

We are pleased to introduce you to Fraunhofer TechFlash - Fraunhofer’s Flash News on latest and exciting technologies. This week’s TechFlash is about the most powerful simulation tool developed by Fraunhofer >> **MESHFREE** << which is ready for industrial implementation.

Fraunhofer Institute for Industrial Mathematics (ITWM) is one of the world's largest mathematical research institutes focussing on developing mathematics as a key technology, give innovative impetus and implement it in practice together with industry partners. Methodologically, Fraunhofer ITWM’s research areas are based on modelling, simulation and optimization. Integral parts of projects are consulting and implementation, support in the application of high-performance computer technology and providing tailor-made software solutions. Fraunhofer ITWM not only uses simulation software, but also develops it by itself, often in cooperation with leading software companies. Companies of all sizes use simulations on regular bases which gives them benefit in terms of product innovation and quality assurance. Fraunhofer ITWM’s customers are mainly in the automotive, mechanical engineering, textile, computer industry and finance sectors.

MESHFREE - Simulate with complex geometries and complex physics

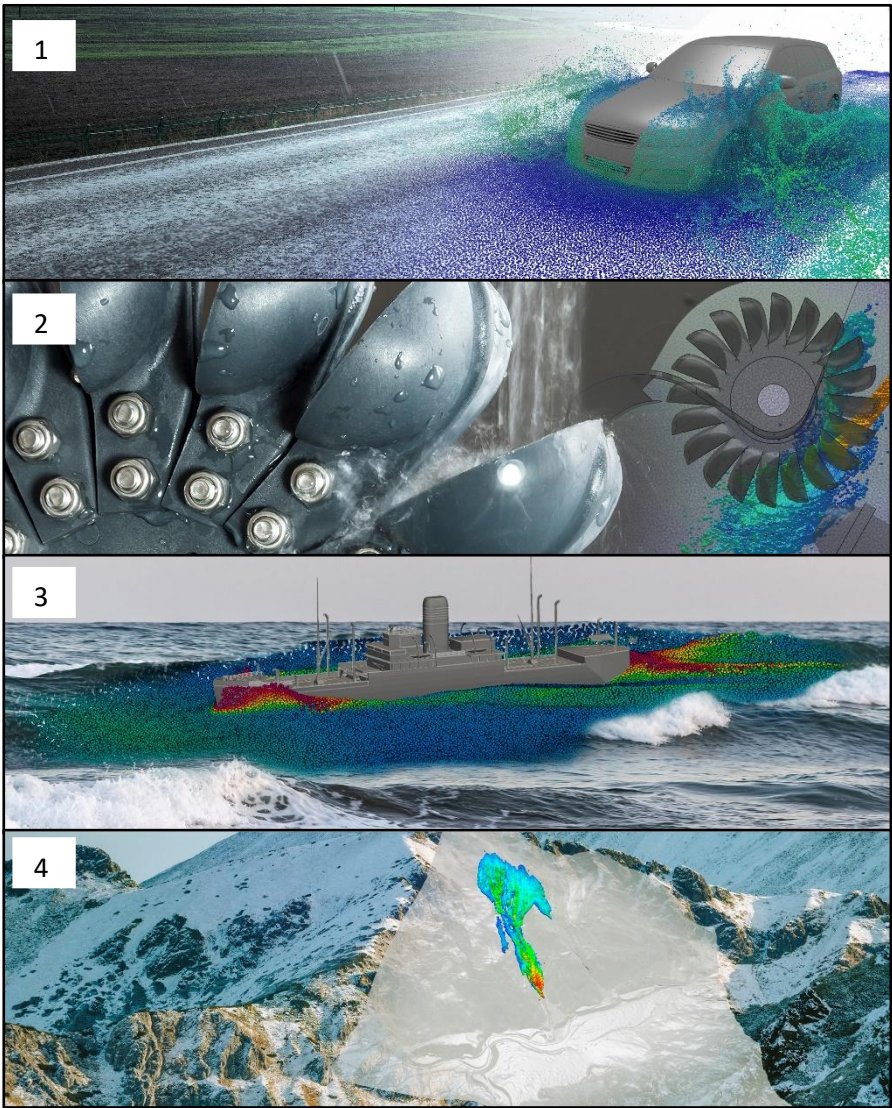


Image 1: Simulation of Water crossing of a car
Image 2: Simulation of Water-air interaction in a Pelton turbine
Image 3: Simulation of waves hitting the ship
Image 4: Simulation of an avalanche

Services

To ensure the best possible cooperation, Fraunhofer offers accompanying services along the entire product and process development cycle.

