



PROMETECH.

[Developer, Main Domestic / Global Dealer]

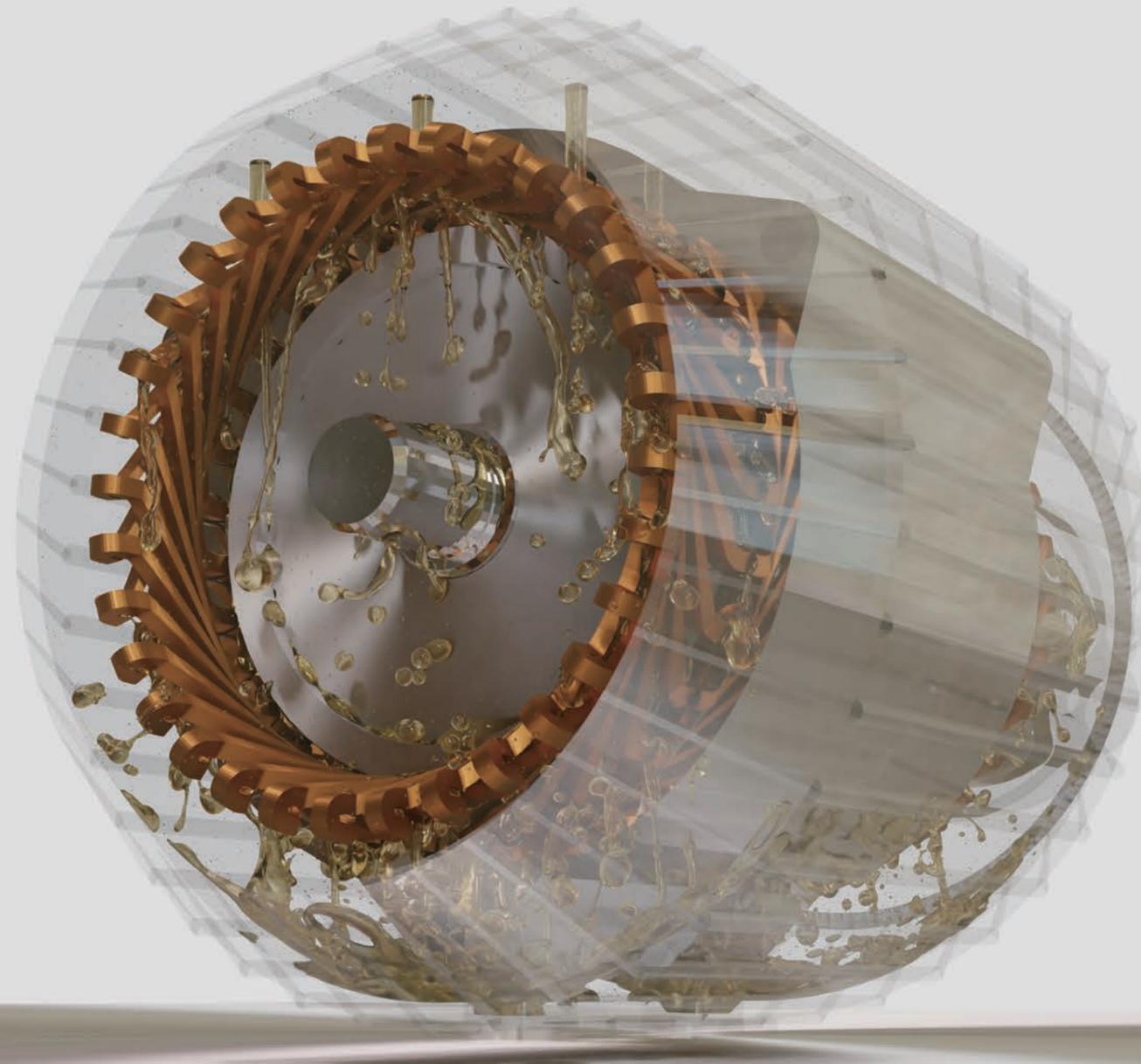
Prometech Software, Inc.



