

OSHIMA LAB.

Predictive Medicine: Medical Imaging x Blood Flow Simulation x AI



Department of Mechanical and Biofunctional Systems
Center for Research on Innovative Simulation Software (CISS),
Center for Research on Engineering in Medicine and Biology (CREMeB)

Department of Mechanical Engineering,
Interfaculty Initiative in Information Studies

Computational Fluid Dynamics

<https://www.oshimlab.iis.u-tokyo.ac.jp/japanese/>

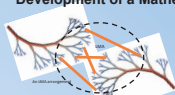
Investigation of Bio/Micro-fluid Mechanics

◆ Objectives

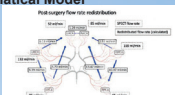
- ❑ To investigate the influences of vascular geometry on hemodynamics
- ❑ To develop a numerical simulation system for clinical diagnosis

1D-0D Simulation

- Assessment of Patient-Specific Collateral Circulation in the Cerebral Peripheral Region through the Development of a Mathematical Model

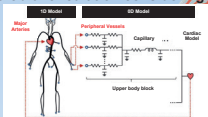
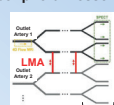


Blood flow redistribution



Simulation Results

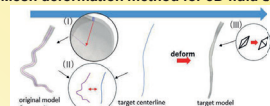
- 1D-0D simulation of cerebral circulation considering peripheral vessels



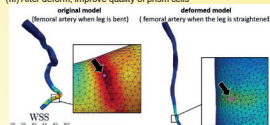
1D-0D Simulation

3D Simulation

- Mesh deformation method for 3D fluid simulation



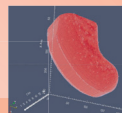
- Correspond prism cells to centerline point
- Calculate parallel and rotational movement from original and target centerline
- After deform, improve quality of prism cells



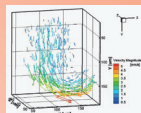
Comparison of the CFD result at correspond surface point with original model and deformed model

Experiment

- Flow measurement for droplet formation inside microchannel using digital holography

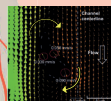


3D interfacial geometry between water and oil



3D flow inside droplet

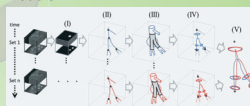
- Simultaneous measurement of the motion of a single Red Blood Cell and surrounding flow using multicolor confocal micro-PIV



Tank-trading motion and surrounding velocity distribution of a single RBC

Data processing

- Designing of modelling system V-modeler



- Segmentation of the vascular lumen
- Centerline extraction
- Surface shape reconstruction
- Shape parameters calculation (curvature and torsion);
- Alignment and position tracking

- Vessel Segmentation, Centerline Extraction, and Bifurcation Detection in cerebral medical images using deep learning-based approaches

