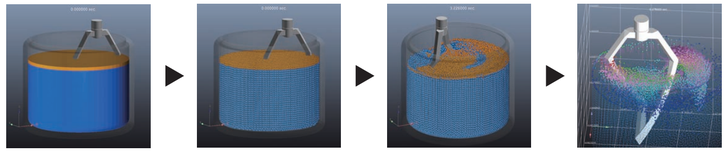
Integrated work flow, no mesh generation

Particleworks is an integrated software that includes the fluid solver, pre-processor and post-processing tools.

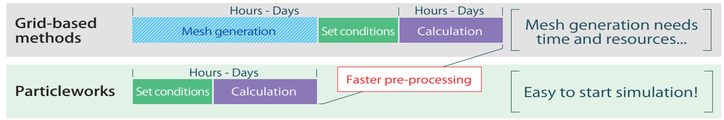
Particleworks work flow

GPU acceleration

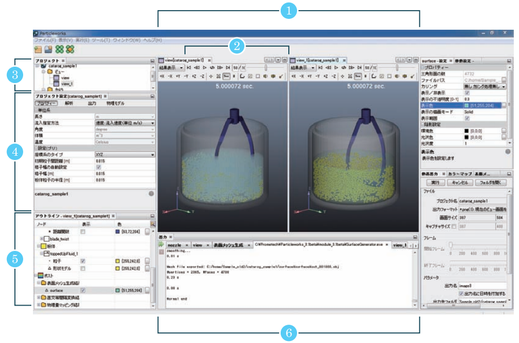


CAD data import | Particle generation (Pre-processing) | Set conditions, start simulation | Result evaluation (Post-processing)

No Mesh Generation, Fast Pre-processing



Intuitive user interface



1 View window
Customizable data display of results (Velocity, Pressure, etc.) in separate views.

2 Animation
Easy and speedy animation. Output formats: AVI, MPEG.

3 Project window
Tree-structured Project management.

4 Project settings window
Settings for Pre-Processing including particle size, calculation conditions, physics models and data output settings.

5 Outline window
Node-based navigation through data elements with quick access to visual properties.

6 Log window
Detailed log messages and solver warnings are displayed.

Features

Solver

Analysis features	CPU	GPU	2D
・Free-surface flow, non-steady flow	◉	◉	◉
・MPS-DEM coupling	◉	◉	—
・Fluid-Rigid coupling	◉	—	◉
・Explicit/Implicit pressure calculation	◉	◉	◉
・Negative pressure	◉	—	—
・Explicit/Implicit viscosity calculation	◉	◉	◉
・Surface tension (Potential/CSF)	◉	◉	◉
・Non-newtonian flow (Bingham/ Power-law/Cross-Arrhenius/User defined tables, functions)	◉	◉	◉
・Turbulent flow (LES+Wall function)	◉	◉	—
・Air resistance	◉	—	—
・Parallel computation (SMP/MPP/Hybrid)	◉	—	◉

Boundary conditions
・Moving inflow
・Moving polygon wall

Option modules
・GPU calculation
・2D calculation

Pre/Post

Pre-processing
・Simulation conditions (Particle generation, polygon wall generation)
・Inflow setting (round shape/rectangle)
・CAD data import (STL format, OBJ format)
・Motion data and user defined viscosity data import (csv format)

Post-processing
・Drawing functions (contour, path of particles, isosurface, animation, surface)
・Output data (positions, velocity, pressure, shear strain velocity, torque, etc)
・Output file (Pictures (JPEG/PNG), Animation video (MPEG/AVI), Surface (STL), result data in ASCII (prof))
・Digital data output (CSV format)

Requirements
・OS:WindowsXP, Windows Vista, Windows7, Linux(64bit only)
・OpenGL:3.0 ～
・Memory:2GB ～
・HDD:5GB ～

GPU recommendations
NVIDIA Tesla C2050 (3GB)/C2070, C2075, M2090 (6GB)
NVIDIA GeForceGTX 480, 580 (1.5GB)

[Developer]

Prometech Software
HIGH PERFORMANCE SIMULATION & COMPUTER GRAPHICS
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2012.6

Prometech Software
HIGH PERFORMANCE SIMULATION & COMPUTER GRAPHICS

Particleworks®
Particle-based simulation software for CAE
Ver. 4.0

DESIGNED FOR NVIDIA CUDA
Low cost & High performance GPGPU

Next-generation particle-based CAE

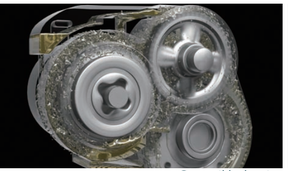
Particleworks is used in a wide range of industrial applications.

