OVERVIEW OF MESHFREE

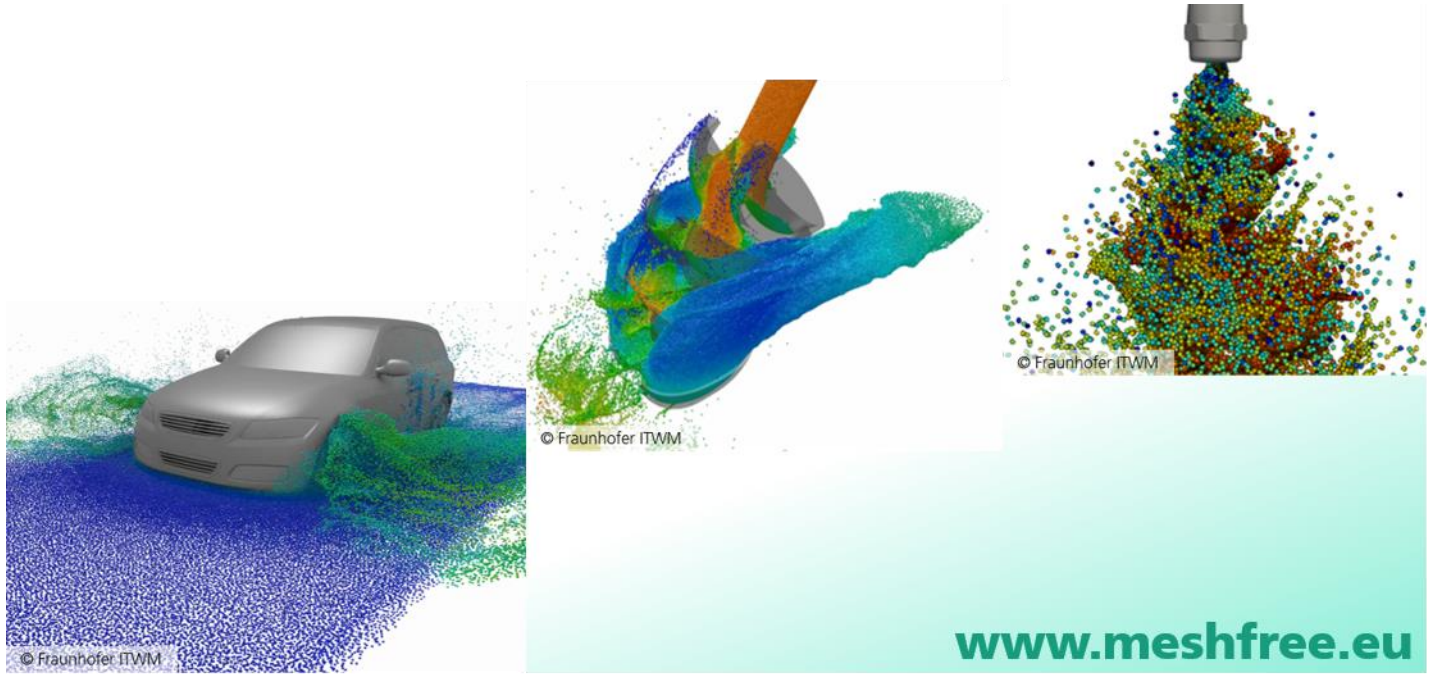
MESHFREE-Team, September 2021

MESHFREE

Fraunhofer ITWM

OVERVIEW OF MESHFREE

- WHO is behind it?
- WHY no mesh?
- WHAT can it do?
- HOW to access it?



WHO is behind it?

MESHFREE-Team	Responsibility
Fraunhofer ITWM	Finite Pointset Method (FPM): meshfree simulation of partial differential equations based on a Generalized Finite Difference Method (GFDM)
Fraunhofer SCAI	Algebraic Multigrid Processes for Systems (SAMG): library of robust and scalable solvers for linear systems of equations
scapos AG	Distribution

WHY no mesh?

