OSHIMA LAB.

Hemodynamic Simulation and in vitro Experimental

Department of Mechanical and Biofunctional Systems
Center for Research on Innovative Simulation Software

Computational Fluid Dynamics
Department of Mechanical Engineering, Graduate School of Engineering/
Interfaculty Initiative in Information Studies

http://www.oshimalab.iis.u-tokyo.ac.jp/

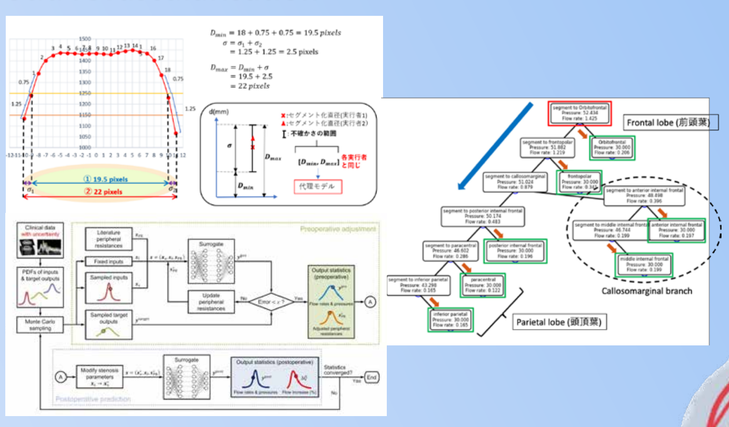
Investigation of Bio/Micro-fluid Mechanics

♦Objectives

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

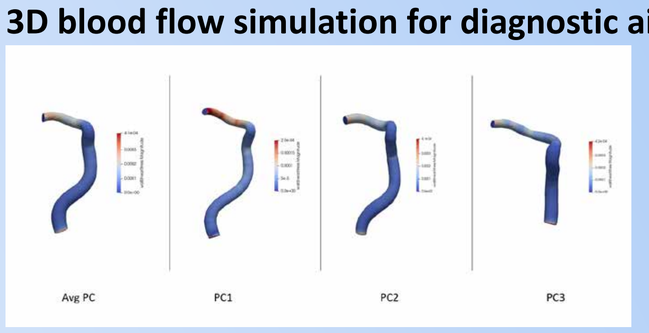
Simulation

● **Probabilistic prediction of the risk of hyperperfusion after carotid revascularisation**



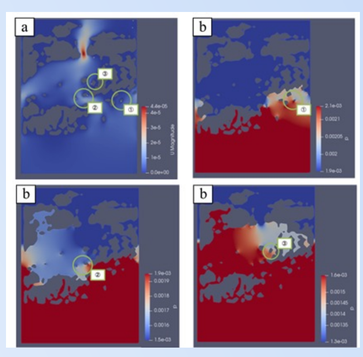
Top left: uncertainty quantification of cerebral artery medical images.
Bottom left: deep neural network surrogate model learned from 1D-0D simulation
Right: anatomy-based modelling of fine peripheral arteries

● **3D blood flow simulation for diagnostic aid**



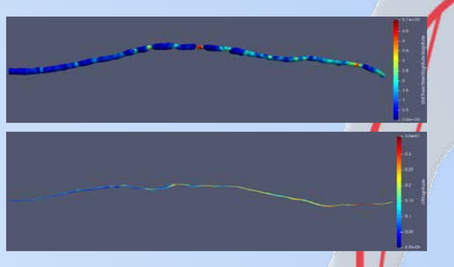
Wall shear stress distribution based on PCA analysis of 104 Internal carotid arteries in BraVa database

● **Multiscale fluid-particle analysis of drug-encapsulated micelles in abdominal aortic aneurysms**



(a) Micelle accumulation points and velocity distribution.
(b) Micelle accumulation points and pressure distribution.

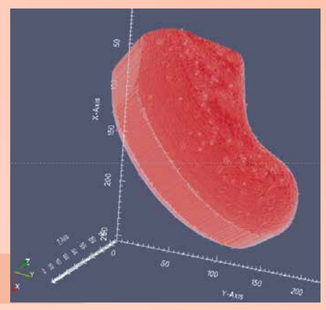
● **Influence of curvature on flow performance inside patient specific femoral artery**



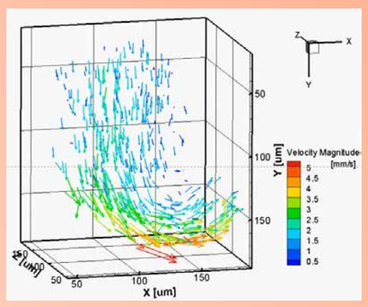
Top: Wall shear stress distribution
Bottom: Streamline

Experiment

● **Flow measurement for droplet formation inside microchannel using digital holography**

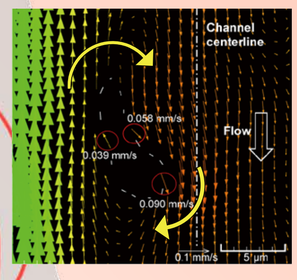


3D interfacial geometry between water and oil



3D flow inside droplet

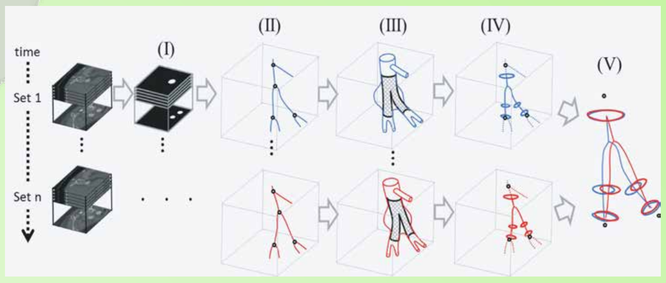
● **Simultaneous measurement of the motion of a single Red Blood Cell and surrounding flow using multicolor confocal micro-PIV**



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

Data processing

● **Designing of modelling system V-modeler**



(I) Segmentation of the vascular lumen
(II) Centerline extraction
(III) Surface shape reconstruction
(IV) Shape parameters calculation (curvature and torsion);
(V) Alignment and position tracking

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