Implementation of a robust coupling between Discrete Element Models and open-source CFD

Dynaflow Research Group – Frank Bos

Delft University of Technology – Kees Vuik

There is a growing demand for high resolution CFD simulations in petrochemical, marine and dredging industries. These applications often involve complex physics including multiphase flows, non-newtonian fluids, turbulence and discrete particle modelling. The main objective of the current MSc proposal is to develop a robust coupling between open-source CFD toolbox OpenFOAM and Discrete Element Models (DEM). The current implementation in OpenFOAM already includes a rudimentary interaction between the modelled particles themselves and between the particles and flow. The interaction is modelled by means of collision equations between the particles themselves and between the particles and any other wall boundaries. Mass/momentum transfer between particles and the flow accounts for any displaced volume effects. The current implementation has significant limitations on the size and shape of the modelled particles. Therefore, the objective is to develop a new and robust coupling algorithm. The MSc project contains three phases:

- Phase 1: Literature study to describe the advantages and disadvantages of the different available Discrete Element Models and explore efficient coupling algorithms,
- Phase 2: Explore the current coupling algorithm (collision models, injection models, particle forces, particle-flow interaction, etc.),
- Phase 3: Improve or replace the current implementation of the coupling between DEM and open-source CFD toolbox OpenFOAM.

During the MSc project the small steps of the method improvements will be tested on simple model problems, but also on real industrial projects related to dredging, drilling and erosion. The latter is essential to verify the efficiency and robustness on large-scale industrial problems.