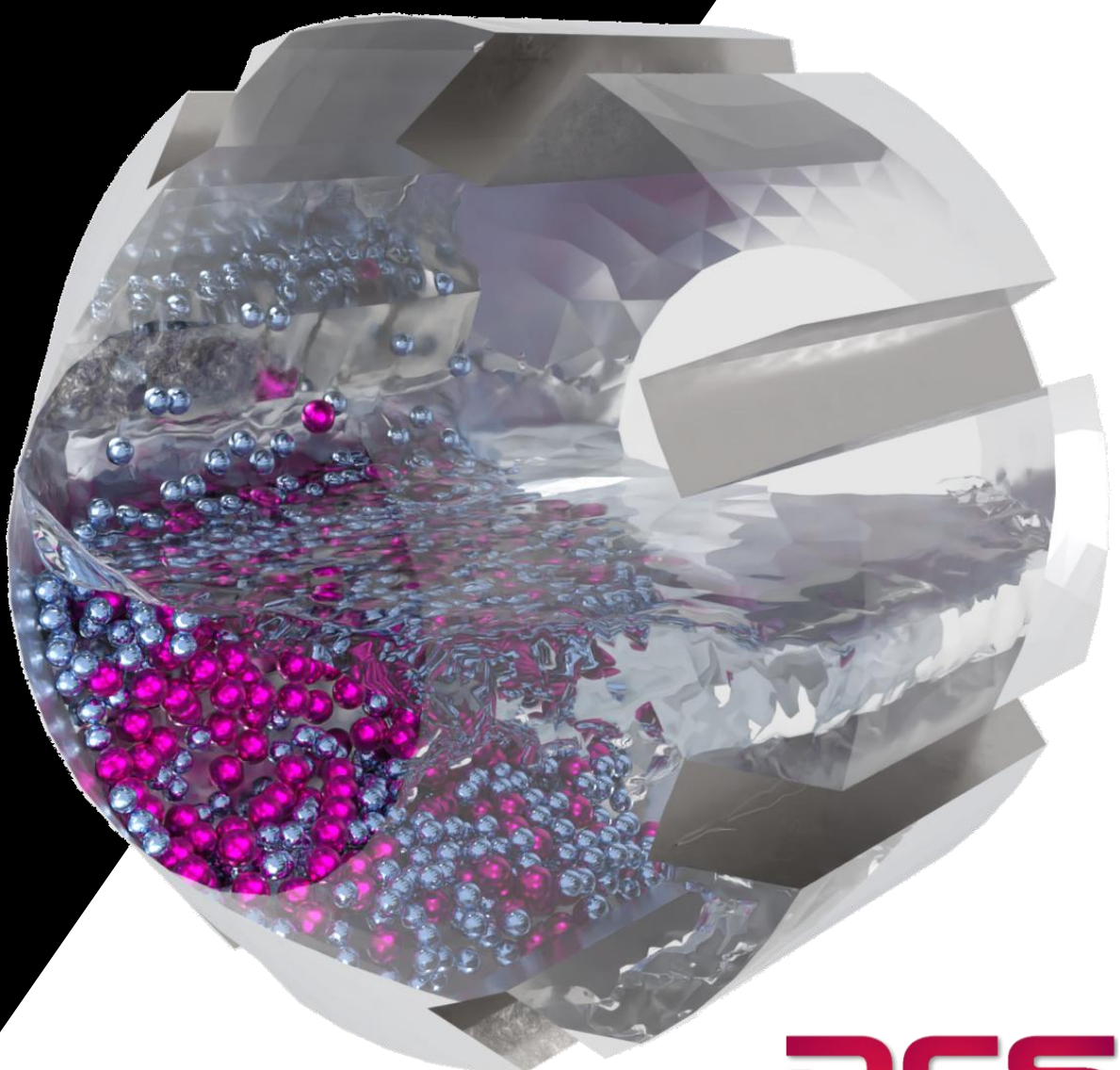
CFDEM COUPLING CHEMISTRY

PRODUCT INFORMATION



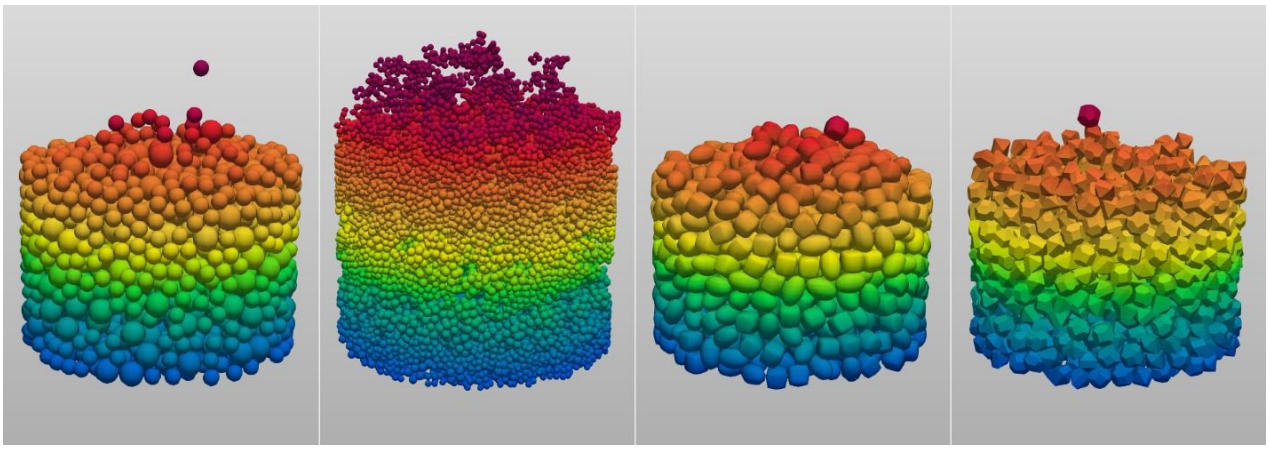
DCS COMPUTING

CFDEM®COUPLING

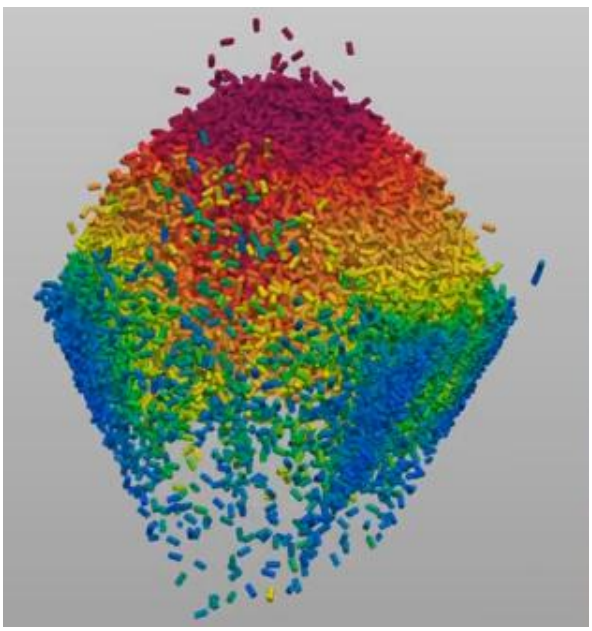
HIGHLIGHTS

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

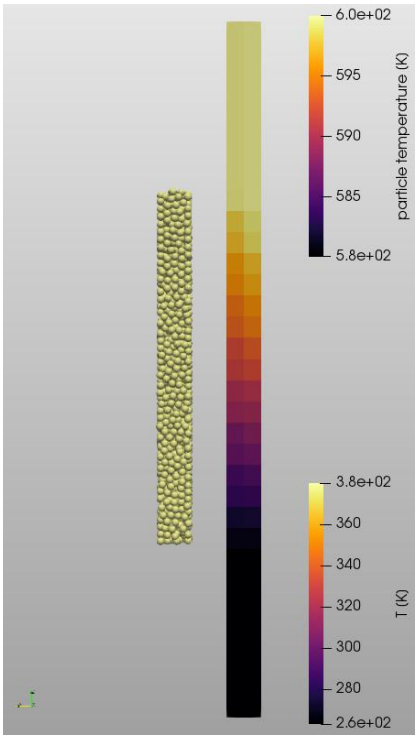