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Computational Reality



The particle method opens up advanced CFD

Simulates fluid behaviors at hi-speed

Particleworks is simulation software for fluids with large deformation that can solve various fluid-related problems — gear oil lubrication, motor cooling, waterway driving, mixing and stirring of chemicals and foods, landslides, and floods.

Shows its true power in GPU computing environments

Particleworks has been developed as being used in GPU computing environments. It drastically reduces resourcing costs and time of product development and encourages engineers to work more creatively.

Co-operation between Industry and Academia

Particleworks has been progressing to realize high value-added manufacturing, supported by knowledge from various universities and user companies.

Wide-range solutions applied for various industries

Because of its application potential, Particleworks has been adopted in various industries; Automotive, transportation, steel and metals, medical and pharmaceuticals, food and lifestyle-related products, civil engineering and construction, electricity, materials and chemicals, social infrastructure, and energy.

Users / Industries and applications

Automotive & Transportation



- Waterway driving
- Splash
- Gear oil stirring
- Chain oil
- Motor oil cooling

Civil engineering & Constructions



- Landslide and Tsunami simulation
- Concrete flow simulation
- Tunneling simulation

Infrastructure & Energy



- Coolant sloshing
- Flows in pressure vessel

Steel & Metals



- Cooling spray behavior simulation
- Extrusion

Chemicals & Materials



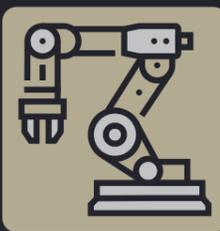
- Soldering, brazing, and welding simulation
- Agitation simulation
- Impregnation behavior simulation of composite materials

Foods & Consumer goods



- Food mixer simulation
- Cosmetic emulsification simulation
- Flow simulation inside a shower head

Electricity & Machinery



- Washing machine balancer simulation
- Washing simulation of cutting chips
- Water splash simulation on electric machine

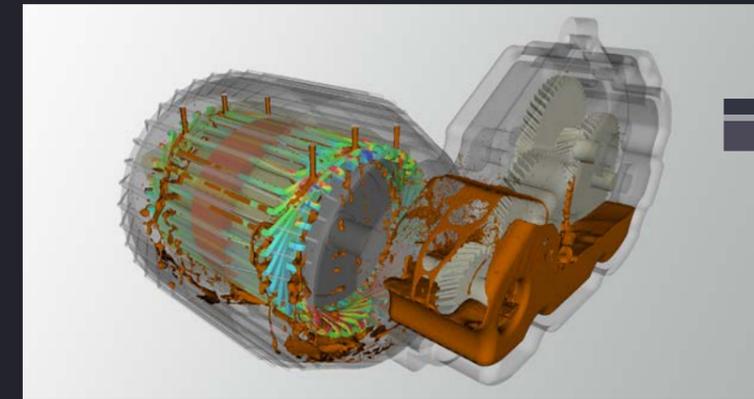
Medical & Pharmaceuticals



- Blood flow simulation
- Mouthwash simulation
- Tablet shape optimization
- Mixing medicine process simulation

Practical solutions

We develop our software to solve on-site issues by incorporating customers' feedback.

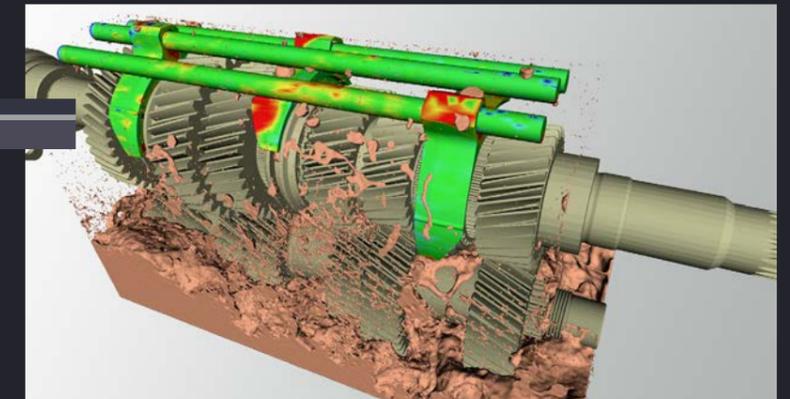


Multiphysics simulation

Co-operating with other software realizes the broader range of simulation.