Motivation

- Geometrical preparation (mesh generation and adaptation) can be time-consuming and cost-intensive for particular applications, often it is not 100% automatable
- Some problems are hardly feasible with standard CFD-methods

→ MESHFREE enables shorter times in product and process design as well as the virtualization of “new“ processes

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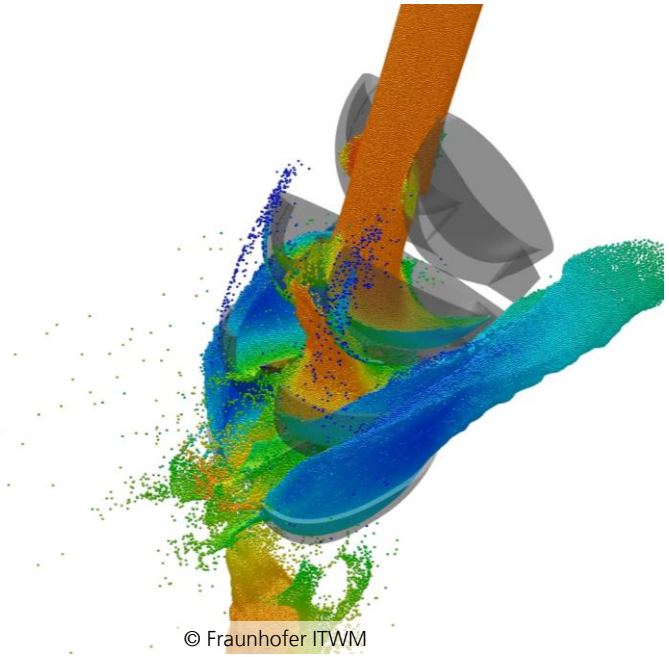
WHY no mesh?

Comparison with standard CFD-methods

- Geometrical preparation: only 2D surface mesh of geometries necessary, automatic generation and management of discretized 3D flow field = moving point cloud
- Simulation of free surfaces: sole computation of „wetted“ area, free surfaces naturally result from this
- Simulation of moving geometries: automatic adaptation of the point cloud to changing topologies



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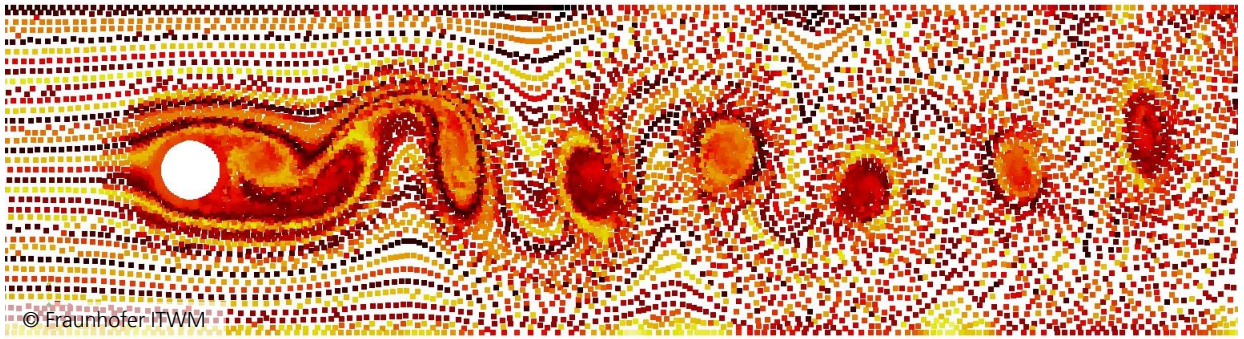
WHY no mesh?

Comparison with standard CFD-methods

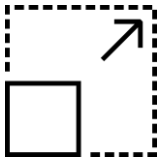
- Local refinement: spatial and temporal refinement of the point cloud also depending on simulation results
- Analysis: intuitive visualization and interpretation of simulation results due to moving point cloud



WHY no mesh?