- Licensing – our partners can license MESHFREE to simulate any application on their own hardware.
- Contract simulations – our partners order MESHFREE simulations for specific applications on Fraunhofer’s hardware
- Feasibility studies – novel applications of partners are investigated at Fraunhofer.
- Research projects – new features and models are developed within the framework of industrial and publicly funded projects in cooperation with our partners from industry, research institutes, and academia.
- Support of young academics – students are assisted in their use of MESHFREE for their thesis.

Computer simulations are an indispensable tool in the design of products and production processes. Virtual models replace real models. In the creation of this virtual world, mathematics is a key technology. Fraunhofer ITWM combines mathematical modelling with High-Performance Computing expertise to provide powerful simulation tools.

In common simulation workflows, the preprocessing step consisting of mesh generation and adaption is very time consuming. It leads to increasing costs in product development. With **MESHFREE**, Fraunhofer ITWM provides a solution to overcome this bottleneck. The simulation tool follows an innovative point cloud approach, avoiding meshes, and thus enabling engineers to design their products much faster.

MESHFREE is a Powerful Simulation Tool for:

- Fluid dynamics
- Continuum mechanics
- Multiphase scenarios

From the automotive sector to production, simulations and digital twins are crucial to many companies. Conventional software is often inadequate at modelling highly dynamic processes. MESHFREE works without a rigid computational grid and can save a great deal of time when simulating complex processes, and it also cuts costs.

MESHFREE simulations can cover a wide range of applications such as water management, avalanches, foam formation, metal cutting, sophisticated fluid-structure interactions and many more. In contrast to classical mesh-based approaches, MESHFREE uses an automatically managed point cloud that adapts itself efficiently to the simulation domain – even if the simulation domain changes rapidly due to moving geometries or large deformations.

The unique features of MESHFREE enable numerical simulation of scenarios that are currently completely out of reach of other simulation tools: simulating a water-crossing car, turbine abrasion or waves hitting a ship and causing sloshing movements in the fuel tanks. With the help of MESHFREE, we can identify optimization potential in the early stages of design. Additionally, the computation can be faster in scenarios that are difficult for mesh-based methods such as free surface flows.

Advantages of MESHFREE:

- MESHFREE is fully MPI parallelized and scales well on clusters (shared and distributed).
- MESHFREE internally uses SAMG – a powerful library for solving the linear systems of equations based on algebraic multigrid technology.
- MESHFREE is already in productive operation for a wide range of applications. A comprehensive scripting language allows for full flexibility in building new applications and fully automated workflows.

MESHFREE is not a static software. It is under continuous development by Fraunhofer’s experts to ensure its status as cutting-edge software. The team adds new features and keeps the numerical methods up to date with the latest research results.

MESHREE Use Cases, please click the hyperlinks below:

- [Automotive Design](#)
- [Hydro Power](#)
- [Maritime Industry](#)
- [Natural hazard - Avalanches](#)

We look forward to hearing of your interest to discuss this exciting technology.

Yes, I am interested

About Fraunhofer-Gesellschaft:

Founded in 1949, the Fraunhofer-Gesellschaft based in Germany is the world’s leading applied research organization. It offers contract-based R&D services for specific industry demand, application-oriented technology development from proof-of-principle up to market-readiness across the value chain and offers technical consultancy and feasibility studies to nearly all the industry sectors. The Fraunhofer-Gesellschaft currently operates 76 institutes and research units throughout Germany. Over 32000 employees, predominantly scientists and engineers, work with an annual research budget of €3.4 billion. Fraunhofer generates €3 billion of this from contract research. Our global footprint is very strong, with offices and research centres in the USA, Europe and Asia. Some of our renowned innovations are the MP3 software, white LED’s and the smallest of cameras. Fraunhofer has been a long-time trusted innovation partner in India, collaborating with some of the major players in the fields of Material Science, Energy, Environment, Automotive, Electro-mobility, Production Technology, Microsystems and Smart Cities, working with Industry, Government and Public Sector.

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