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MESHFREE AND PARTICLE METHODS FOR LARGE STRAIN SOLID MECHANICS AND COUPLED PROBLEMS

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ABSTRACT

Classical meshfree and particle approaches (SPH, MPM, PFEM, DEM, EFG, RKPM, Peridynamics, etc) face several well-documented challenges in the simulation of multi-physics solids undergoing large deformation at high dynamic loading rates [1], such as in scenarios like contact-impact, crash and fracture. These challenges include handling large evolving interfaces, multi-material interfaces, phase changes, and the propagation of discontinuities. In addition, practitioners often contend with numerical issues such as pressure checkerboarding, shear and/or volumetric locking, and inadequate resolution for strains and stresses. Recent literature introduces several implementable approaches in meshfree solvers designed to alleviate, if not eliminate, these issues without resorting to *ad-hoc* treatments that may compromise the underlying physical principles.

Despite these advancements, there remains a pressing need to continue developing new meshfree and particle approaches to address the unique challenges of large deformation problems [2]. Several emerging ideas are currently being explored across various research groups. The objective of this invited session is to gather researchers from different teams to discuss these challenges. The goal is to develop numerically convergent solutions with high predictive fidelity for systems undergoing fast dynamics. Relevant problem domains may include, but are not limited to, impact mechanics, crash simulation and fracture modelling. Contributions that explore the interaction between solids and fluids, as well as multi-physical aspects involving solids, are also welcome. Industry applications are encouraged, as they provide valuable insights into practical challenges and solution implementation.

REFERENCES

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[2] Lee C.H., Gil A. J., de Campos P.R.R., Bonet J., Jaugielavicius T., Joshi S., Wood C., *A novel Arbitrary Lagrangian Eulerian Smooth Particle Hydrodynamics algorithm for nonlinear solid dynamics*, Computer methods in Applied Mechanics and Engineering, 2024. Under review.