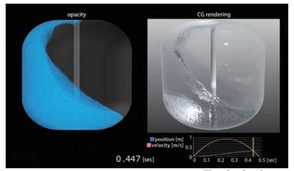
- **Auto**
  - Gear oil behavior
  - Tank sloshing
- **Nuclear**
  - Spent fuel storage pool sloshing
  - Loss-of-coolant accident analysis
- **Civil Engineering**
  - Tsunami
  - Flood
- **Machinery**
  - Steel stamp cooling
  - Debris wash out
- **Consumer Goods**
  - Detergent flow
- **Chemical**
  - Chemical mixer
- **Food**
  - Food mixier
- **Material**
  - Injection molding
  - Compound material forming

Particle works®
Particle-based simulation software for CAE

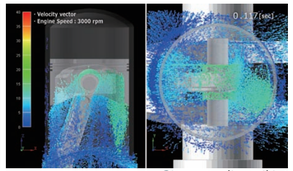
Case studies

*Some models are rendered using third-party renderers.

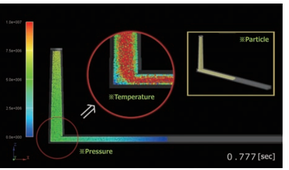

Gear oil behavior



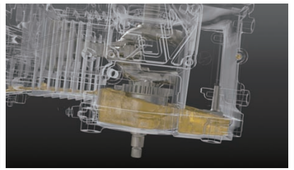
Tank sloshing

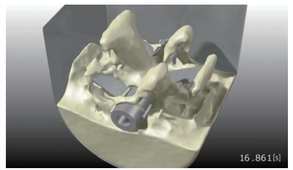


Piston cooling oil jet

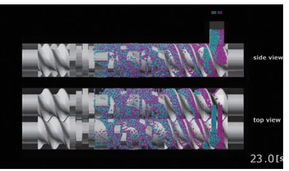


Plastic molding

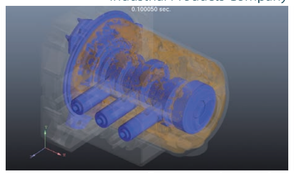

Crankcase oil sloshing
Courtesy of Fuji Heavy Industries Ltd.
Industrial Products Company

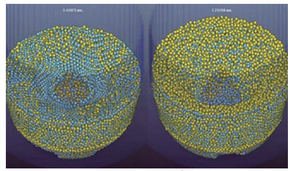


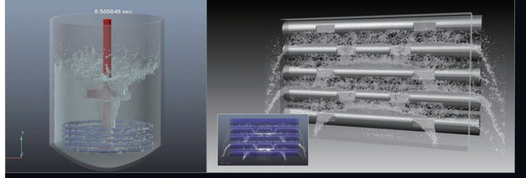
High-viscosity mixing



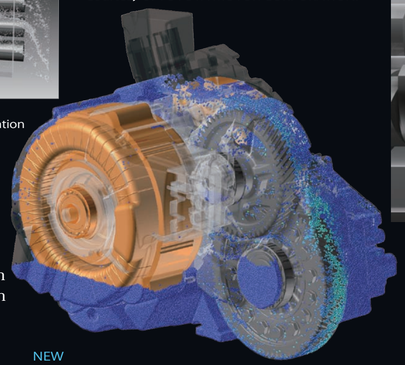
Twin-screw injection molding
Courtesy of The Japan Steel Works, LTD.


Crankcase oil splashing
Courtesy of agricultural machinery company


Barrel finishing machine
Courtesy of Tipton Corp.


Mixing simulation with deep vortex
Courtesy of
Mitsubishi Chemical Corporation

Cooling in continuous casting
Courtesy of Nippon Steel Corporation


Oil behavior in HV transaxle
Courtesy of TOYOTA MOTOR CORPORATION.

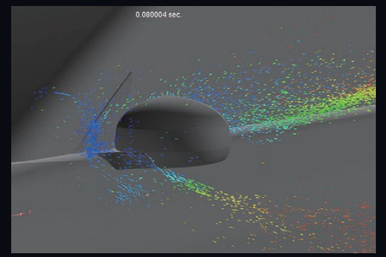
Robust simulation for free-surface flow

Particleworks can simulate complex liquid and powder phenomena with free surface which can not be analyzed by existing grid-based simulation methods.