Supports all Aspherix® particle shapes



Drag laws for all flow regimes



Particle-fluid heat transfer

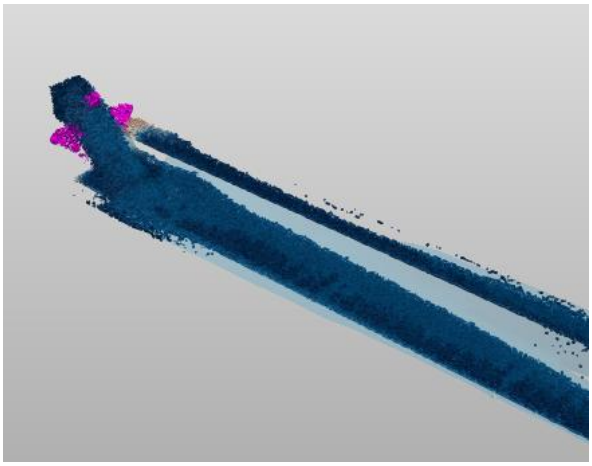


* functionality GPU compatible

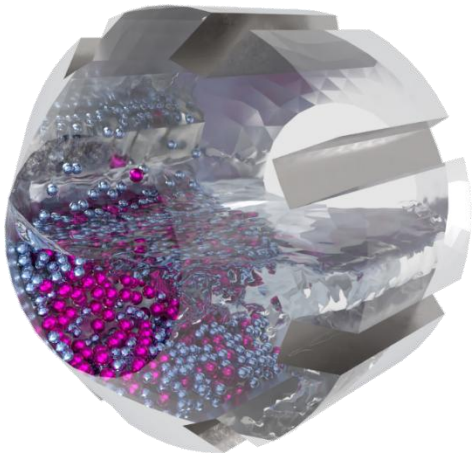
CFDEM®COUPLING

HIGHLIGHTS

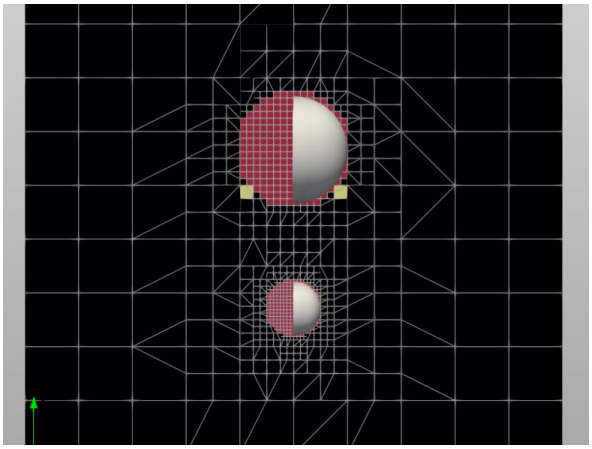
Spray coating & evaporation

