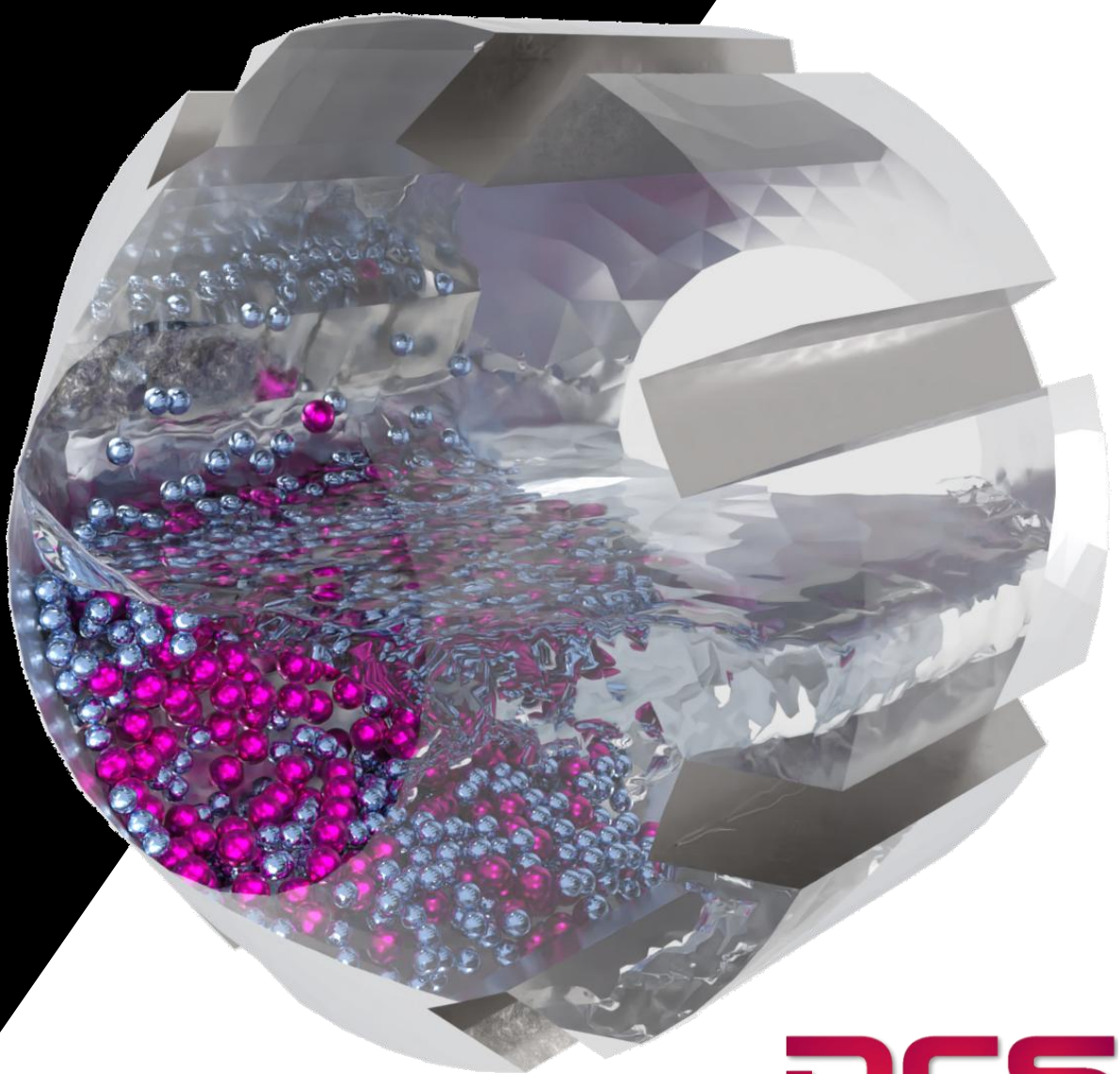
CFDEM COUPLING

MULTIPHASE

PRODUCT INFORMATION



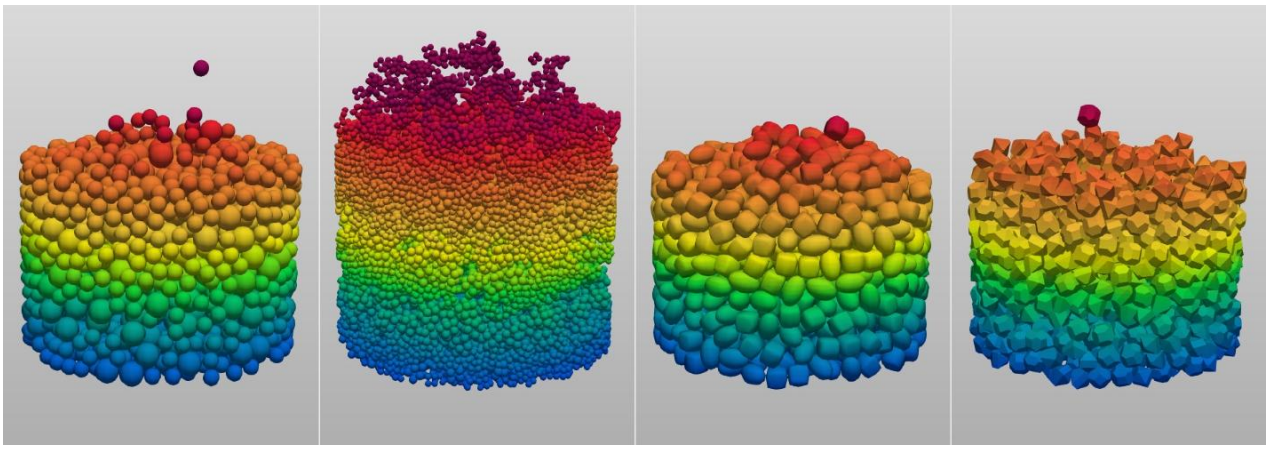
DCS COMPUTING

