Blood flow simulation, medical imaging, AI, cardiovascular disease De504

OSHIMA LAB.

Medical Image x Simulation x AI

Department of Mechanical and Biofunctional Systems

Bio-microfluidics

Department of Mechanical Engineering, Graduate School of Engineering
Interfaculty Initiative in Information Studies

https://www.oshimalab.iis.u-tokyo.ac.jp/japanese/

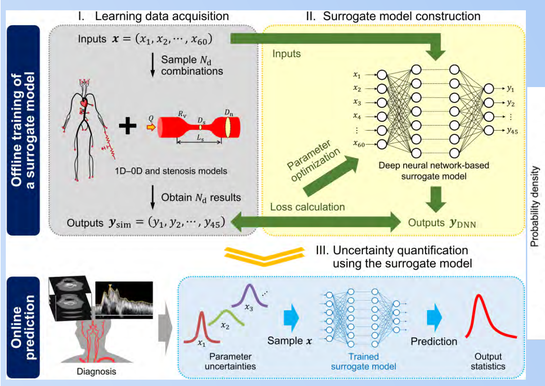
Investigation of Bio/Micro-fluid Mechanics

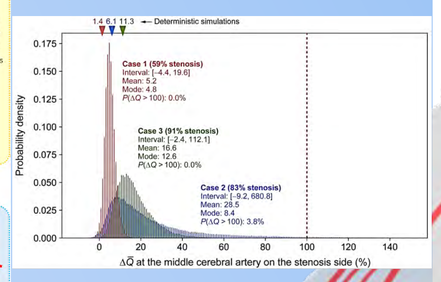
♦Objectives

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

Simulation

● **Uncertainty quantification of hyperperfusion after carotid revascularisation**

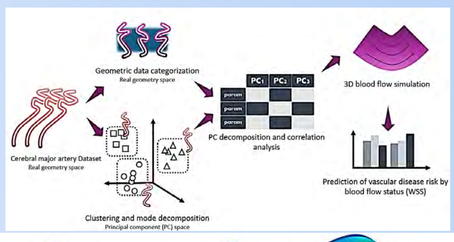




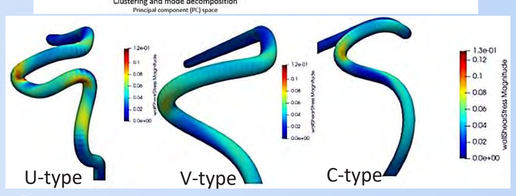
Develop a surrogate model that quickly predicts cerebral circulation for a given condition by machine learning

Overperfusion risk distribution by uncertainty analysis

● **3D blood flow simulation for clinical study**

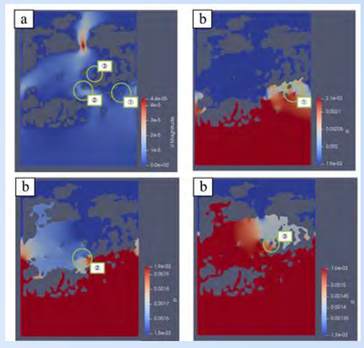


Pipeline of shape analysis by PCA & bloodflow simulation



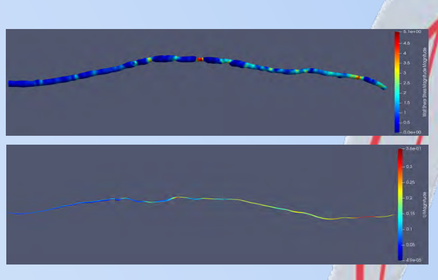
Wall shear stress distribution various geometry classification based on 104 Internal carotid arteries in BraVa database

● **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.

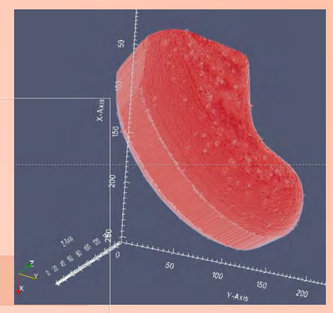
● **Influence of curvature on flow performance inside patient specific femoral artery**



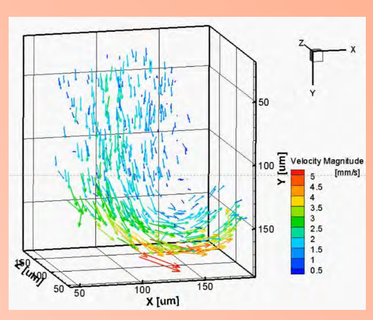
Top: Wall shear stress distribution
Bottom: Streamline

Experiment

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

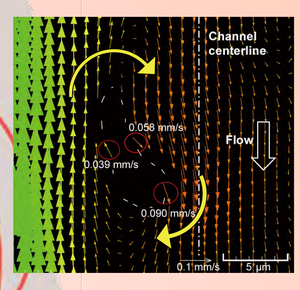


3D interfacial geometry between water and oil



3D flow inside droplet

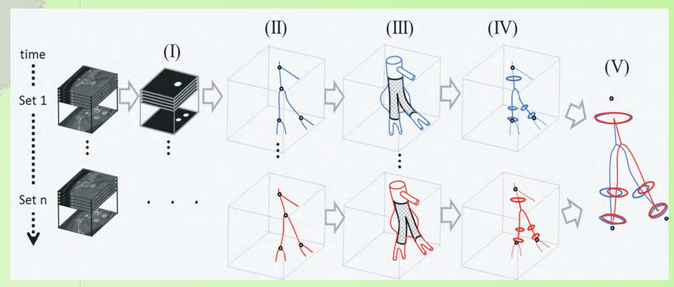
● **Simultaneous measurement of the motion of a single Red Blood Cell and surrounding flow using multicolor confocal micro-PIV**



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