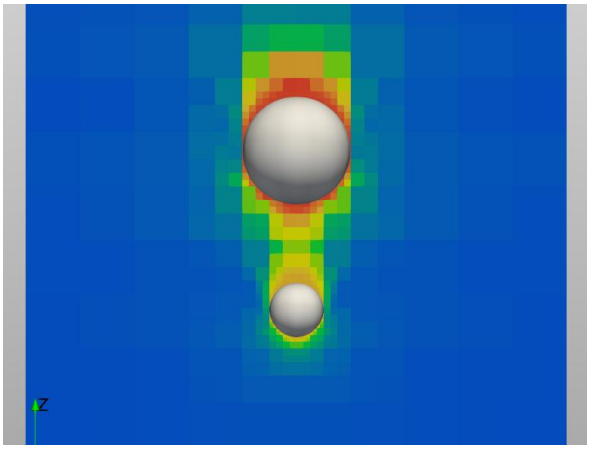


Volume-of-Fluid multiphase

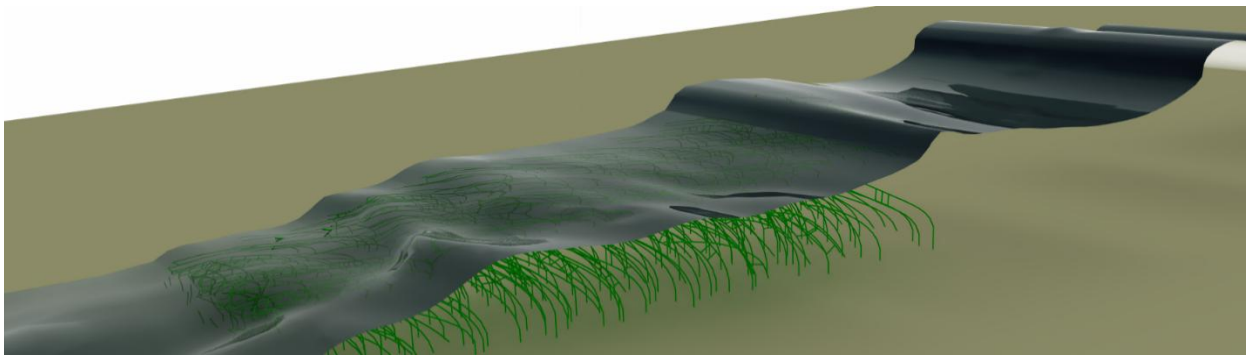


Immersed boundary method with adaptive mesh refinement





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



* functionality GPU compatible

DCS Computing GmbH | www.dcs-computing.com