CFDEM®COUPLING

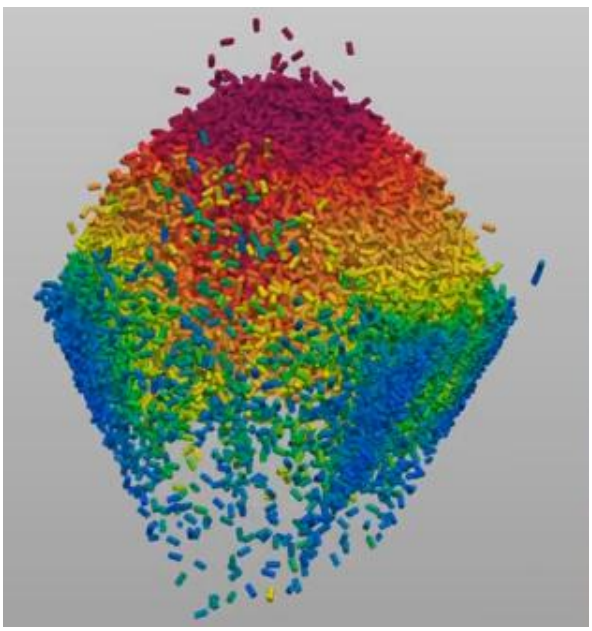
HIGHLIGHTS

CFDEM®coupling has numerous cutting-edge physics models and great options for integration.