HPC Customization for your demand

We provide the best hardware environment for each customer.



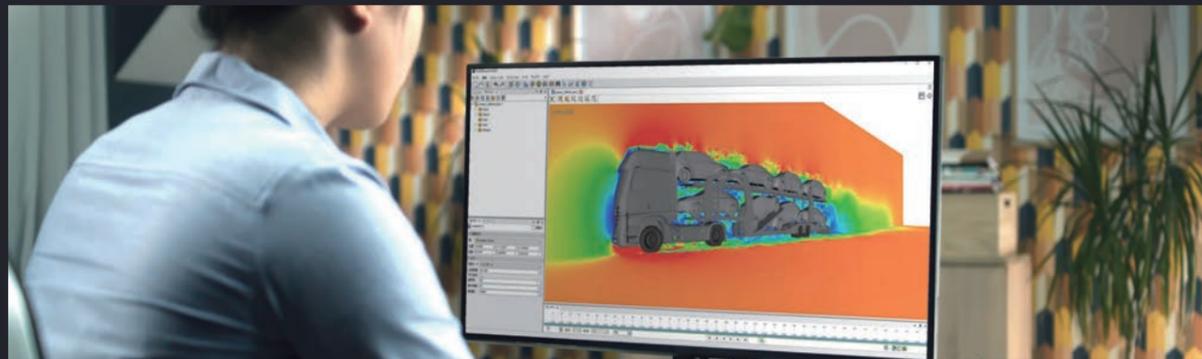
Visualization

Let us know if you want photoreal images and videos based on CAE results.

Intuitive GUI

GUI

Equipped with a viewer compatible with Windows and Linux, the GUI allows intuitive operation of pre-processing, calculation, and post-processing. The efficient and simple design and architecture reduce the time spent on initial user training and facilitate complex project management, calculation setup, post-processing, and evaluation of calculation results.



Post-processing

Physical quantity measurement of fluid particles

In addition to functions necessary for evaluating calculations, such as particle information acquisition, physical quantity statistics, and filtering, our software also features detailed customization options including a color bar, ruler, and time code functions.

Fluid surface extraction

A fluid surface mesh can be generated from the particle information based on the calculation results. This enables visualization close to reality and makes it possible to check the liquid surface behavior and calculate surface areas. The mesh can be exported in STL or OBJ format for external use.

Video export / Screenshot

Input models with moving-rotating settings and calculation results can be animated in the view window and exported as a movie file or sequentially numbered image files. PNG, JPEG, MP4, and WMV are supported as output formats. The screenshot function exports PNG image files.

Pre-processing

With an intuitive setting wizard, various calculation conditions such as material properties (e.g., density, kinematic viscosity coefficient), physical models (e.g., viscosity, surface tension), initial time step, initial particle distance, and calculation end time can be set. Physical properties and calculation conditions can be programmed as user-defined functions.

Physical quantity mapping against polygon walls

The polygon wall does not have physical quantities, but it is possible to map them from particle information near the wall surface to vertices of the polygon wall shape. The results can be displayed or exported as text data.

Exporting simulation results

Loading exported CSV files with spreadsheet software, physical quantities, such as particle coordinates, velocity, pressure, density, and shear rate, can be evaluated graphically.

Free Viewer

For visualization, we provide a dedicated free viewer that can display the results of calculations without consuming a license, with features such as animation playback, color map modification, and snapshot application. These functions help with simple evaluation and analysis.

