedures towards fluid-structure interaction (FSI) problems under the influence of uncertain parameters, e.g. flow conditions and fluid parameters. The applications are to be directed towards hemodynamics. For the purposes of the project, the (RANS/LES) Navier-Stokes FreSCo$^+$ code is to be used and further developed (for the fluid part of the FSI system). It employs the finite volume method (FVM) for the numerical solution of the primal and dual (adjoint) equations of laminar or turbulent flows.

The work is primarily concerned with the application of gradient-based shape optimization [1-2] for hemodynamic FSI systems, e.g. artificial arteries. The objective function will be closely related to blood damage indices (metrics). During the first year (2020-21) the project will focus on (1) the development of appropriate blood-damage objective functions, their coupling with the CFD solver as well as their inclusion in the adjoint formulation and (2) a primal FSI formulation of the problem.

At a later phase, the adjoint FSI formulation as well as the robustness of the design will be taken into account by considering inflow and material variables under uncertainties.

WWW

http://www.tuhh.de/fds

Weitere Informationen

[1] Kröger, J., Kühl, N., Rung, T. Adjoint Volume-of-Fluid Approaches for the Hydrodynamic Optimisation of Ships. *Ship Technology Research* (2018) 65, pp. 47 – 68 doi: 10.1080/09377255.2017.1411001

[2] Kröger, J., Rung, T. Cad-free hydrodynamic optimisation using consistent kernel-based sensitivity filtering. *Ship Technology Research* (2015) 62, pp. 111 – 130 doi: 10.1080/09377255.2015.1109872

Projektpartner

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Förderung

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