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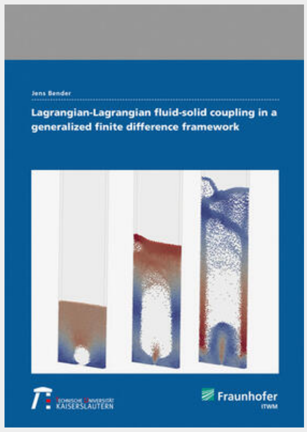
Lagrangian-Lagrangian fluid-solid coupling in a generalized finite difference framework.

We consider the modeling and simulation of flows composed of a fluid with an immersed particulate solid phase within a two-way coupled scheme, which we embed into the generalized finite difference framework of the finite pointset method (FPM). Both phases are described in a Lagrangian formalism and are represented by point clouds. This allows us to treat all phases in a common framework and to take advantage of synergies in terms of data structures and algorithms. A key challenge, which the generalized finite difference setting introduces, is the calculation of averaged quantities. Due to the properties of our mesh-free approach, which is missing an inherent definition of cell volume, conventional averaging strategies from mesh-based schemes are not directly applicable. We employ an approach which circumvents these problems and takes the finite difference nature of the FPM into account. Additionally, we bring to light the required changes to a projection method for the fluid phase to incorporate the multi-phase setting. The solid phase solver, averaging scheme, and fluid solver are embedded into a coupled algorithm with a substepping procedure to improve efficiency.



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