4 Steps to complete the simulation process

There is no need to make troublesome model modifications. The whole simulation process, from settings to visualization of results, can be done with seamless operation along the wizard. The GUI makes it easy to set up even more complex conditions.

STEP 01 Modeling

The modeling phase would be done by simply importing CAD data (STL, OBJ, and Nastran are supported) directly into Particleworks.

STEP 02 Setting conditions

Apply motion and rotation conditions to the imported shape models, and specify fluid properties such as viscosity and surface tension for each fluid to be simulated.

STEP 03 Calculation

No meshing is required. Particles are automatically generated before the calculation runs. Results can be checked even during the calculation. GPU computing is supported, allowing for faster computation.

STEP 04 Post-processing

Visualization of simulation results is possible through a wide range of post-processing functions, including fluid surface extraction, data export in CSV format, and exporting movie data.

Make your process simpler
with incredibly intuitive operation



Basic functions & physics solver

In addition to robust and stable computations using the high-performance MPS solver as the core, a conjugate heat transfer solver and an airflow solver are included to enable multiphysics simulations that more closely approximate real-world phenomena.

GPU computing

High-speed computation can be performed with GPU computing. Highly scalable multi-GPU computing is also supported, allowing calculations with more than a hundred million particles.

Pressure calculation

Implicit method / Explicit method

You can choose between implicit and explicit pressure calculation methods. Calculations can be speeded up with the explicit method, provided that the speed of sound is appropriately given.

Pressure oscillation suppression function

The pressure oscillation suppression function reduces the spatial pressure fluctuations inherent in the particle method.

Viscosity calculation

Not only Newtonian fluids but also Bingham and non-Newtonian fluids using Power-law models are available. Moreover, you can achieve even greater flexibility in setting viscosity with table data and user function definitions.

Turbulence model

A hybrid model of the LES (Large Eddy Simulation) model and a wall model, which compensates for the lack of resolution near walls, is adopted as the turbulence model. This enables the simulation of flows containing turbulent effects.

Rigid model

Non-deforming objects can be set as rigid particles. Complex flow and rigid body behavior can be analyzed through coupled calculations with fluid particles.



Boundary conditions

Wall boundary, moving boundary

Both particle walls and polygon walls are available for wall boundaries. Using polygon walls can reduce memory usage and speed up calculations. Moreover, the movement setting function allows for reproducing complex movements of walls (objects).

Inflow/outflow boundary, pressure boundary

The inlet function allows you to simulate the inflow of fluids and granular materials into the computational domain. You can set the motion of the inflow boundary and the time-varying velocity or flow rate.

Moving computational domain, periodic boundary

The computational domain itself can be arbitrarily moved to save computing resources for analyses covering a wide domain, such as waterway driving.

Surface tension model

CSF and potential models are implemented to calculate surface tension from the geometric shape of the interface and interfacial energy between objects, respectively. It is possible to consider contact angles between wall-fluid and fluid-fluid interfaces, enabling simulations of various immiscible fluids like water and oil.

Heat transfer coefficients

The heat transfer coefficients of fluid particles can be evaluated. The heat transfer coefficient distribution mapped on the structure can be exported for use in other software.



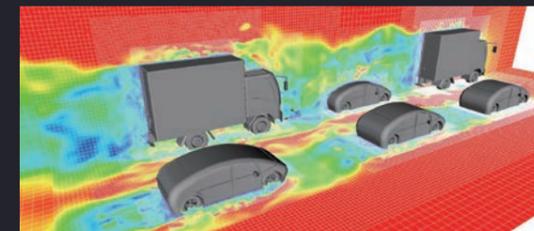
Advanced simulation functions and physical models

Multi-resolution

This method divides the simulation domain into the Coarse domain and the Fine domain, which are computed using coarse and fine particles, respectively. By only placing fine particles in areas that require high resolution or are narrow, it is possible to reduce computational load and memory consumption.