Errors and clerical errors reserved.

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

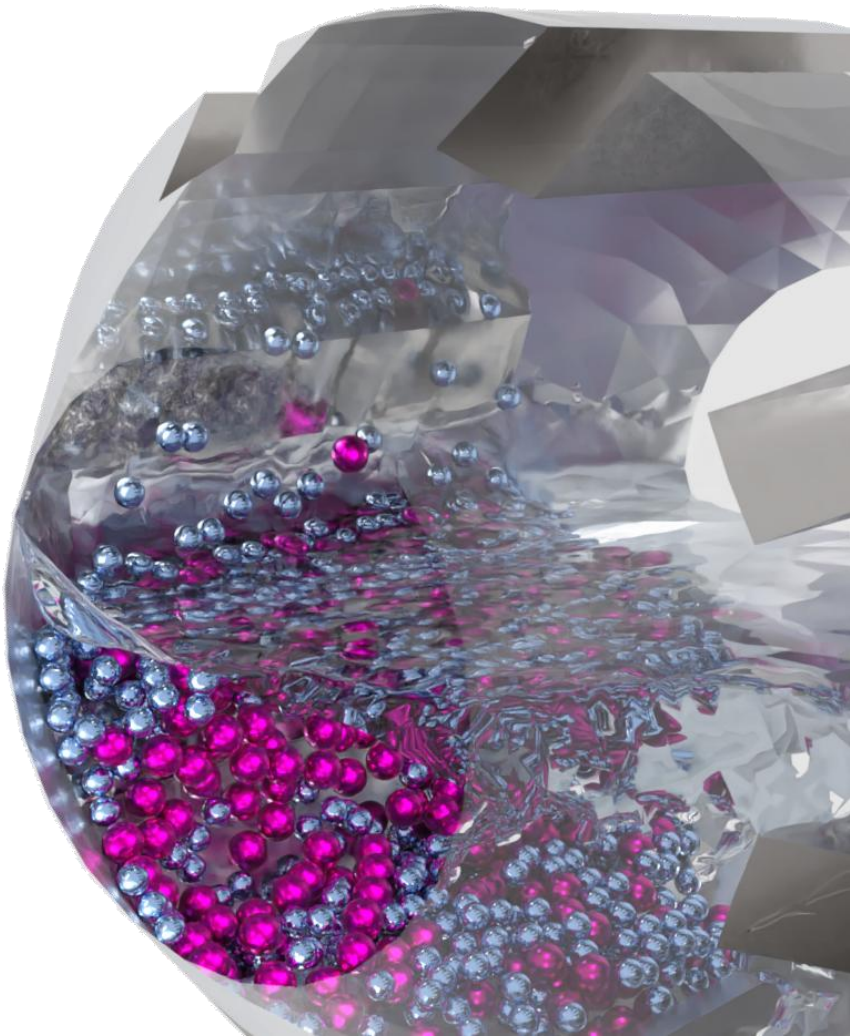
**This offering is not approved or endorsed by OpenCFD Limited, producer and distributor of the OpenFOAM software via www.openfoam.com, and owner of the OPENFOAM® and OpenCFD® trade marks.*

