TECHNISCHE UNIVERSITÄT DRESDEN

Institut für Strömungsmechanik, Professur für Strömungsmechanik

Vortrag

A fluid-structure interaction approach for the simulation of biological flows

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Fluid-structure interaction (FSI) problems are found in many engineering areas and their computational modeling is particularly challenging. Among different FSI problems, biological applications are becoming of ever increasing interest in the scientific community. In such cases, describing the dynamics of the interaction between the body and the fluid is not a trivial task, since the numerical method needs to be able to handle in an efficient way complex and very thin geometries undergoing large deformations, while preserving accuracy.

In this seminar, a versatile numerical method is presented to predict the fluid-structure interaction of bodies with arbitrary thickness immersed in an incompressible fluid, with the aim of simulating different biological engineering applications. A direct-forcing immersed boundary method is adopted, based on a moving-least-squares approach to reconstruct the solution in the vicinity of the immersed surface. A simple spring-network model is considered for describing the dynamics of deformable structures, so as to easily model and simulate different biological systems that not always may be described by simple continuum models, without affecting the computational time and simplicity of the overall method. The fluid and structures are coupled in a strong way, in order to avoid instabilities related to large accelerations of the bodies. The effectiveness of the method is validated by means of several test cases involving: rigid bodies, infinitely thin elastic structures with mass, flapping flags and inverted flags in a free stream, with a very good agreement with available experimental data and numerical results obtained by different methods.

Finally, the blood dynamics through artificial heart valves is selected as a case study. Realistic geometries for three valves (bi- and tri-leaflet mechanical, bio-prosthetic) and ascending aorta are considered under pulsatile flow conditions. The numerical tool presented is able to reproduce accurately the flow and structure dynamics, giving results in good agreement with experimental data obtained for similar configurations. Even in the case of a bio-prosthetic valve, where the thin leaflets are significantly deformed by the fluid in which they are immersed, the solver is able to manage high pressure differences across the surface, still obtaining very smooth hydrodynamic forces.

Termin: **23. Oktober 2017, 11:00 Uhr**
Ort: **Zeuner-Bau, Raum 252**

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