Conjugate heat transfer

Fluid-structure and structure-structure heat transfer calculations are available for both steady-state and transient simulations. Steady-state simulations support boundary settings via CSV files and fast computations with a high-speed matrix solver.



Snow model

We provide the modeling of snow as a Bingham fluid (a fluid that does not flow until it is subjected to a certain shear stress). This allows for calculations such as snow compaction behavior, where snow is deposited and compressed.

FVM airflow solver

The FVM solver enables one-way/two-way airflow-coupled simulation with MPS fluid particles. It supports both steady-state and transient simulations.

LBM airflow solver

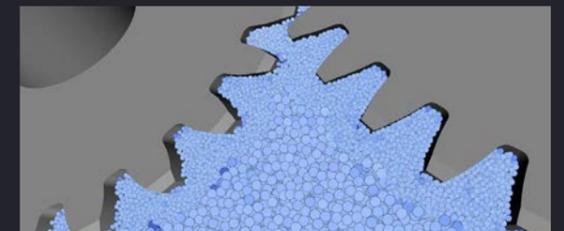
The Lattice Boltzmann Method (LBM) solver enables airflow-coupled simulation with MPS fluid particles. It is possible to apply wall boundary conditions that model boundary layer flow near walls in high Reynolds number flows.

MPFI

MPFI is a method that simultaneously calculates the pressure and viscosity terms of the Navier-Stokes equations implicitly without separating them. This method is effective for problems with low Reynolds numbers and high pressure, such as the flow of high-viscosity fluids like resins.

Dynamic contact angle model

In surface tension calculations, both uniform and dynamic contact angle settings can be used, allowing representation of the forward and backward contact angles of sliding droplets.



Particle shifting

The Particle Shifting function is implemented to move particles and make their distribution uniform by eliminating bias. This function effectively stabilizes calculations of highly viscous fluids where the particle distribution may not be uniform.

Negative pressure function

With the newly implemented pressure gradient model, stable calculations can be conducted without disregarding negative pressure. In the original MPS method, the minimum particle pressure was set to 0 Pa to stabilize the calculation, making it difficult to handle negative pressure.

Passive scalars

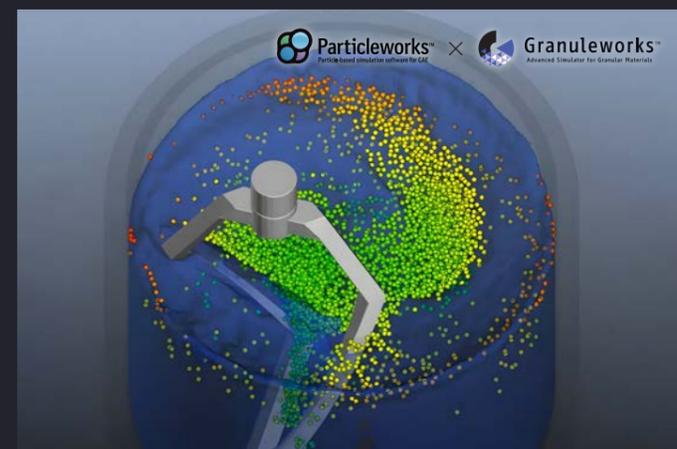
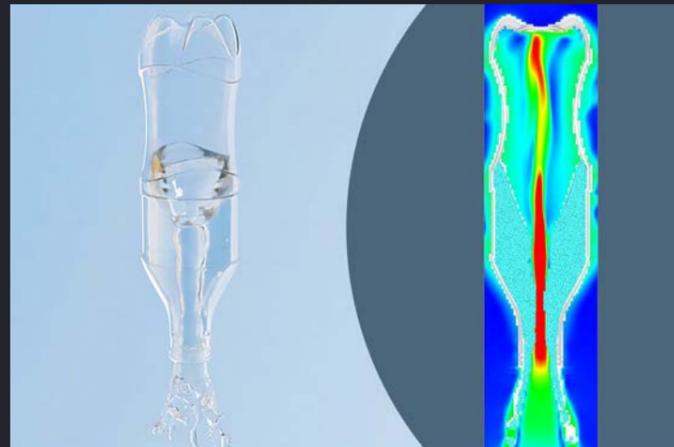
"Passive Scalars" like concentrations, which are transported passively without affecting the flow, are available and applicable to MPS particles and FVM grids.

