

AVL Powertrain Engineering Inc.



PreonLab SPH - the fastest CFD

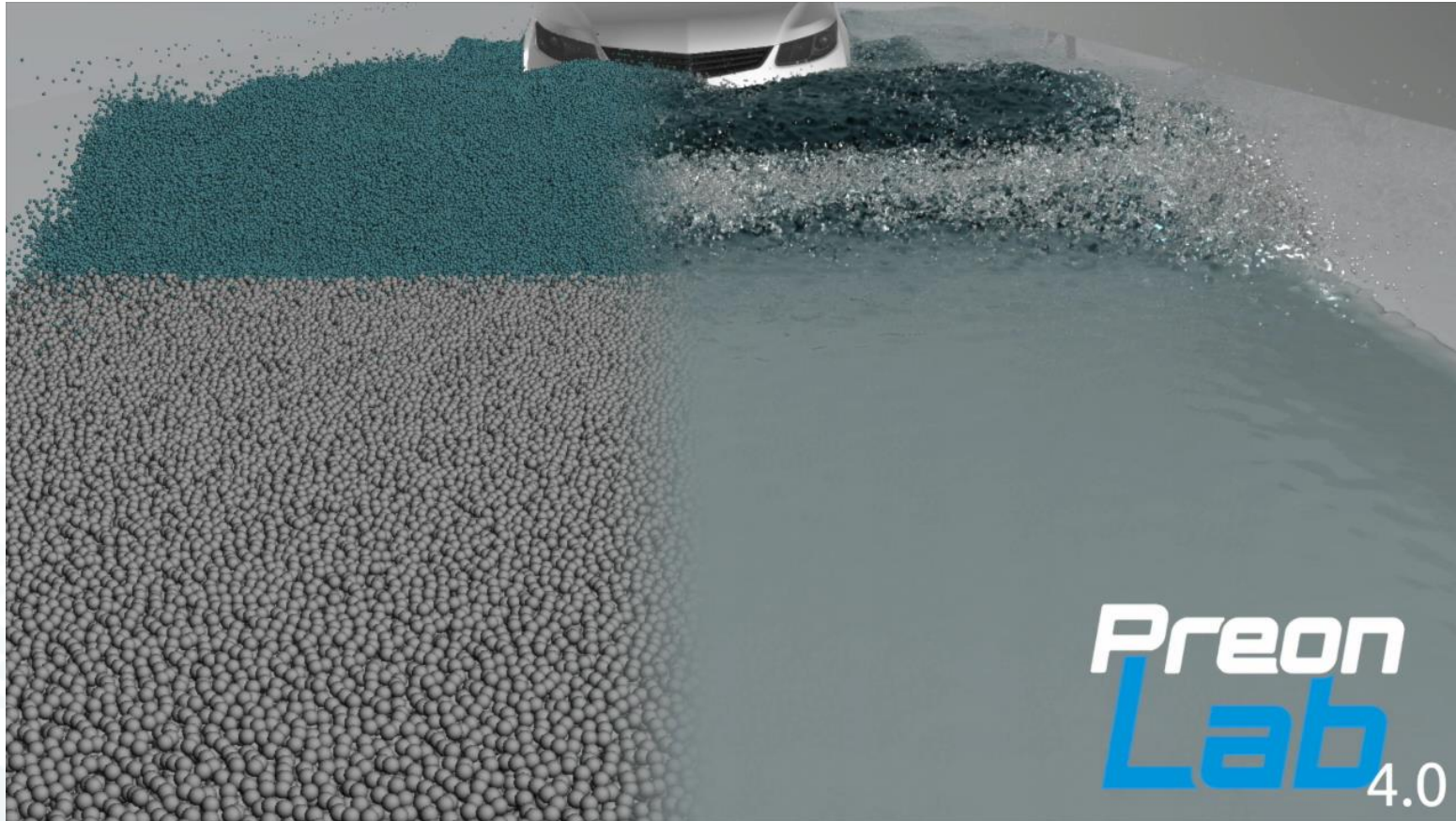
Update and Release 4.0

Car suspension model improvement

Preon
Lab