Advantages of MESHFREE

- Scaling:
  - MPI-parallelization (shared and distributed memory)
  - Numerical resolution
- Robustness: reliable handling of diverse models and material properties based on AMG-technology
- Flexibility: comprehensive scripting language for integration in fully automated work flows



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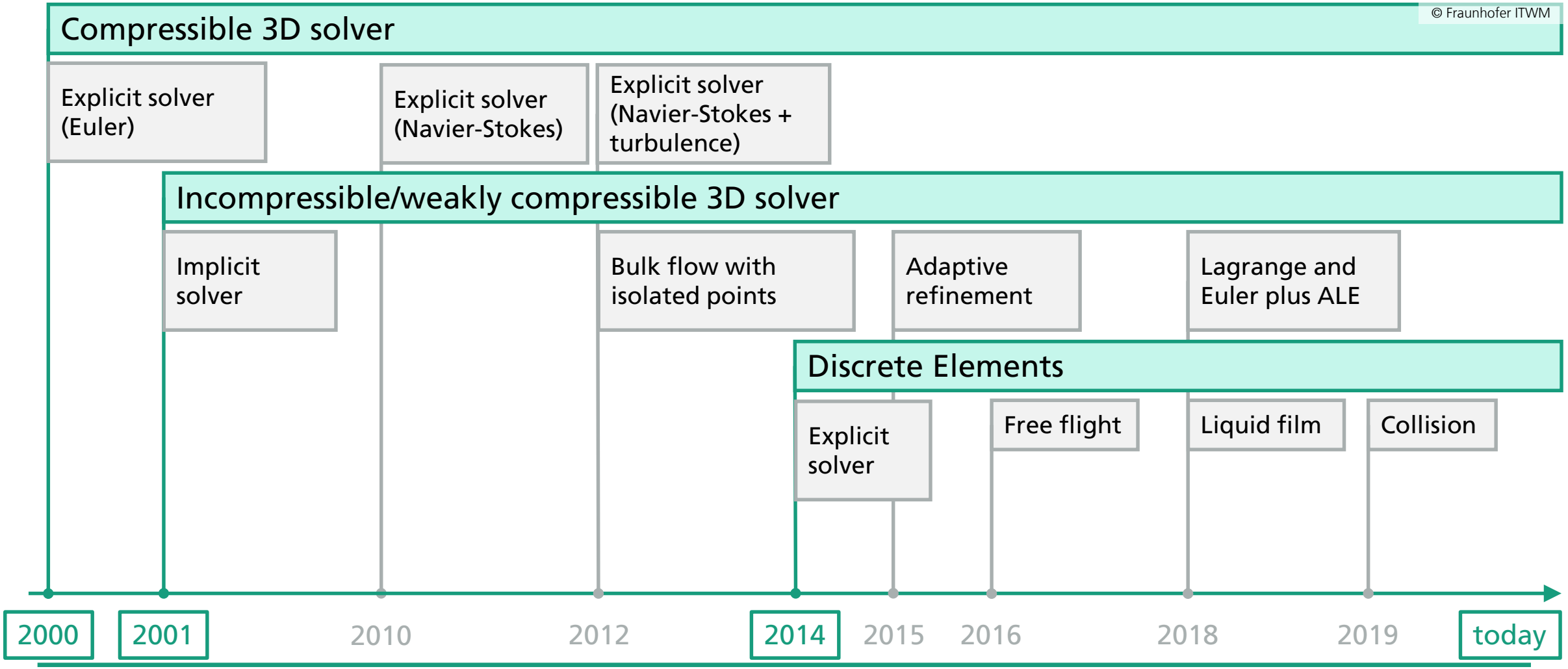
WHAT can it do?



WHAT can it do?