*** 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

Errors and clerical errors reserved.

FEATURE LIST OVERVIEW



CFDEM®COUPLING

FEATURE LIST - OVERVIEW

Physics models

Immersed Boundary Method	Magneto-hydro-dynamics
Stokes dynamics	chemistry
drag correction	evaporation
fibre	film formation
momentum sources	particle drag forces
particle fluid forces	particle fluid scalar exchange
particle lift forces	radiation
scalar transport (Eulerian)	spray handling
turbulence	velocity correction
viscosity models	voidfraction models

Boundary conditions

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

Meshes and geometry

Immersed Boundary Method	mesh motion

* functionality GPU compatible

FEATURE LIST - OVERVIEW

Numerics

default settings	mesh refinement
stabilization	

Postprocessing

averaging	particle statistics
visualization	

Solver

Immersed Boundary Method	chemistry
compressible fluid	incompressible fluid
nonspherical particles	particle fluid scalar exchange
solver wrapper	spray handling

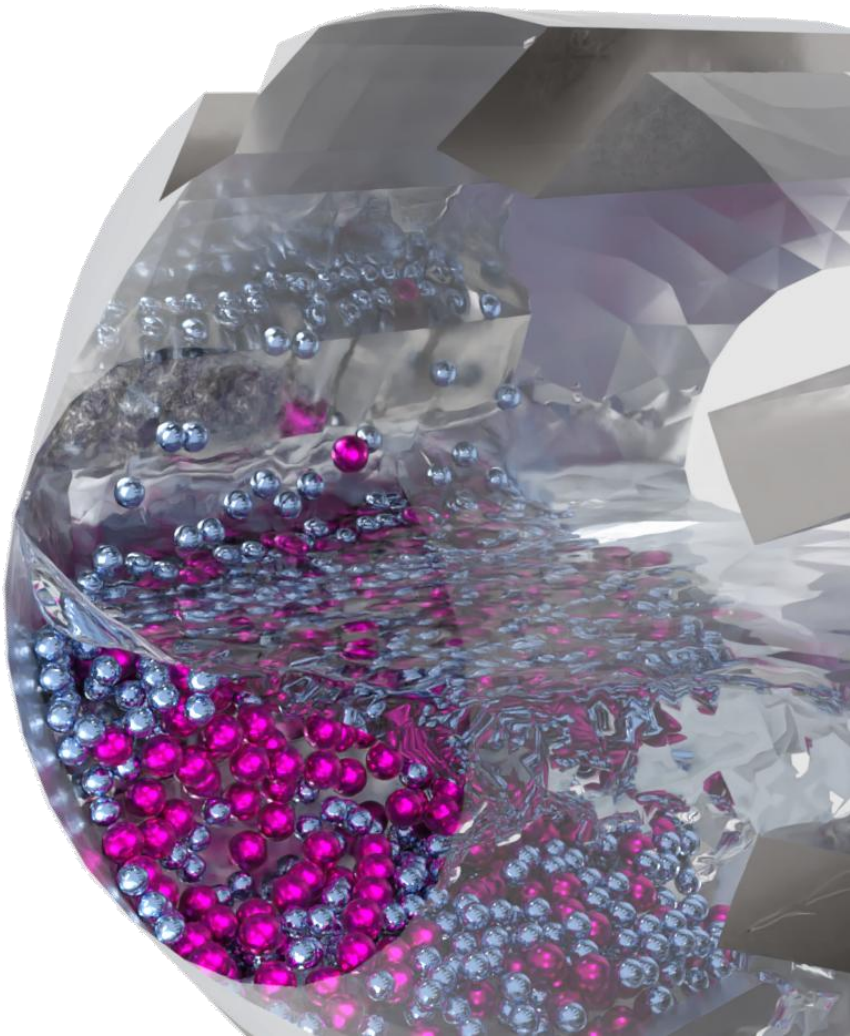
Utility

case setup	postprocessing

* functionality GPU compatible

DCS Computing GmbH | www.dcs-computing.com
Errors and clerical errors reserved.

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

Chemistry

EulerImplicit	voidfraction-aware ODE-solver
voidfraction-aware chemistry	

Drag correction

scaleDragByFieldFunction	scaleDragByReFunction

* functionality GPU compatible

DCS Computing GmbH | www.dcs-computing.com
Errors and clerical errors reserved.

FEATURE LIST - PHYSICS MODELS

Evaporation

transfer vapour	

Fibre

Hoelzer-Sommerfeld	

Film formation

particle film formation	particle film formation from spray

Momentum sources

fieldExplicitPorositySource	force superficial velocity

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

DCS Computing GmbH | www.dcs-computing.com
Errors and clerical errors reserved.

FEATURE LIST - PHYSICS MODELS

Particle fluid forces

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

Particle fluid scalar exchange

particle film formation	particle film formation from spray
scalar capture	scalar emission
particle mass change	particle spray interaction
particle heat exchange	generalized particle scalar exchange
manual scalar transport model (several scalars)	

Particle lift forces

Auton	Mei

* functionality GPU compatible

DCS Computing GmbH | www.dcs-computing.com
