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COMPUTATIONAL FLUID–STRUCTURE INTERACTION FOR MULTIPHYSICS COUPLING AND EMERGING APPLICATIONS

SANG LEE[*] AND SANGJOON SHIN[†]

[*] Korea Advanced Institute of Science and Technology
Department of Aerospace Engineering
291 Daehak-ro, Yuseong-gu, Daejeon 34141, Republic of Korea
slee1@kaist.ac.kr https://cfd.kaist.ac.kr/

[†] Seoul National University
Department of Aerospace Engineering
301-dong 117-ho, 1 Gwanak-ro, Gwanak-gu, Seoul 08826, Korea
ssjoon@snu.ac.kr https://helicopter.snu.ac.kr

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ABSTRACT

A minisymposium is proposed on Computational Fluid–Structure Interaction (FSI), dedicated to recent advances in numerical methods, high-fidelity simulation techniques, and multidisciplinary applications involving the interaction of fluids with deformable, flexible, or moving structures. Fluid–structure interaction is a fundamental and challenging topic in computational mechanics because of the strong nonlinear coupling between fluid flow and structural response across multiple spatial and temporal scales[1,2]. Accurate and efficient treatment of interface conditions, added-mass effects, and stability in strongly coupled systems remains a major research focus in both academia and industry.

This minisymposium will bring together researchers working on partitioned and monolithic coupling algorithms, immersed boundary and fictitious domain methods, arbitrary Lagrangian–Eulerian formulations, reduced-order modeling, and machine learning-enhanced computational frameworks for FSI problems. Special attention will be given to scalable and robust simulation strategies for incompressible and compressible flows interacting with elastic solids, thin structures, flexible membranes, and bio-inspired systems. Applications of interest include aeroelasticity, vortex-induced vibrations, offshore and marine structures, wind and energy systems, cardiovascular flows, and biomedical device modeling, where predictive simulations are essential for design and optimization[3-5].

The objective of this minisymposium is to provide an interdisciplinary platform for exchanging ideas among experts in computational fluid dynamics, solid mechanics, applied mathematics, and scientific computing. The aim is to highlight the emerging trends such as high-performance computing for large-scale FSI simulations, uncertainty quantification, data-driven surrogate modeling, and validation through experimental and hybrid computational

approaches. By fostering collaboration among researchers from academia, industry, and national laboratories, the session will promote the development of next-generation computational tools for complex multiphysics systems and align strongly with the scientific mission of the IACM Computational Fluids Conference.

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