»Fraunhofer has already shown its expertise in water management simulations. For us, MESHFREE is a high-potential software.«

Robert Reilink, Manager Function (Body Engineering CAE),
Porsche AG

Video:
MESHFREE – getting to the points

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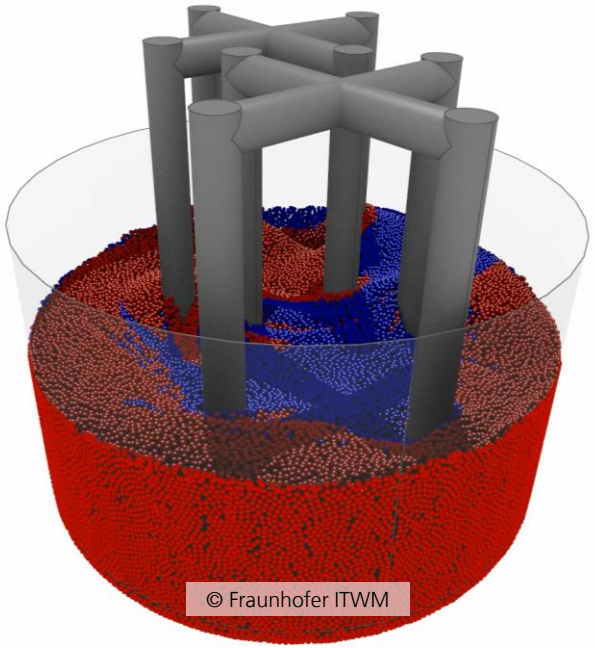
WHAT can it do?

Fields of application

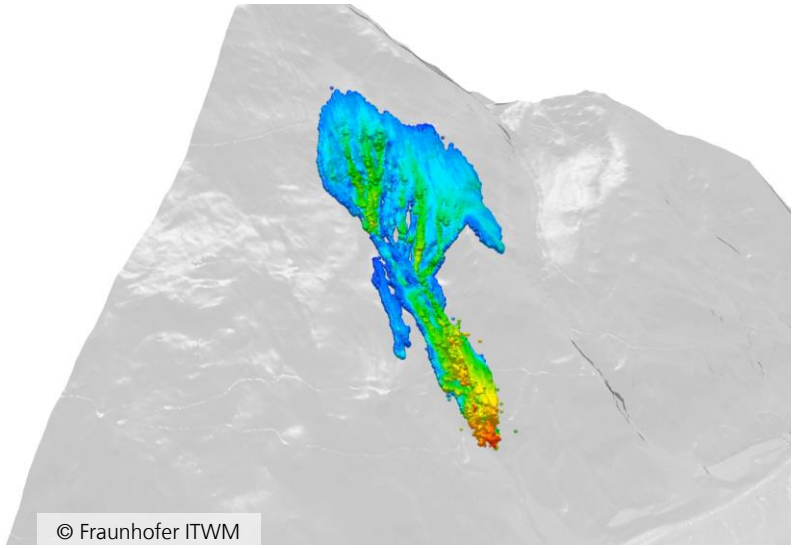
- Automotive: water management, fuel management, safety, transmission components
- Hydro power: moments, nozzle filling, efficiency of deflectors, abrasion for Pelton turbines
- Manufacturing engineering: dry and wet metal cutting
- Chemical engineering: static mixing, dynamic mixing and stirring, mold filling



WHAT can it do?

Fields of application

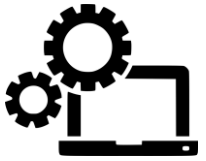
- Natural hazards: forecast of potential runout zones of avalanches, stability analysis of floating bridges
- Food industry: filling, formation of froth, baking, melting and freezing, cleaning
- Medicine and health: pulsating flow in flexible pipes



HOW to access it?

Service/cooperation along the entire product and process development cycle

- Licensing incl. training: simulation of any application on own hardware
- Contract simulations: simulation of specific applications on Fraunhofer hardware
- Feasibility studies: investigation of novel applications
- Research projects: development and implementation of new features and models
- Support of young academics: assistance in the use of MESHFREE for theses



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