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MICRO/MESO SIMULATIONS FOR FLUIDIZED BEDS

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ABSTRACT

Due to the wide range of spatial scales and complex features of solid/solid and solid/fluid interactions in dense fluidized beds, the system can be studied at different length scales, namely, micro, meso and macro. In this work, an accurate cross-comparison of results from Particle resolved simulation of uniform liquid/solid fluidization with that of locally averaged Euler/Lagrange meso-scale simulation is performed. Particle resolved simulations at the micro-scale are carried out by a parallel Distributed Lagrange Multipliers solver in the framework of fictitious domain. For simulations at the meso-scale, the set of mass and momentum conservation equations are averaged in control volumes encompassing few particles and momentum transfer between the two phases is modelled using appropriate drag laws. Both methods are coupled to a Discrete Element Method combined with a soft-sphere contact model to solve the Newton-Euler equations with collisions for the particles in a Lagrangian framework. A test case of intermediate size with 2000 spheres is chosen that compromises between the size limitations of the meso-scale model for an appropriate averaging process and computational resources required for the micro-scale simulation. The aim of this research is to achieve a deeper understanding of the momentum transfer at different spatial scales of the flow, along with accurate investigation of the validity of approximations adopted at the meso-scale model. Results demonstrate an acceptable agreement between the micro and meso-scale predictions on integral measures as hydrodynamic pressure drop, bed height, etc. The performances of various drag laws from the literature are investigated and a special attention is given to the dynamics of system of particles.