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Combining an a priori space-time separated model-order reduction technique to the Particle Finite Element Method

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The Particle Finite Element method is a fluid solver based on Lagrangian finite elements combined with efficient re-meshing algorithms. It was shown to be effective in a large amount of applications, especially in the case of free surface fluids flows or fluid-structure interactions. Up to now, this method has never been paired up with any model-order reduction technique because of the difficulties linked to the re-meshing schemes. This remains however, an important area of research to uncover as it could drastically reduce the computational cost of the method. In this work, we focus on an a priori reduction method called Proper Generalized Decomposition (PGD) with a space-time decomposition. The PGD does not require any knowledge of past solutions and builds the reduced model iteratively. To deal with moving mesh and remeshing, a new expanded formulation is introduced. Particular efforts have to be made to ensure both correct mesh and solution interpolation at the re-meshing instances and adequate update of the mesh after every new mode calculation. The proposed technique has been validated with simple tests showing very promising results.

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