Errors and clerical errors reserved.

FEATURE LIST - PHYSICS MODELS

Radiation

particle fluid radiation heat exchange	constant scatter model
pseudo scatter model	P1 radiation model

Scalar transport (eulerian)

generic eulerian scalar field	temperatureModel

Spray handling

particle film formation from spray	particle spray interaction

Turbulence

transfer turbulence	turbulence induced slip
stochastic dispersion	

Velocity correction

superficial velocity	

Viscosity models

Batchelor	Krieger-Dougherty
temperatureDependent	

* functionality GPU compatible

DCS Computing GmbH | www.dcs-computing.com
Errors and clerical errors reserved.

FEATURE LIST - PHYSICS MODELS

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

DCS Computing GmbH | www.dcs-computing.com
Errors and clerical errors reserved.

FEATURE LIST - BOUNDARY CONDITIONS

Coupled heat transfer

fixedValue for scalar from external source	

Inflow with particles

uniformFixedValueVoidfraction	

Outflow with additional modelled pressure loss

uniformFixedValueTube	

Particle fluid scalar exchange

externalWallHeatTransfer	

* functionality GPU compatible

DCS Computing GmbH | www.dcs-computing.com
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

DCS Computing GmbH | www.dcs-computing.com
Errors and clerical errors reserved.

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

DCS Computing GmbH | www.dcs-computing.com
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 temperature	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_pvd
write_series	

* functionality GPU compatible

DCS Computing GmbH | www.dcs-computing.com
Errors and clerical errors reserved.

CFDEM®COUPLING

FEATURE LIST - SOLVER

Immersed boundary method

cfdemSolverIB	

Chemistry

cfdemSolverChem	

Compressible fluid

cfdemSolverChem	cfdemSolverRhoPimple

Incompressible fluid

cfdemSolverPimple*	cfdemSolverPiso*
cfdemSolverPisoNonspherical	cfdemSolverPisoScalar

Nonspherical particles

cfdemSolverPimple	cfdemSolverPisoNonspherical

Particle fluid scalar exchange

cfdemSolverPisoScalar	

Solver wrapper

cfdemCleanCase	cfdemSimulate

* functionality GPU compatible

Spray handling

cfdemSolverChem	

* functionality GPU compatible

Errors and clerical errors reserved.

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

DCS Computing GmbH | www.dcs-computing.com
Errors and clerical errors reserved.