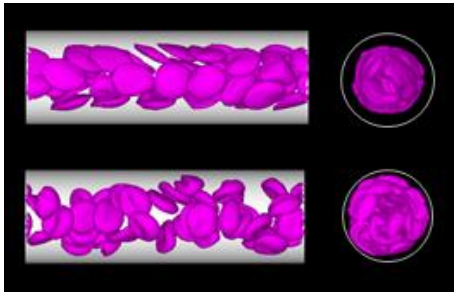
Fluid Dynamics Laboratory (Hyakutake Lab)

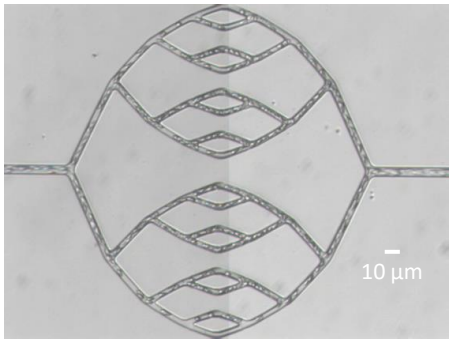
Keyword; Fluid dynamics, Biomechanics, Micro flow

Research on Microcirculation

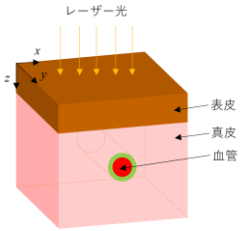
In small arterioles and capillaries, where vessel diameters are on the order of tens of micrometers, the size of red and white blood cells becomes comparable to the vessel diameter, resulting in highly complex flow behavior. Our laboratory conducts multiphase flow analyses that take into account the unique rheological properties of red blood cells. We also focus on nanoparticles known as artificial red blood cells, simulating their dispersed-phase behavior within microvessels. Recently, we have begun numerical studies on the effectiveness of artificial red blood cell delivery in laser treatment of vascular malformations.



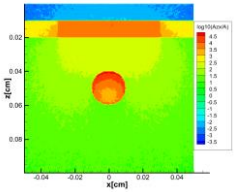
Simulation of RBC flow in microvessels (Normal and low deformability model)



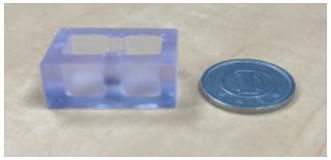
In vitro experiment with capillary network model



Skin tissue model

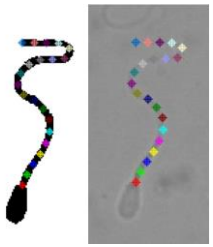


Light propagation simulation

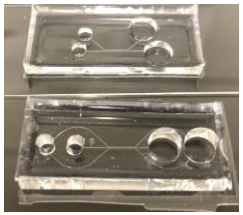


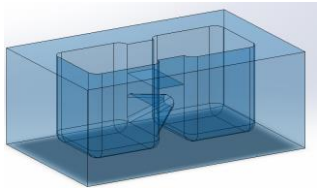
Research on Biofluid Dynamics

We investigate the locomotion of flagellated organisms—such as sperm cells, a key component of reproduction—as they move through the mucus within the fallopian tubes, using both experimental and computational fluid dynamics approaches. One practical application of this research is the development of microfluidic devices for the selective separation of highly motile sperm. Such technologies have the potential to contribute to advancements in assisted reproductive medicine as well as in the livestock industry.



Sperm motion analysis





IVF chip (left: silicon, right 3D printer)

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