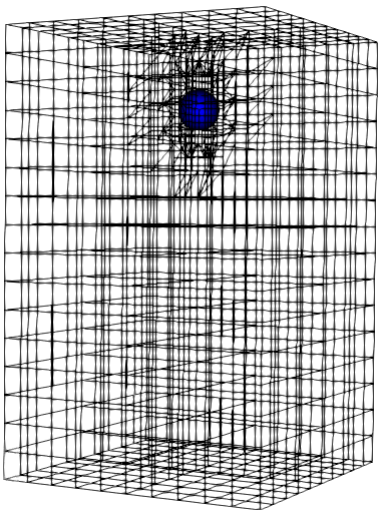
Validation Cases in CFDEM®coupling:

CASE I: SETTLING SPHERE

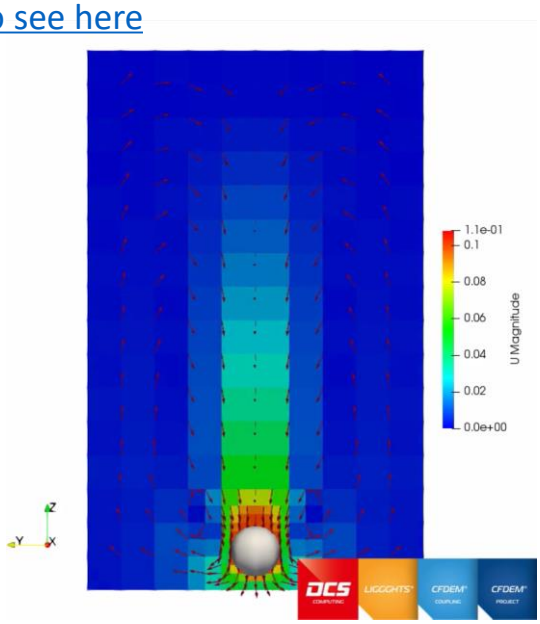
Case setup:



Single particle is released in a cubic box and starts to settle under the influence of gravity

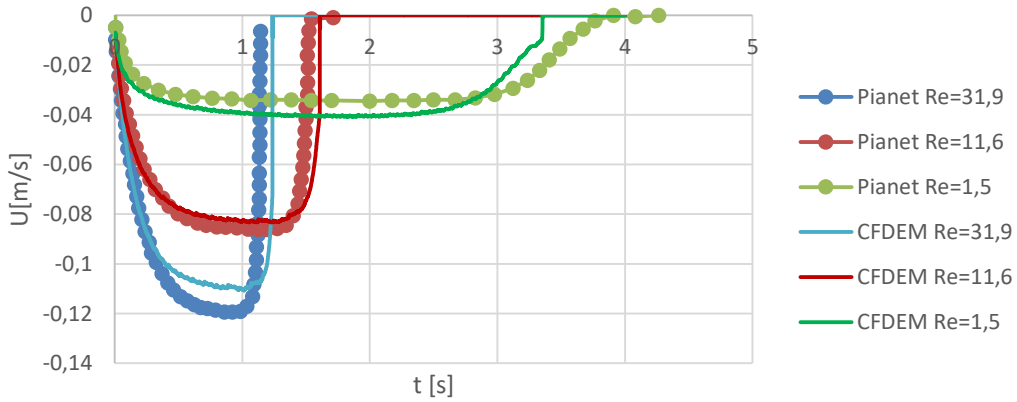
Method: resolved CFD-DEM – cfdemSolverIB (freely available as part of CFDEM®workbench-PUBLIC), i.e. no usage of drag force models

Video see here



Results:

Resolved Sphere Settling Pianet 2007 vs. CFDEM(R)-PUBLIC [resolved]



Comparison of settling velocity: simulation with CFDEM®coupling against results published by Pianet et al., Computers & Fluids 36 (2007), 359-375 shows a good match.

