Hessisches Kompetenzzentrum
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Numerical Simulation of Physiological Pulsuating Flows in Aneurysm Models



Project Manager
Maximilian Bopp

Researchers
Sebastian Wegt

Principal Investigator
Prof. Dr.-Ing. Suad Jakirlic

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Introduction

In the present investigation, the Lichtenberg supercomputer was used for the numerical simulation of steady and physiological pulsuating flows in aneurysm models. The goal of this research is the validation of different numerical codes for difficult flow configurations and the calculation of wallshearstresses in healthy and damaged aortic blood vessels during a cycle of a human heartbeat.

Methods

The Reynolds-averaged-navier-stokes (RANS) simulations have been performed using different reynoldsstress models developed by the Institute of Fluid Mechanics and Aerodynamics (SLA). Steady and pulsuating velocity field data from a magnetic resonance velocimetry (MRV) of an equal flow configuration is used for validation of the numerical codes and results.

Results

The first part of the current investigation addresses the steady and pulsuating flow through a healty aortic blood vessel. The simulated data is compared to the corresponding MRV data and literature data. The comperison shows a high correnpondence between the different results. The numerical codes are thereafter able to calculate steady and pulsuative flow through a simple aortic blood vessel geometry. After the successful validation of simple flow configurations in the first step, a more

complex flow configuration is calculated hereinafter. The second part of the present paper contains the validation of the prior used numerical code for a steady flow through a generic aneurysm.

Discussion

Numerical calculations for a steady aneurysm flow configurations at different reynoldsnumbers are performed. The numerical codes are, as a result of the comperison with corresponding MRV data, able to correctly calculate steady through a generic aortic ameurysm geometry. A pulsuating flow configuration through an aortic aneurysm based on the prior findings is performed. The comparison between the transient MRV data of the pulsuating flow and the numerical data shows a high level of correnpondence. The numerical codes are able to track complicated flow behavior and calculate correct wallshearsstress values over the cycle of a whole heartbeat.

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