Multiphysics simulation

For a more realistic evaluation of designs, various coupled calculations can be performed with Granuleworks, Prometech's granular solver, and third-party CAE software that handles other calculations such as; structure, impact, mechanism, fluid, and electricity.

Fluid - airflow simulation

MPS-airflow coupling simulation is possible by coupling with the FVM (Finite Volume Method) and LBM (Lattice Boltzmann Method) solver in Particleworks. The coupling simulation with MPS fluid particles can be 1-way/2-way coupling.



Fluid - granular simulation

By coupling the Discrete Element Method (DEM) with the MPS method, complicated simulations such as mixing, stirring, and conveying granular materials and fluids can be performed. With the aeration function, you can model air bubbles in oil behavior simulations, mixing tank simulations in chemical processing, etc.

Co-operating with other software

Simulation results of Particleworks can be imported to other simulation software such as; Abaqus, ANSYS, MSC Nastran, NX Nastran, LS-DYNA, and JMAG. The physical quantity data of particles can also be exported as CSV files, and converted to other formats so that you can use it as boundary conditions in other CAE software.

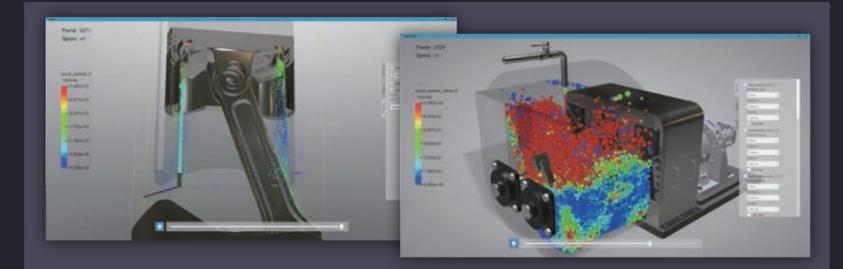
e.g.

Co-simulating with RecurDyn, the MBD simulation tool from Functionbay enables a two-way simulation between fluids and mechanisms.



SIMUNIMA - The efficient visualization program for CAE results -

SIMUNIMA enables CG software to edit and render CAE results by converting them into a universal CG format. It supports Particleworks/Granuleworks natively, enabling efficient visualization, movie creation, and development of XR content.

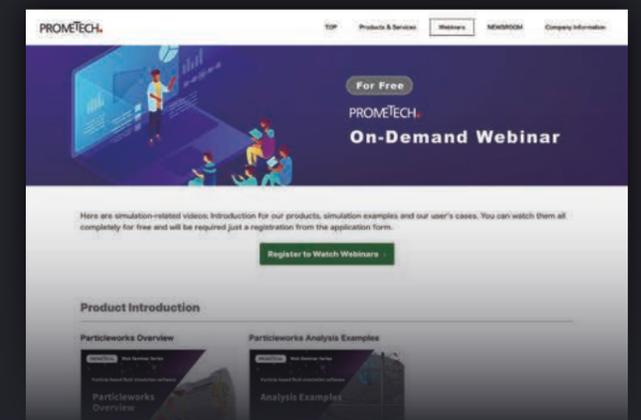


Webinars

You can see on-demand webinars such as introductions for our products, simulation examples and our user's cases. They are all completely for free and will be required just a registration from the application form.

Prometech on-demand webinar

https://www.prometech.co.jp/web_seminar_outline_en.html



Website

Our website offers a variety of useful content, including not only product introductions, but also a wealth of analysis case study videos and technical columns.

Particleworks Product Site

https://www.particleworks.com/home_en.html

