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Introduction to the Special Issue on Recent Developments of Peridynamics

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Peridynamics is a nonlocal continuum mechanics theory. Peridynamics overcomes the computational challenges in classical continuum mechanics and enables the solution of complex mechanical and physical equations in the presence of jump discontinuities or singularities with ease and simplicity, while preserving a length scale to capture nonlocal behavior. Peridynamics has been recently extended and further developed to solve mass and heat transfer and fluid dynamics. Therefore, peridynamics can now be used for analyzing multiphysics and multiscale problems involving damage and cracks. As a rapidly rising topic in computational mechanics, peridynamics has gained intensive and wide interests in the community.

In order to disseminate the recent advances in peridynamics in time, the three guest editors conceived the idea of organizing this Special Issue to our readers with interests. This Special Issue is now concluded and we are glad to announce and share the publication of this issue to our colleagues. This Special Issue contains nine peer-reviewed papers, which are authored by researchers from seven research institutes and universities active in the topic of peridynamics worldwide. The Special Issue is dedicated to the innovative theory, model, technique, algorithm as well as applications of peridynamics. Specifically, topics across dual-support smoothed particle hydrodynamics, multi-horizon peridynamics, theoretical analysis of singularity and anomalous dispersion, hybrid local/nonlocal continuum mechanics modeling, coupled digital image correlation (DIC) and peridynamics, fracture of functionally gradient materials, interaction between ice and structure and dynamic fracture of ice are included.

Specifically, "A Dual-Support Smoothed Particle Hydrodynamics for Weakly Compressible Fluid Inspired by the Dual-Horizon Peridynamics" by Zhuang et al. [Zhuang, Rabczuk and Ren (2019)], extends the dual-horizon peridynamics with variable horizon sizes to the fluid flow application of SPH, e.g., dam break; "A Possible Reason about Origin Of Singularity and Anomalous Dispersion in Peridynamics" by Huang [Huang (2019)] regards the singularity of uniaxial tension and anomalous dispersion of wave in peridynamics stemming from the lack of local stress characterizing contact

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interactions; "A Hybrid Local/Nonlocal Continuum Mechanics Modeling and Simulation of Fractures in Brittle Materials" by Han et al. [Han, Wang and Lubineau (2019)] further develops a hybrid model of classical continuum mechanics and peridynamics and introduces their software for crack propagation of quasi-brittle materials; "Coupled Digital Image Correlation and Peridynamics for Full-Field Deformation Measurement and Local Damage Prediction" by Li et al. [Li, Zhang, Gu et al. (2019)], attempts to compensate the damage evolution and crack propagation with peridynamic simulation considering the DIC cannot capture the crack evolution continuously; "Dynamic Fracture Analysis of Functionally Gradient Materials with Two Cracks by Peridynamic Modeling" by Cheng et al. [Cheng, Jin, Yuan et al. (2019)], investigates the influences of cracks positions and distance, and FGMs gradient pattern on the crack propagation pattern with bond-based peridynamics; "Peridynamics Modeling and Simulation of Ice Craters by Impacts" by Song et al. [Song, Yan, Li et al. (2019)] develops a particle refinement technique in the non-ordinary state-based peridynamic simulation corresponding to a modified Drucker-Prager constitutive model for ice crater; "The Multi-horizon Peridynamics" by Jenabidehkordi et al. [Jenabidehkordi and Rabczuk (2019)] proposes a refinement approach by introducing multiple domains to the nodes in the refinement zone; "Numerical Simulation of Dynamic Interaction between Ice and Wide Vertical Structure Based on Peridynamics" by Jia et al. [Jia, Ju and Wang (2019)] tries to calculate ice damage, ice forces and vibration responses of structures in the duration through bond-based peridynamic simulation; "Numerical Simulations of the Ice Load of a Ship Navigating in Level Ice Using Peridynamics" by Xue et al. [Xue, Liu, Liu et al. (2019)] adopts the bond-based peridynamics to predict the ice loads for a ship navigating in level ice and dynamic fracture of ice.

As a final remark, it is hoped that the presented topics will give this special issue a much more lasting value and make it appealing to a broad audience of researchers, practitioners, and students who are interested in peridynamics, and each reader can find in this special issue something useful or inspiring.

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