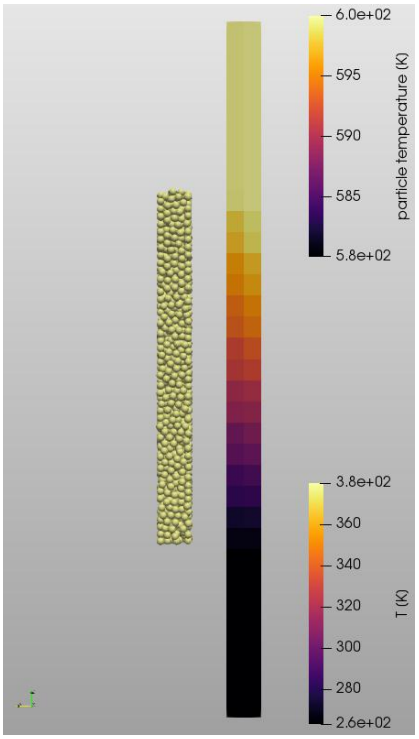
Supports all Aspherix® particle shapes



Drag laws for all flow regimes



Particle-fluid heat transfer

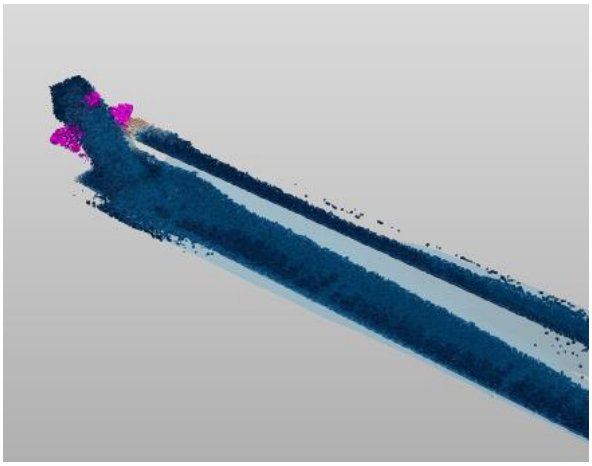


* functionality GPU compatible

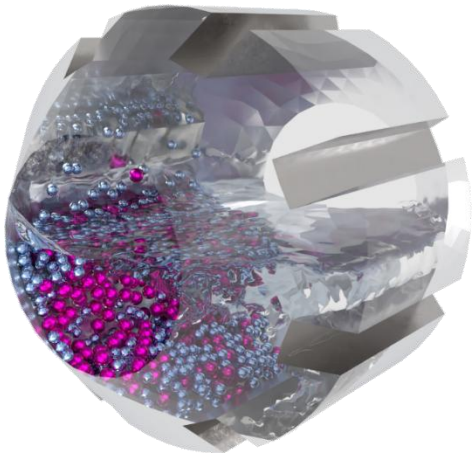
CFDEM®COUPLING

HIGHLIGHTS

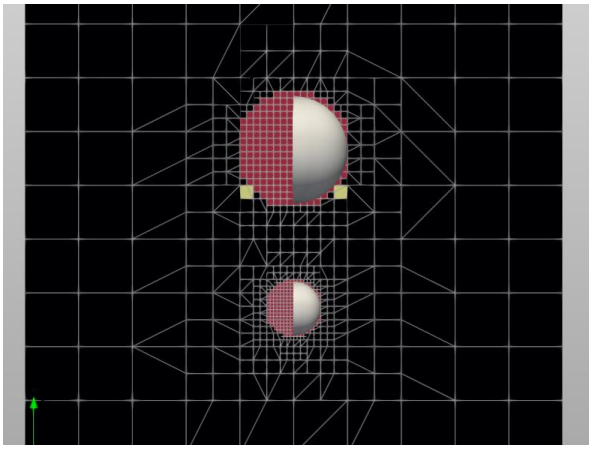
Spray coating & evaporation

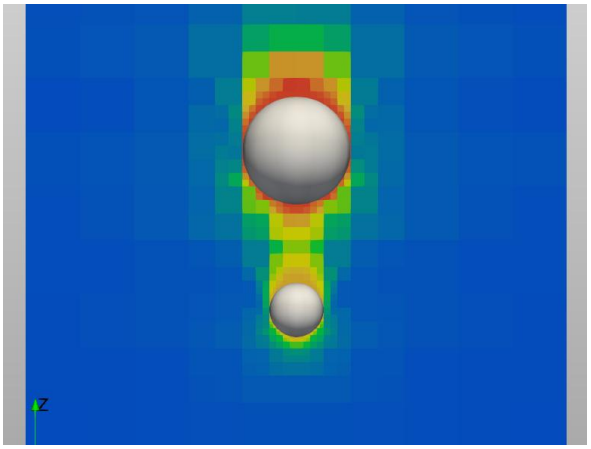


Volume-of-Fluid multiphase

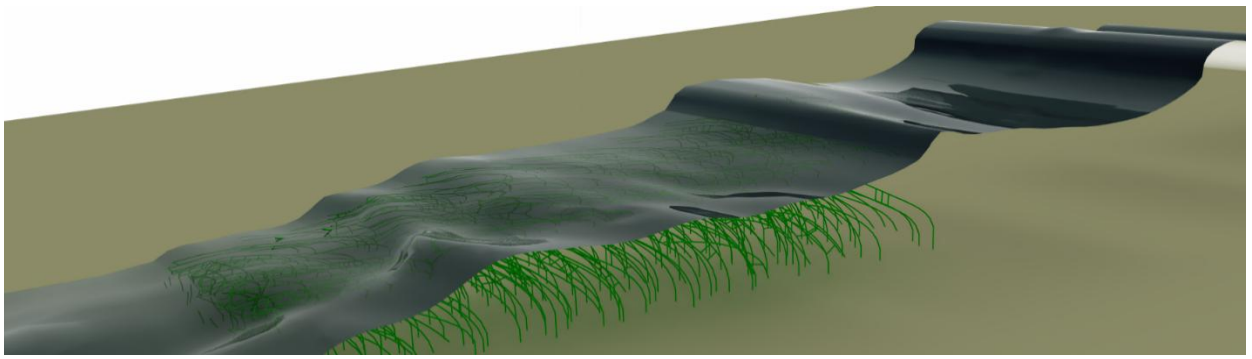


Immersed boundary method with adaptive mesh refinement





Volume-of-Fluid multiphase also with non-spherical particles



* functionality GPU compatible

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CFDEM®COUPLING

SYSTEM REQUIREMENTS

Prerequisites for CFDEM®coupling

- OpenFOAM 10*
- Linux only (systems as specified below)
- System prerequisites of specified OpenFOAM version apply
- cmake 3.13

System requirements - Operating systems

- Ubuntu 22.04, 24.04, 26.04
- Centos Stream 9, 10
- Suse Enterprise 15 SP2+, 16; Open Suse tumbleweed

CFDEM®coupling on GPU**

- SPUMA derivation of OpenFOAM®-v2412
- Linux only
- System prerequisites of specified SPUMA version apply
- cmake 3.13

**This offering is not approved or endorsed by OpenCFD Limited, producer and distributor of the OpenFOAM software via www.openfoam.com, and owner of the OPENFOAM® and OpenCFD® trade marks.*

*** CFDEM®coupling on GPU is in beta-testing and has only been tested with the NVIDIA backend. Not all features and functionalities have been tested and validated.*

