3D movie and demo experiment are being displayed!!

OSHIMA LAB.

[Bio fluid mechanics, micro-fluid and biochemical system]

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

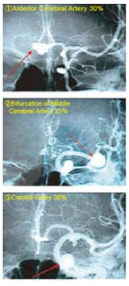
http://www.oshimalab.iis.u-tokyo.ac.jp/

Research Field : Computational Fluid Dynamics

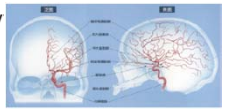
Department of Mechanical Engineering

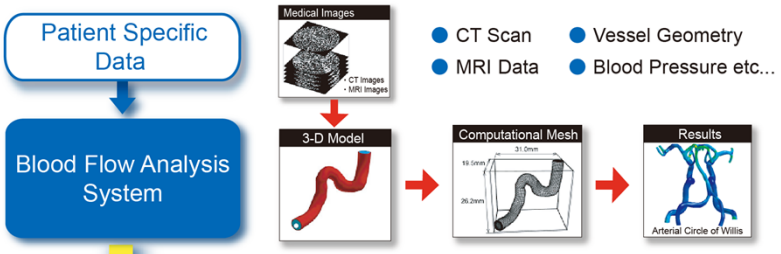
Background / Purpose

- The 2nd Highest Rate of Death in Japan
  - Cerebrovascular disorders
  - → 10%%-subarachonoid hemorhage
  - → 90%%-rupture of cerebral aneurysm
- Characteristics in formation of aneurysm
  - Preferential location such as bend, bifurcation
  - Preferential age groups between 40's and 50's



→ Any relation between vessel geometry and aneurysm?



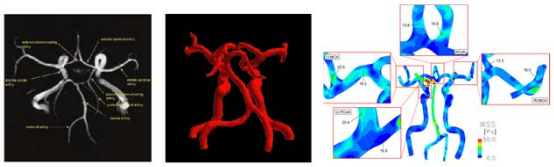


Research Aim

- Investigation of the effects of vessel geometry on the hydrodynamics
- Development of an integrated hemodynamic simulation system for clinical diagnosis

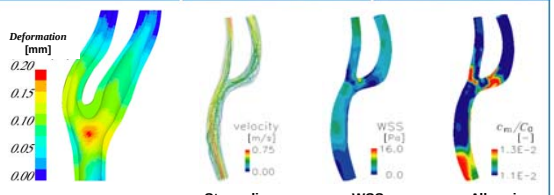
Computational

Numerical Simulation of Blood Flow in the Circle of Willis



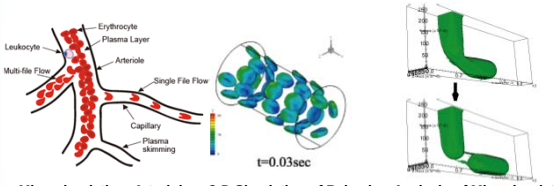
CT Image of the Circle of Willis | 3D Vessel Structure Model | Wall Shear Stress

Fluid-Structure Interaction and Mass Transport Analysis in Carotid Artery



Wall Deformation | Streamline •Velocity | WSS | Albumin Concentration

Numerical Simulation in Microscale



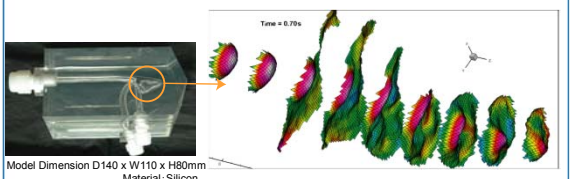
Microcirculation: Arteriole | 3-D Simulation of Behavior of RBCs by the Lattice Boltzman Method | Analysis of Microdroplet Formation

Macro [mm～cm]

Micro [μm]

Experimental

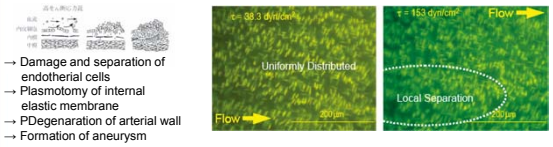
Stereoscopic PIV Measurement in Cerebral Artery Model



Model Dimension D140 x W110 x H80mm
Material: Silicon

Cerebral Artery Model | Velocity Distribution at Maximum Inflow

Quantitative Evaluation of Blood Vessel Damage

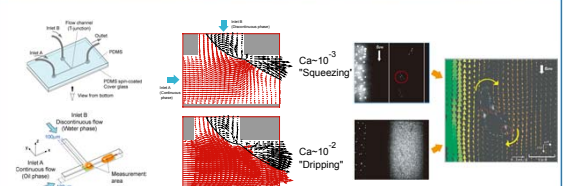


→ Damage and separation of endotherial cells
→ Plasmotomy of internal elastic membrane
→ PDegenaration of arterial wall
→ Formation of aneurysm

Effect of High WSS

Damage of Endothrial Cells Under WSS (Left: Low WSS , Right: High WSS)

Micro-PIV Measurement of Micro-Multiphase Flow



Micro T-shaped Junction for Droplet Formation | Velocity Distribution at Droplet Formation | Simultaneous Measurement of Red Blood Cells and Surrounding Fluid