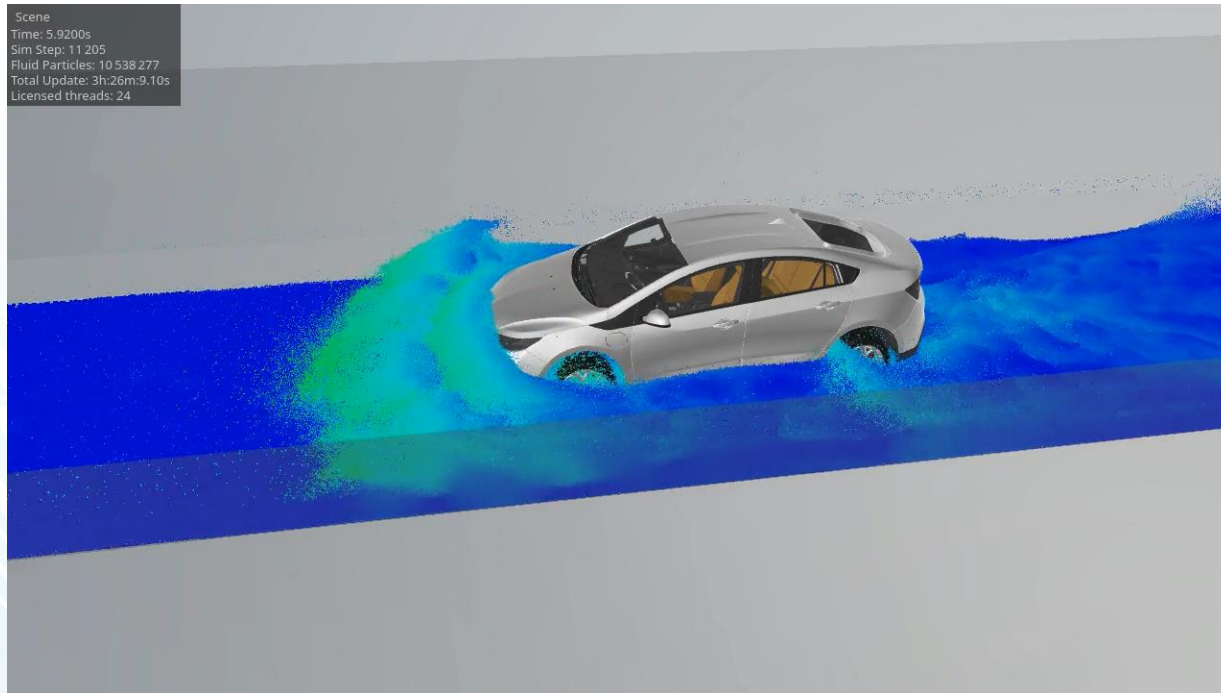
Water Wading

Local refinement

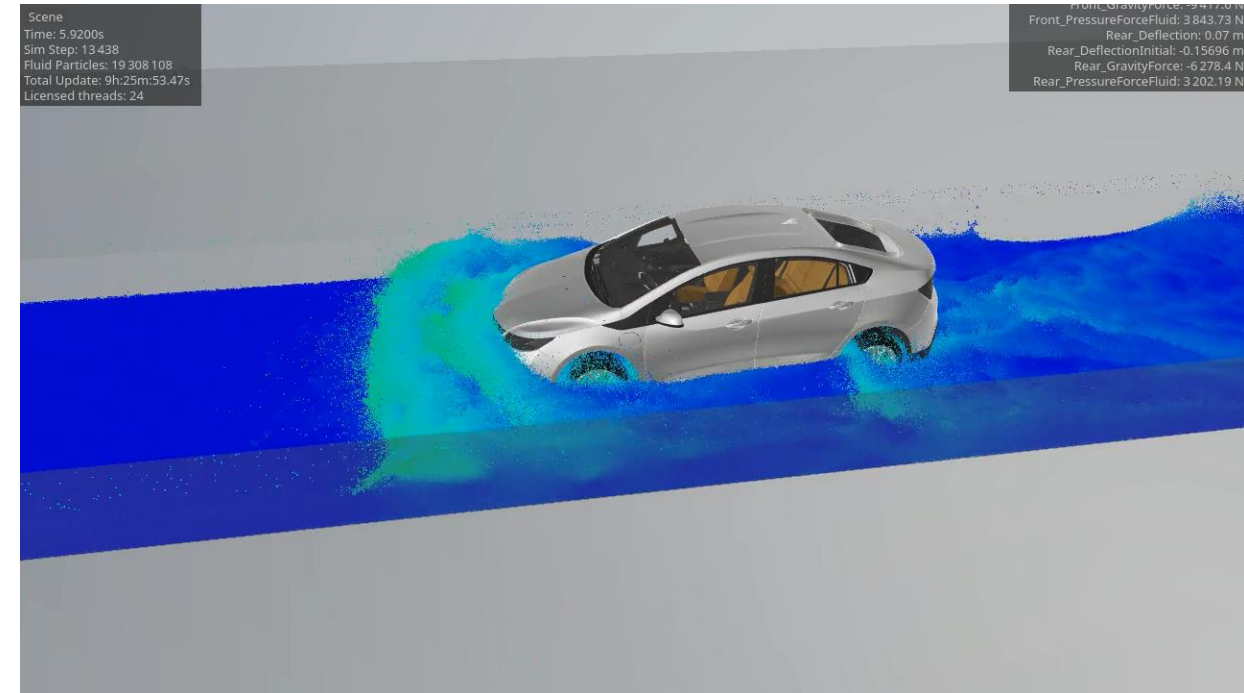


Local refinement algorithm (novel approach invented by FIFTY2)
Two-level refinement and coarsening