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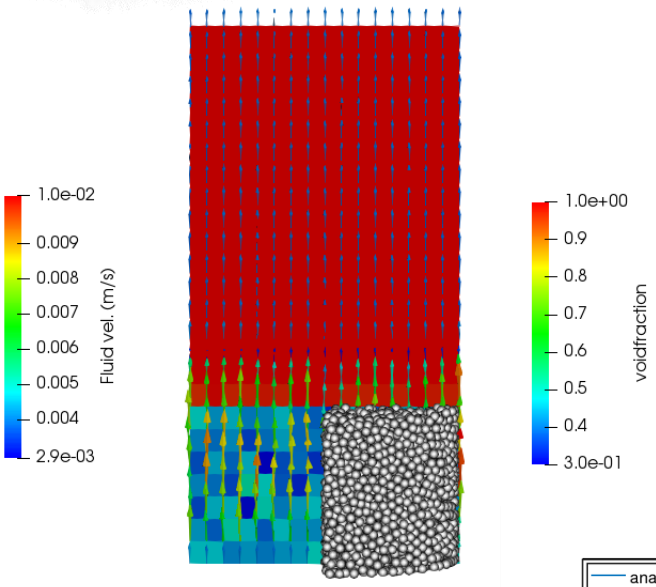
Validation Cases in CFDEM®coupling:

CASE II: ERGUN TEST CASE – FIXED BED

Case setup:

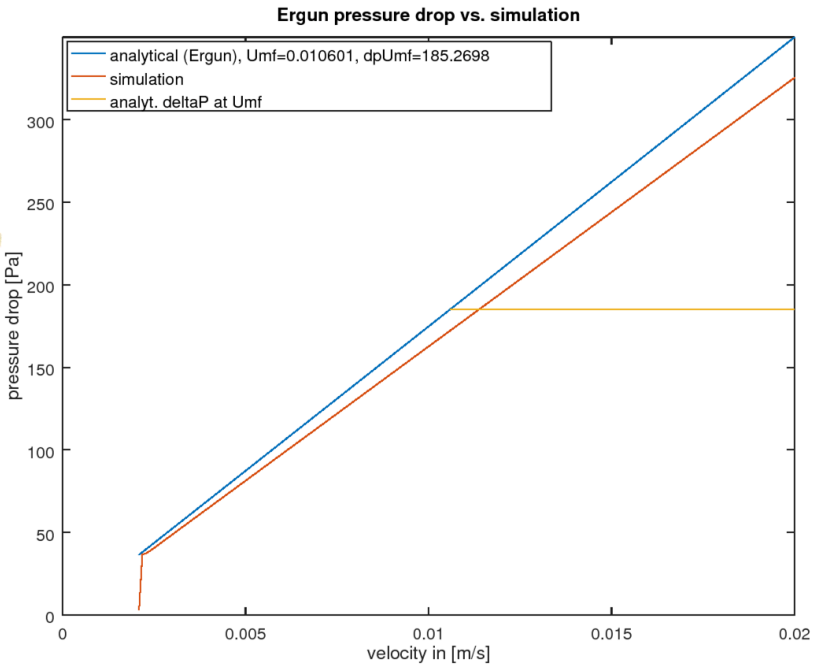


Fluid flow through a fixed particle bed – the Ergun equation describes the resulting pressure drop in dependence of the fluid velocity

Since the particles cannot move, no fluidization can occur and the pressure drop increases linearly with increasing flow velocity.

Method: unresolved CFD-DEM – cfdemSolverPiso (freely available as part of CFDEM®workbench-PUBLIC

Results:



Comparison of the pressure drop against the analytical solution provided by the Ergun equation.

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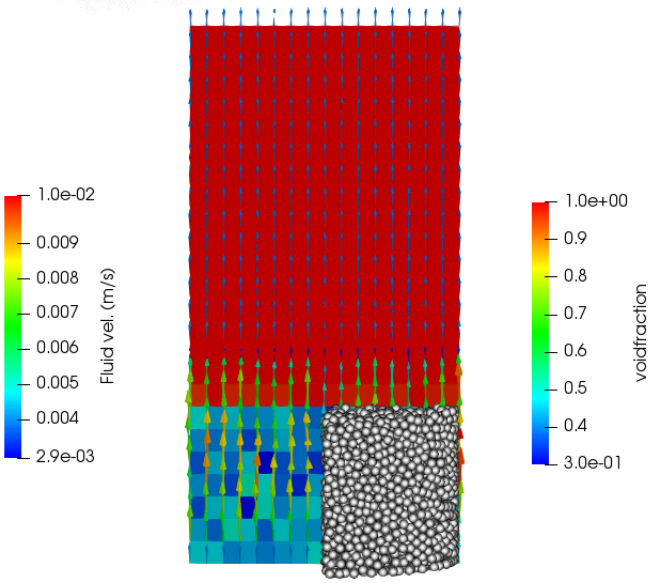
Validation Cases in CFDEM®coupling:

CASE III: ERGUN TEST CASE – FLUIDIZATION

Case setup:

