

Biofluid and Flow Control Laboratory (BFCL)

Diagnosis of various biofluid flow phenomena and development of creative biomimic technologies

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Education

Ph.D. 1986 Korea Adv. Inst. of Sci. & Tech.(KAIST)
M.S. 1982 Korea Adv. Inst. of Sci. & Tech.(KAIST)
B.S. 1980 Busan National University

Experience

2010. 9~Present POSTECH Fellow
1987. 1~Present POSTECH, Professor
1996. 8~1997. 8 Johns Hopkins University, Visiting Professor
1988. 9~1989. 9 Imperial College, Visiting Professor
1986. 2~1986. 12 KIMM, Senior Researcher

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Biofluid Laboratory was founded in 1987 and designated as a National Research Laboratory (NRL) of Korea in 2000 and National Leading Research Laboratory in 2006. On 2008, this lab was designated as Biofluid and Biomimic Research Center (BBRC) from MEST/NRF as a creative research initiatives (CRI) laboratory with the research topic of "Diagnosis of Biofluid Flow Phenomena and Biomimic Research".

In the initial stage, the main research areas were flow control, microfluidics, biofluids, bluff-body aerodynamics and wind engineering (environmental fluid mechanics). For example, various passive and active flow control techniques were applied to various practical flows to reduce drag or to resolve various practical engineering problems such as ventilation in vehicles and factory buildings. The laboratory has developed almost all kinds of advanced quantitative flow visualization techniques for measuring spatial distributions of velocity, temperature and pressure of various thermo-fluid flows. These advanced experimental techniques have been applied successively to analyze complicated flow structures of various flows.

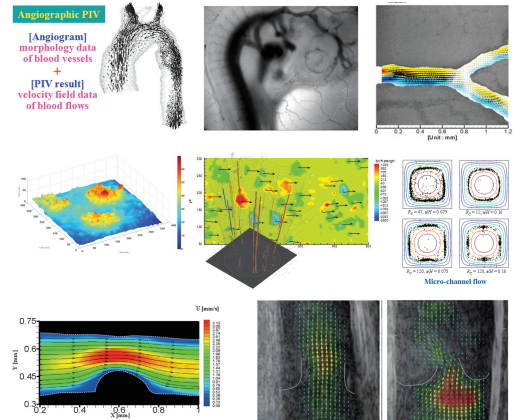
We are diagnosing various biofluid flows and microfluidic flows such as blood flows related with circulatory vascular diseases(CVDs) and biological flows in living creatures using advanced bio-imaging techniques.

As biological flows in living creatures, we are investigating the sap flows in xylem vessels of vascular plants, liquid-feeding phenomena of mosquitoes and butterflies, and blood flows in chicken embryos and zebra fishes. Whole velocity fields of the flows around plant leaves, butterflies and planktons are also measured to investigate their fluid-dynamic characteristics. These researches play an important role in various engineering applications, development of creative biomimic techniques. In addition, blood flows related with circulatory vascular diseases have been measured by using X-ray PIV or Echo-PIV to investigate the pathogenesis of CVDs. In addition, we are developing new advanced flow visualization techniques (angiographic X-ray PIV, holographic micro-PTV, ultrasound-PIV) and biodegradable nano/micro-particles for biomedical imaging in clinical applications.

The current and on-going research works are:

● Diagnosis of biological flows and development of biomimic technologies

- ▶ Experimental analysis of various biological flows to reveal the secrets of nature
- ▶ Bio-imaging of biological flows in plants and animals
 - Sap flow in xylem vessels of various vascular plants
 - Liquid-feeding of insects such as mosquitoes and butterflies
- ▶ Development of creative biomimic technologies
 - Mosquito pump, plant-inspired pump, bioinspired solar cells and fuel cells
- ▶ Blood flows related with circulatory vascular diseases(CVDs)
 - Blood flows in animal disease models
 - Investigation on pathogenesis of CVDs
 - Development of biochips for early detection of CVDs



● Flow control and experimental fluid mechanics

- ▶ Wind tunnel studies for bluff bodies (vehicles, building etc.)
- ▶ Drag reduction using active and passive flow control techniques
- ▶ Wind engineering studies to resolve environmental flow problems
- ▶ Flow control using microfluidics such as microriblets and nano surface morphology

Major Publications

- S. Ahn, E. Seo, KH Kim, SJ Lee, "Controlled cellular uptake and drug efficacy of nanotherapeutics", Scientific Reports, Vol.3, pp.1997, 2013
- YJ Kang, ES Yeom, SJ Lee, "A microfluidic biosensor for monitoring temporal variations of hemorheological and hemodynamic properties using an extracorporeal rat bypass loop", Analytic Chemistry, Vol.85, pp.10503-10511, 2013
- SJ Lee, JW Hong, YK Kim, KH Kang, IS Kang, SJ Lee, "Electrowetting-induced droplet detachment from hydrophobic surfaces", Langmuir, Vol. 30, pp.1805-1811, 2014
- JE Ryu, S. Ahn, SG Kim, T Kim, SJ Lee, "Interactive ion-mediated sap flow regulation in Olive and Laurel stems", PLOS ONE, Vol.9, e98484, 2014
- SC Lee, SJ Lee, "Experimental analysis of the liquid-feeding mechanism of the butterfly Pieris rapae", J. Exp Biology, Vol.217, pp.2013-2019, 2014
- KW Seo, SJ Lee, "High-accuracy measurement of depth-displacement using a focus function and its cross-correlation in holographic PTV", Optics Express, Vol. 22, pp. 15542~15553, 2014
- KH Song, ES Yeom, SJ Lee, "Real-time imaging of pulvinus bending in Mimosa pudica", Scientific Reports, Vol.4, 6466, 2014
- S. Ahn, SJ Lee, "Nanoparticle role on the repeatability of stimuli-responsive nanocomposites", Scientific Reports, Vol.4, 6624, 2014
- HJ Ha, DH Hwang, WR Choi, JH Baek, SJ Lee, "Fluid-dynamic optimal design of helical vascular graft for stenotic disturbed flow", PLOS ONE, Vol.9, e111047, 2014
- SC Lee, SJ Lee, "Uptake of liquid from wet surfaces by the brush-tipped proboscis of a butterfly", Scientific Reports, Vol.4, 6934, 2014