* functionality GPU compatible

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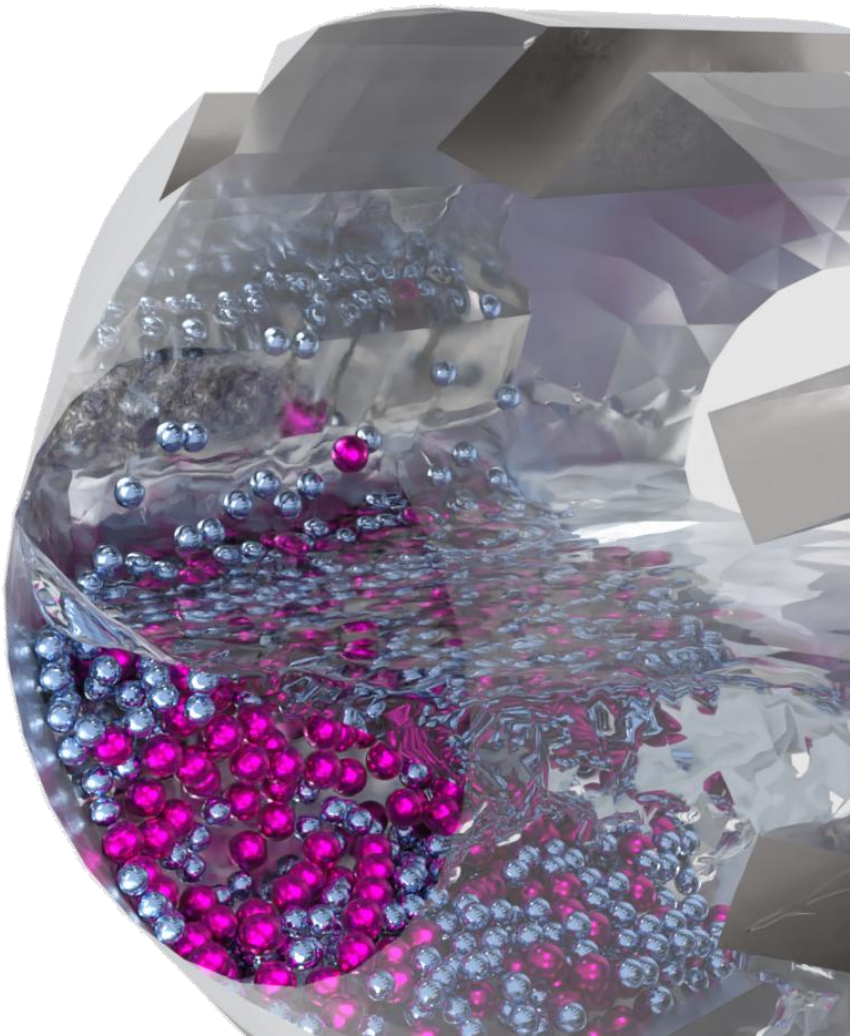
FEATURE LIST OVERVIEW



FEATURE LIST - OVERVIEW

Physics models

Immersed Boundary Method	Magneto-hydro-dynamics
Stokes dynamics	Volume of Fluid
drag correction	evaporation
fibre	heat sources
momentum sources	particle drag forces
particle fluid forces	particle fluid scalar exchange
particle lift forces	phase change
photon interaction	physical properties
scalar transport (Eulerian)	turbulence
velocity correction	viscosity models
voidfraction models	waves

Boundary conditions

inflow with particles	outflow with additional modelled pressure loss
particle fluid scalar exchange	

Meshes and geometry

Immersed Boundary Method	mesh motion

* functionality GPU compatible

Errors and clerical errors reserved.

FEATURE LIST - OVERVIEW

Numerics

default settings	mesh refinement
stabilization	

Postprocessing

averaging	particle statistics
visualization	

Solver

Euler-multiphase	Immersed Boundary Method
Volume of Fluid	incompressible fluid
light particles	nonspherical particles
particle fluid scalar exchange	solver wrapper

