

Entirely Lagrangian Meshfree Fluid-Structure Interaction Solvers - Recent Advances and Future Perspectives

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ABSTRACT

This talk presents a concise review on the state-of-the-art developments and future perspectives corresponding to entirely Lagrangian meshfree FSI (Fluid-Structure Interaction) solvers. Specifically, entirely SPH- or MPS-based partitioned FSI solvers will be targeted followed by a concise overview of the theoretical and numerical backgrounds¹⁾ of these particle methods. The considered fluid models including Incompressible SPH (ISPH), Weakly Compressible SPH (WCSPH) and Moving Particle Semi-implicit (MPS) will be briefly presented along with the considered structure models, namely, Updated Lagrangian SPH, Total Lagrangian SPH, Hamiltonian SPH²⁾ and Hamiltonian MPS. Different possible coupling algorithms³⁾ will be discussed with the focus on interface compatibility conditions.

This talk highlights the potential robustness of entirely Lagrangian meshfree FSI solvers, as new generation computational methods, in reproducing FSI corresponding to extreme events and portrays the future perspectives for systematic developments⁴⁾ towards reliable engineering applications with respect to rapid advances in technology and emergence of so-called advanced materials that can result in complex and highly non-linear structural responses. Accordingly, the necessity for accurate modelling of comprehensive structural responses, including viscoelastic, elastoplastic and progressive damages/failures, by the advanced entirely Lagrangian meshfree FSI solvers will be highlighted. In this regard, extensions of the structure model are suggested to be conducted in a variationally consistent framework to ensure stability, accuracy and physical reliability, including thermodynamic consistency. The challenges in establishment of reliable entirely Lagrangian FSI solvers will be also reviewed along with effective and physically consistent stabilisation schemes⁵⁾. Finally, the key aspects corresponding to advancements in terms of reliability, adaptivity and generality of targeted FSI solvers will be outlined along with corresponding future research perspectives.

REFERENCES

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