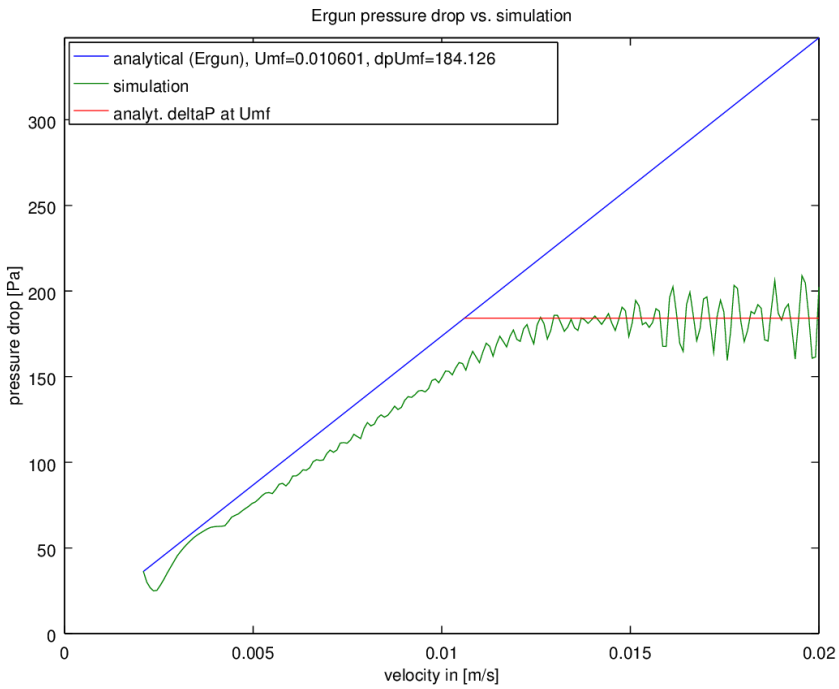


Fluid flow through a particle bed – the Ergun equation describes the resulting pressure drop in dependence of the fluid velocity

When a certain minimal fluidization velocity is reached the particle bed will fluidize which will result in a constant pressure drop despite increasing fluid velocity.

Method: unresolved CFD-DEM – cfdemSolverPiso (freely available as part of CFDEM®workbench-PUBLIC

Results:



Comparison of the pressure drop against the analytical solution provided by the Ergun equation, particle bed fluidizes at predicted minimal fluidization velocity Umf.

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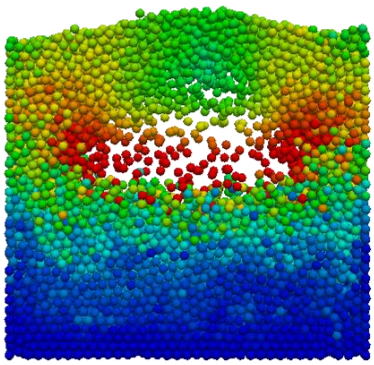
Validation Cases in CFDEM®coupling:

CASE IV: FLUIDIZED BED

Case setup:

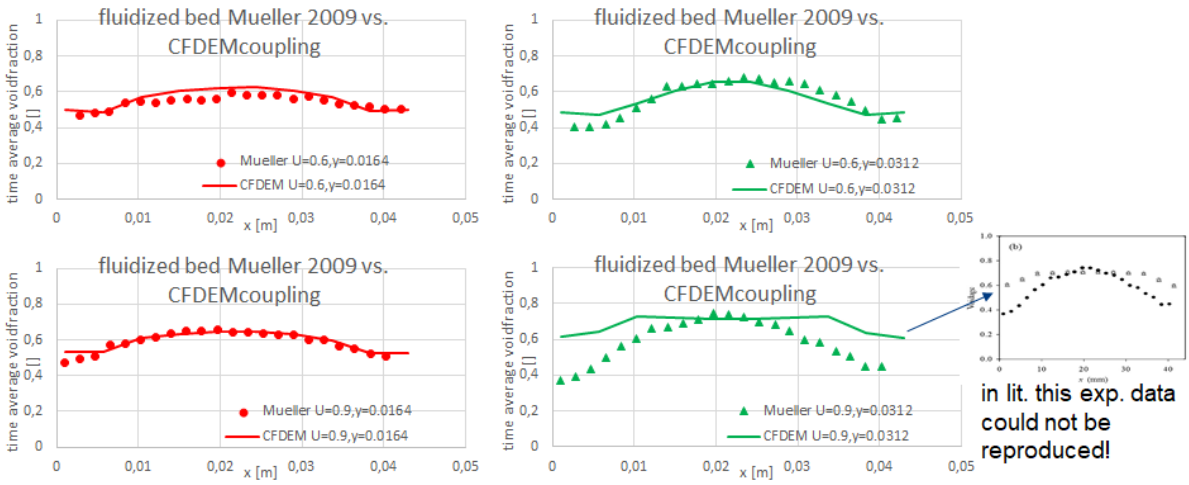


An vertical air exerts a drag force onto the particles and causes a fluidization of the bed. A good measure for quantifying the behavior is the consideration of the time-averaged void fraction (see results below).