Utility

case setup	postprocessing

* functionality GPU compatible

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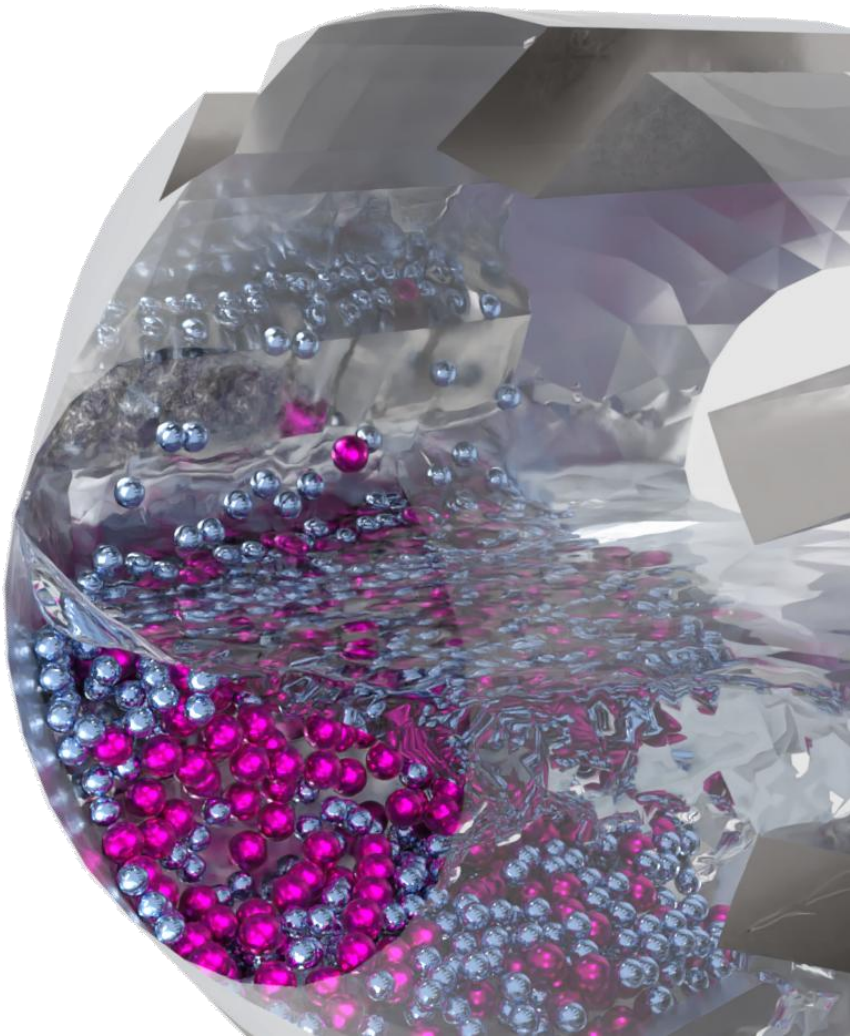
FEATURE LIST DETAILS



FEATURE LIST - PHYSICS MODELS

Immersed boundary method

Archimedes buoyancy	particle heat exchange
Shirgaonkar	IB-based particle deposition and clogging
IB voidfraction	IB voidfraction for convex particles
IB voidfraction for superquadrics	hybrid resolved/unresolved voidfraction

Magneto-hydro-dynamics

Lorentz force	

Stokes dynamics

Stokes clump drag	Stokes spheroid drag

Volume of fluid

interface	photon reflection at liquid-gas surface

Drag correction

scaleDragByFieldFunction	scaleDragByReFunction

* functionality GPU compatible

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FEATURE LIST - PHYSICS MODELS

Evaporation

thermal evaporation	transfer vapour

Fibre

Hoelzer-Sommerfeld	

Heat sources

gasBurner	

Momentum sources

fieldExplicitPorositySource	gasBurner
force superficial velocity	phase fraction-based momentum source

Particle drag forces

Beetstra	Benyahia
DEM based drag	Di Felice*
Gidaspow	Hoelzer-Sommerfeld
Koch-Hill	Ozel-Sundaresan
Rong	Schiller-Naumann
Shirgaonkar	Stokes clump drag
Stokes spheroid drag	noDrag

* functionality GPU compatible

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FEATURE LIST - PHYSICS MODELS

Particle fluid forces

Archimedes buoyancy*	Electrostatic force
pressure gradient force*	interface
periodic pressure	virtual mass force
viscous force*	IB-based particle deposition and clogging

Particle fluid scalar exchange

scalar capture	scalar emission
particle heat exchange	photon reflection at liquid-gas surface
generalized particle scalar exchange	generalized particle scalar exchange for phase change
manual scalar transport model (several scalars)	

Particle lift forces

Auton	Mei

* functionality GPU compatible

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FEATURE LIST - PHYSICS MODELS

