

ADVANCES IN PARTICLE METHODS: THEORIES AND ALGORITHMS FOR HIGH-ORDER AND HIGH-FIDELITY SCHEMES

MITSUTERU ASAI^{*}, TAKUYA MATSUNAGA^{*}, ABBAS KHAYYER[†],
AHMAD SHAKIBAEINIA^{††} AND KUMPEI TSUJI[‡]

^{*} Kyushu University
744 motooka, nishi-ku, Fukuoka 819-0395, JAPAN
asai@doc.kyushu-u.ac.jp

^{*} The University of Tokyo
Kashiwa-no-ha 5-1-5, Kashiwa-shi, Chiba 277-8581, Japan
tmatsunaga@edu.k.u-tokyo.ac.jp

[†] Kyoto University
Kyotodaigaku-Katsura, Nishikyo, Kyoto 615-8510, Japan
khayyer.abbas.3w@kyoto-u.ac.jp

^{††} Polytechnique Montreal
2500, chemin de Polytechnique, Montreal (Quebec), Canada
ahmad.shakibaeinia@polymtl.ca

[‡] Tohoku University
6-6-06 Aramaki Aoba, Aoba, Sendai, Miyagi 980-8579, Japan
kumpei.tsuji.e1@tohoku.ac.jp

ABSTRACT

Particle and meshfree methods have emerged as powerful computational frameworks for simulating complex physical phenomena involving large deformations, moving interfaces, and evolving topologies. Despite their success, achieving high-order accuracy, numerical consistency, and long-term stability remains a significant challenge. This session provides a multidisciplinary forum for presenting recent advances in theoretical foundations, numerical formulations, and algorithmic developments, including hybrid data-driven computational frameworks, for particle and meshfree methods. Particular emphasis will be placed on high-order spatial discretization, advanced time-integration techniques, and efficient algorithms for incompressible, multiphase, and multiphysics systems. Topics of interest include consistent boundary treatments, particle regularization and shifting techniques, adaptive and multi-resolution approaches, error estimation, and coupled problems such as fluid–structure interaction. Contributions addressing both fundamental methodological developments and challenging engineering applications are highly encouraged.