Local refinement



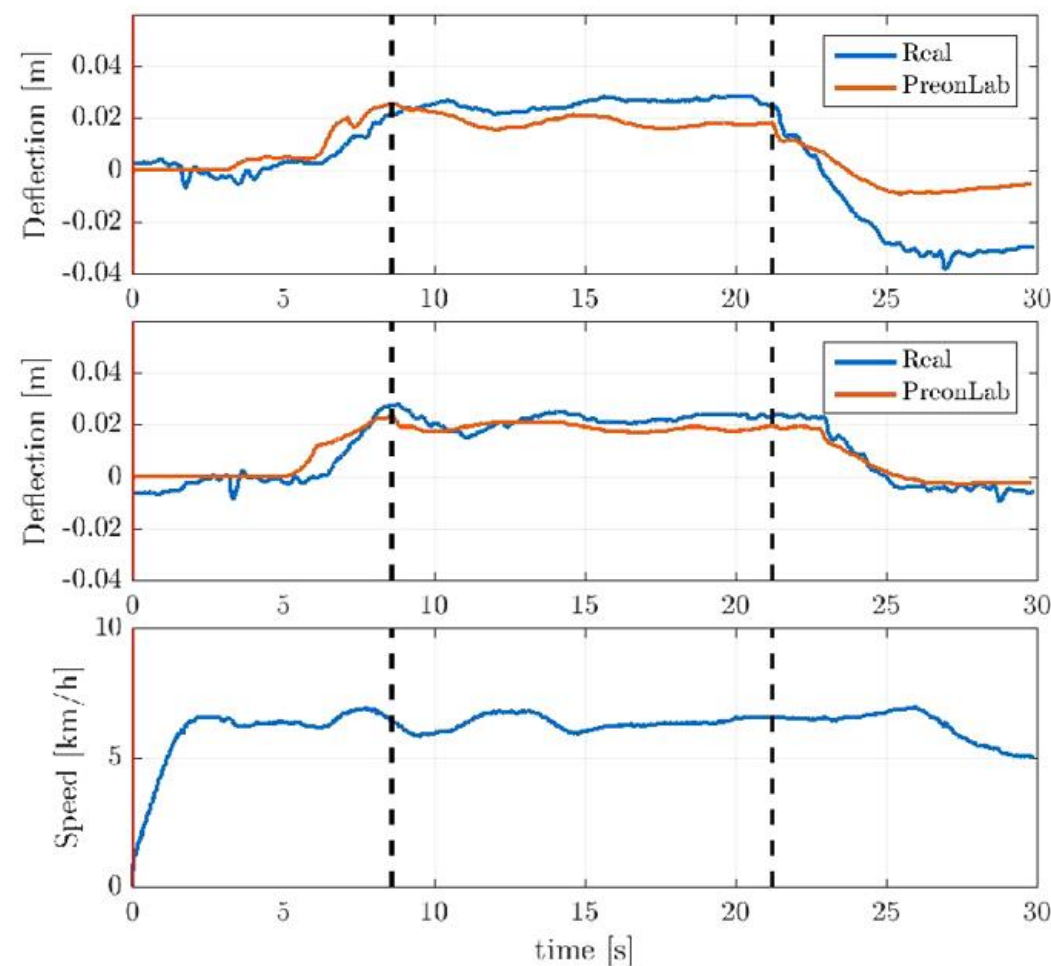
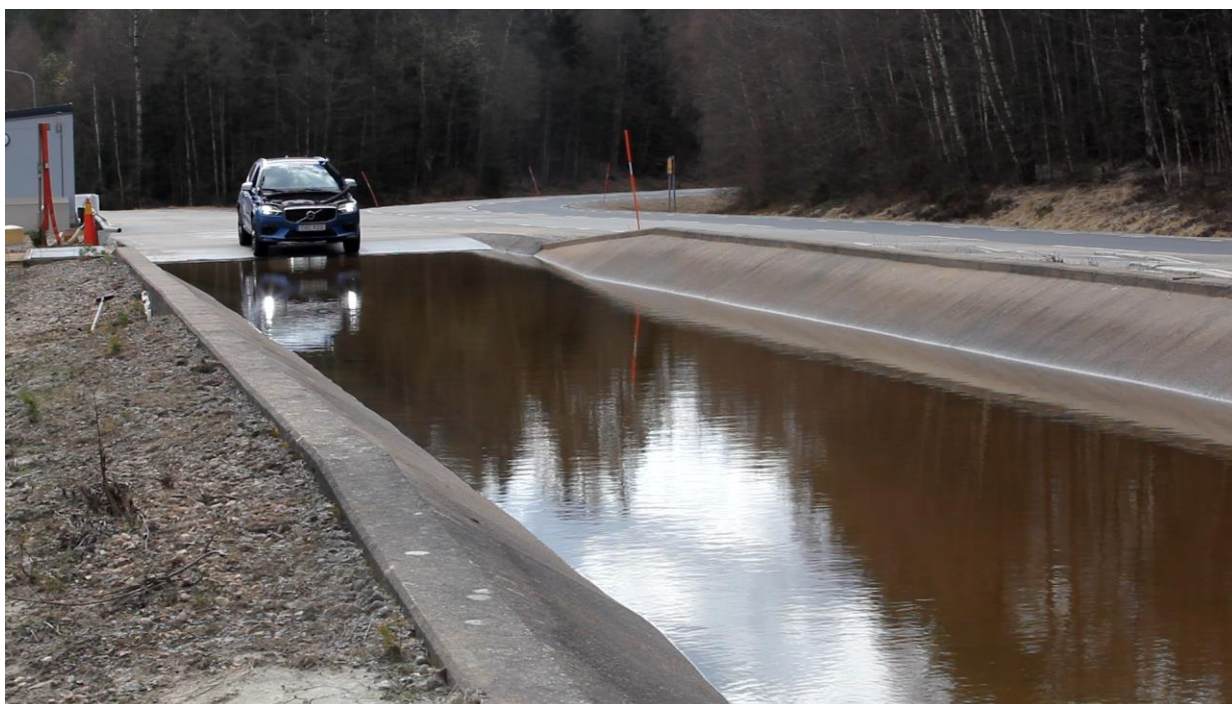
Refinement around car
Time: 9h45min