Phase change

thermal evaporation	melting
changeScalar	

Photon interaction

photon reflection at liquid-gas surface	

Physical properties

heRhoThermoCFDEM	

Scalar transport (eulerian)

generic eulerian scalar field	temperatureModel

Turbulence

transfer turbulence	turbulence induced slip
stochastic dispersion	

Velocity correction

superficial velocity	

* functionality GPU compatible

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FEATURE LIST - PHYSICS MODELS

Viscosity models

Batchelor	Krieger-Dougherty
temperatureDependent	

Voidfraction models

IB voidfraction	IB voidfraction for convex particles
IB voidfraction for superquadrics	bigParticleVoidFraction
divided voidfraction using user-defined marker points	hybrid resolved/unresolved voidfraction
centre voidfraction	divided voidfraction*
divided voidfraction for convex particles	divided voidfraction for superquadrics
tet-based voidfraction	

* functionality GPU compatible

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FEATURE LIST - PHYSICS MODELS

Waves

Boussinesq	Grimshaw
McCowan	StokesI
StokesII	StokesV
cnoidal	irregularMultiDirectional
multiphaseMangrovesSource	multiphaseMangrovesTurbulenceModel
shallowWaterAbsorption	streamFunction
waveAlpha boundary condition	waveMaker
waveVelocity boundary condition	

* functionality GPU compatible

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FEATURE LIST - BOUNDARY CONDITIONS

Inflow with particles

uniformFixedValueVoidfraction	

Outflow with additional modelled pressure loss

uniformFixedValueTube	

Particle fluid scalar exchange

externalWallHeatTransfer	

* functionality GPU compatible

Errors and clerical errors reserved.

FEATURE LIST - MESHES AND GEOMETRY

Immersed boundary method

IB motion of meshed geometry	IB motion of particle

Mesh motion

IB motion of meshed geometry	cellZone rotation

* functionality GPU compatible

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FEATURE LIST - NUMERICS

Default settings

default discretization schemes (precision)	default discretization schemes (robust)
default schemes and solver settings	default solver settings (precision)
default solver settings (robust)	

Mesh refinement

dynamic mesh refiner	

Stabilization

limit fields by indicator	check coupling interval
check flux balance	bound field
smooth coupling fields	smooth coupling fields, particle-size dependent

* functionality GPU compatible

Errors and clerical errors reserved.

FEATURE LIST - POSTPROCESSING

Averaging

average slip velocity	field calculation wrapper
Favre-average field	time average field
store field with relaxation	

Particle statistics

particle surface in cell	particle volume in cell
particle volume	total momentum exchange
type concentration	particleProbe

Visualization

basic particle IO	cutomizable IO
particles with temperature	IO for pathlines
paraview macro and plugins	transfer fields
additional field IO	write_series

* functionality GPU compatible

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CFDEM®COUPLING

FEATURE LIST - SOLVER

Euler-multiphase

cfdemSolverMultiPhaseEuler	

Immersed boundary method

cfdemSolverIB	

Volume of fluid

cfdemSolverInter	

Incompressible fluid

cfdemSolverPimple*	cfdemSolverPiso*
cfdemSolverPisoNonspherical	cfdemSolverPisoScalar

Light particles

cfdemSolverBubble	

Nonspherical particles

cfdemSolverPimple	cfdemSolverPisoNonspherical

Particle fluid scalar exchange

cfdemSolverPisoScalar	

* functionality GPU compatible

Errors and clerical errors reserved.

FEATURE LIST - SOLVER

Solver wrapper

cfdemCleanCase	cfdemSimulate

* functionality GPU compatible

FEATURE LIST - UTILITY

Case setup

decomposePar for CFD-DEM cases	reconstructPar for CFD-DEM cases
surfaceMeshTriangulate for CFD-DEM cases	

Postprocessing

fluid field export on cell centres	foamToVTK for CFD-DEM cases
clockModel timings postprocessor	

* functionality GPU compatible

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