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HPC-CFD AND AI FOR COMPLEX INDUSTRIAL FLOWS: IN HONOR OF PROF. NOBUYUKI OSHIMA

TAKUJI NAKASHIMA[*], MAKOTO TSUBOKURA[†] AND RYOICHI KUROSE[††]

[*] Hiroshima University
1-4-1 Kagamiyama, Higashi-Hiroshima, Hiroshima 739-8527, Japan.
nakashima@hiroshima-u.ac.jp

[†] RIKEN R-CCS and Kobe University
7-1-26 Minatojima-minami-machi, Chuo-ku, Kobe, Hyogo 650-0047, Japan.
mtsubo@riken.jp

[††] Kyoto University
Kyoto daigaku-katsura, Nishikyo-ku, Kyoto 615-8540, Japan.
kurose.ryoichi.6x@kyoto-u.ac.jp

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ABSTRACT

High-performance computing-based computational fluid dynamics (HPC-CFD) has become an indispensable technology for understanding, predicting, and designing complex flow phenomena in industrial systems. In fields such as automotive engineering, combustion systems, turbomachinery, energy systems, and environmental engineering, large-scale CFD enables high-fidelity simulations of complex, multi-physics phenomena that are difficult to assess by experiments alone.

At the same time, the role of CFD is rapidly expanding. Large-scale simulations are no longer used only as virtual experiments for individual design cases; they also generate massive, high-quality datasets that can serve as a foundation for artificial intelligence. By combining HPC-CFD with data-driven modeling and AI technologies, it is becoming possible to construct new design systems in which simulation and AI accelerate engineering innovation.

This minisymposium focuses on recent advances and future perspectives in HPC-CFD and AI for complex industrial flows. Particular attention will be given to the transition from the Fugaku era to the FugakuNEXT era, where further advances in heterogeneous supercomputing, GPU-oriented algorithms, and AI-integrated simulation technologies are expected to transform industrial design and analysis. At RIKEN, industry–academia consortia focusing on Automotive CAE and Combustion Systems have been established to develop and demonstrate integrated HPC-CFD and AI technologies in collaboration with industrial partners. These activities aim to create next-generation simulation and design platforms that can support practical industrial applications while opening new frontiers.

Although automotive and combustion applications provide important motivating examples, the scope of this minisymposium is not limited to these areas. Contributions are welcome from a broad range of industrial flow problems, including but not limited to transportation, propulsion, energy conversion, turbomachinery, manufacturing, built environments, and multi-physics systems. Through invited and contributed presentations, this minisymposium will provide a forum to discuss how HPC-CFD and AI can jointly reshape the future of industrial simulation and design.

This minisymposium is organized in honor of Prof. Nobuyuki Oshima, recognizing his long-standing contributions to computational fluid dynamics, high-performance computing, and their applications to complex industrial flow problems.