NEW

Air resistance model

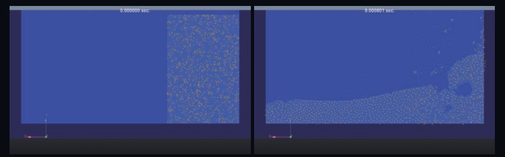
This function enables you to simulate behavior of droplets or water mass affected by air flow. Particleworks simulates the behavior by referring the velocity field of the air flow obtained from other CFD codes. Ex.) Driving in rain.



NEW

Random powder configuration

You can choose to generate powder particles at regular intervals or in a random manner as an initial particle configuration.

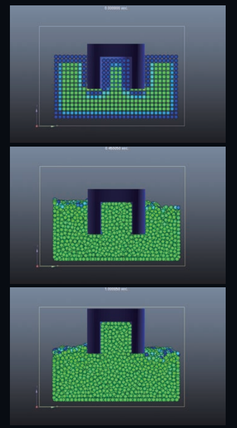


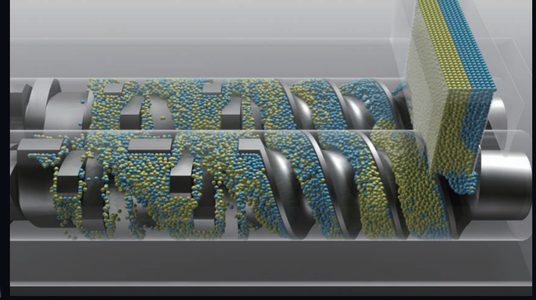
NEW

Negative pressure treatment

In the general MPS simulation, it is impossible to consider the negative pressure effects.
However, Prometech and the University of Tokyo have developed a new model and succeeded to consider the effects.

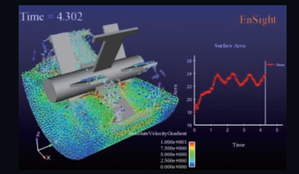
*Kazuya Shibata, Koji Murozono, Masahiro Kondo, Mikio Sakai and Seiichi Koshizuka,
Numerical modeling of gas-phase pressure, negative pressure and curl operator by the MPS method,
Proceedings of the conference on computational engineering and science, Vol.17, C-2-3, (2012) [In Japanese]




Twin screw extruder analysis
Courtesy of The Japan Steel Works, LTD.

Innovation of material mixing

Complicated boundary conditions can be directly set from original CAD data.



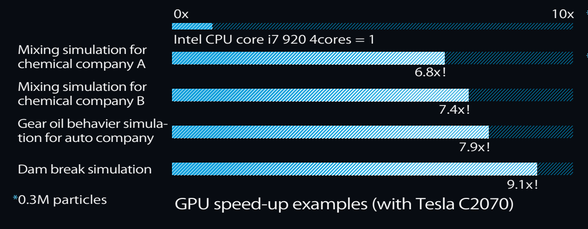
Compatibility with EnSight

*EnSight is a post-processing and visualization software for scientific data and a product of CEI SOFTWARE.
Calculation results from Particleworks can be converted to EnSight format.
This tool is free and non-support.

High-performance simulation with Multi-GPU

With the GPU technology, Particleworks is capable of performing massive amount of computational work. GPUs will save energy, costs, spaces and calculation time. (Option module)

5x～10x Speed-up!



*0.3M particles

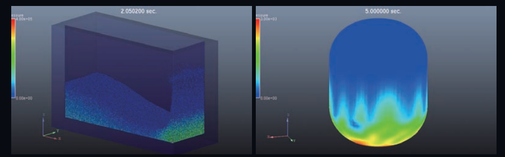
GPU speed-up examples (with Tesla C2070)

*1M Particle simulation requires about 6GB GPU Memory in case of GPU computation
*Multiple GPUs make it possible to expand the maximum number of particles


GPU Computing Board
NVIDIA Tesla™ C2075

Physical quantities mapping to structured surface(mesh)

Particleworks is able to map physical quantities from particles which exist along with structured surface (mesh) to structure.



NEW

User defined function for non-newtonian flow

UDF for Non-Newtonian flow makes it possible to define various flow characteristics with functions and user defined tables.