Method: unresolved CFD-DEM – cfdemSolverPiso (freely available as part of CFDEM®workbench-PUBLIC

Video see here

Results:



Comparison of the time averaged void fraction of the bed at different heights – simulation results with CFDEM®coupling are in good accordance with experimental results from the literature.

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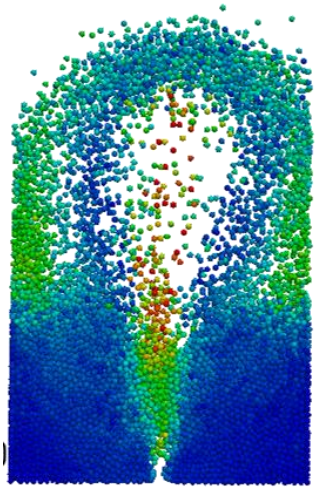
Validation Cases in CFDEM®coupling:

CASE V: SPOUTED BED

Case setup:

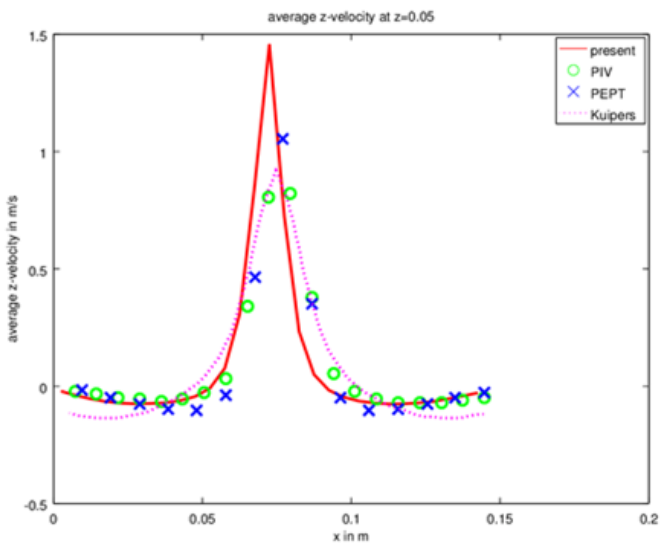


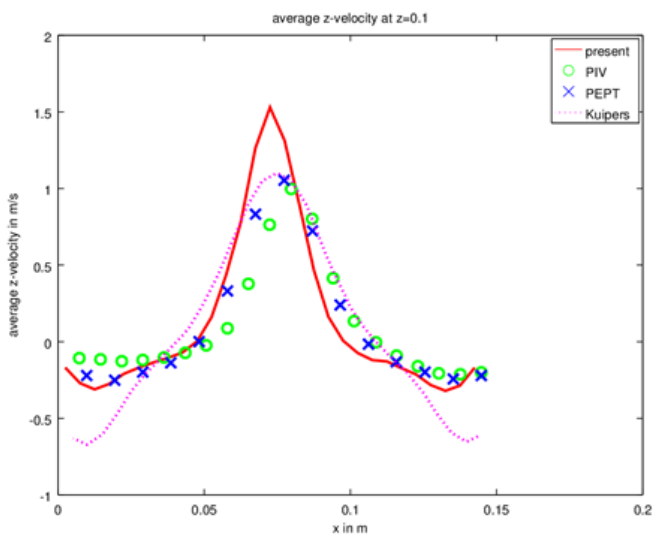
A continuous air jet enters through a hole in the bottom and causes a periodic motion of the particle bed. A good measure for the behavior of the spouted bed is the velocity at different heights (see results below.)

Method: unresolved CFD-DEM – cfdemSolverPiso (freely available as part of CFDEM®workbench-PUBLIC

Video see here

Results:





Comparison of the vertical velocity component at different heights – the simulation results obtained with CFDEM®coupling are in good accordance with experimental results.

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