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EULERIAN–LAGRANGIAN MOMENTUM COUPLING BETWEEN XDEM AND OPENFOAM USING PRECICE

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Eulerian-Lagrangian couplings consider problems with a discrete phase as a particulate material that is in contact with a fluid phase. These applications are as diverse as engineering, additive manufacturing, biomass conversion, thermal processing or pharmaceutical industry, among many others [3] A typical approach for this type of simulations is the coupling between Computation Fluid Dynamics (CFD) and Discrete Element Method (DEM), which is challenging in many ways. Such CFD–DEM couplings [4, 2, 5] are usually implemented using an ad-hoc coupling layer, specific to the both DEM and CFD software, which considerably reduces the flexibility and applicability of the proposed implementation.

In this work, we present the coupling of eXtended Discrete Element Method (XDEM) [3], with the CFD library OpenFOAM, using the preCICE coupling library [1] on volumetric meshes. Such momentum coupling requires the CFD side to account for the change of porosity due to the particulate phase and the particle momentum, while the particles of the DEM will be affected by the buoyancy and drag force of the fluid. While preCICE significantly simplifies the coupling between standalone libraries, each solver and, its respective adapter, have to be made aware of the new data involved in the physic model.

For that, a new adapter has been implemented for XDEM and the existing adapter for OpenFOAM has been extended to include the additional data field exchange required for the momentum coupling, e.g porosity, particle momentum, fluid velocity and density. Our solution is tested and validated using simple benchmarks and advanced testcases such as a dam break, and shows consistent results.

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