Uniform resolution
Time: 17h



Test 1 – 6 km/h



Front

Rear

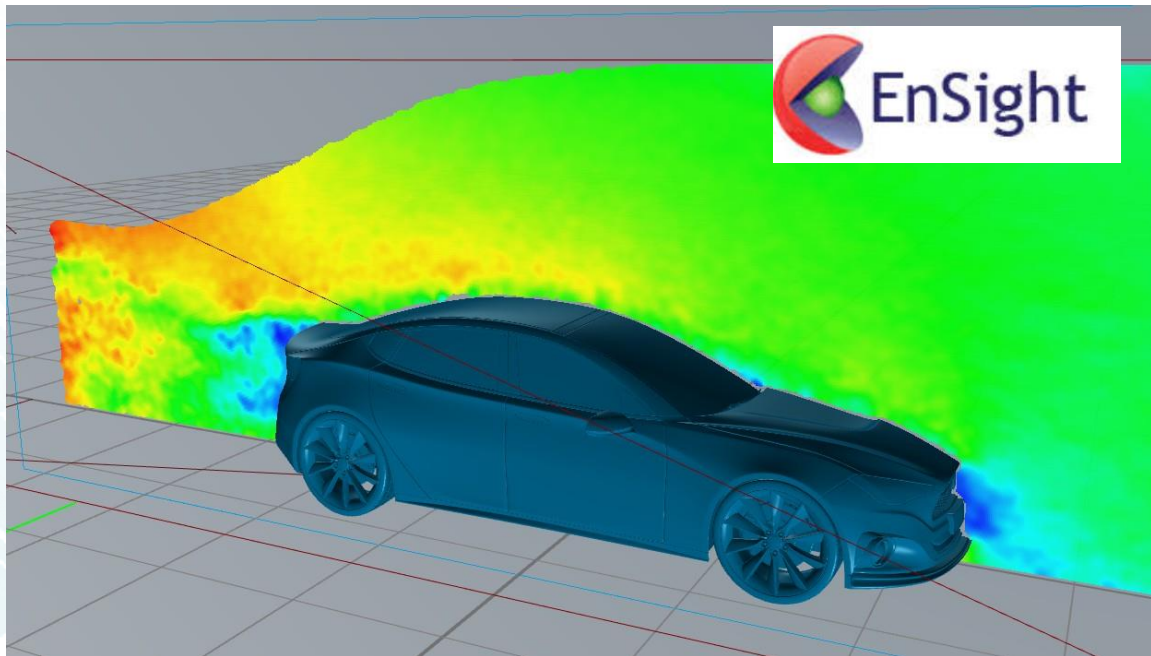
Non-Newtonian fluids



Non-Newtonian fluids

Different flow behavior indices

Transient airflow import

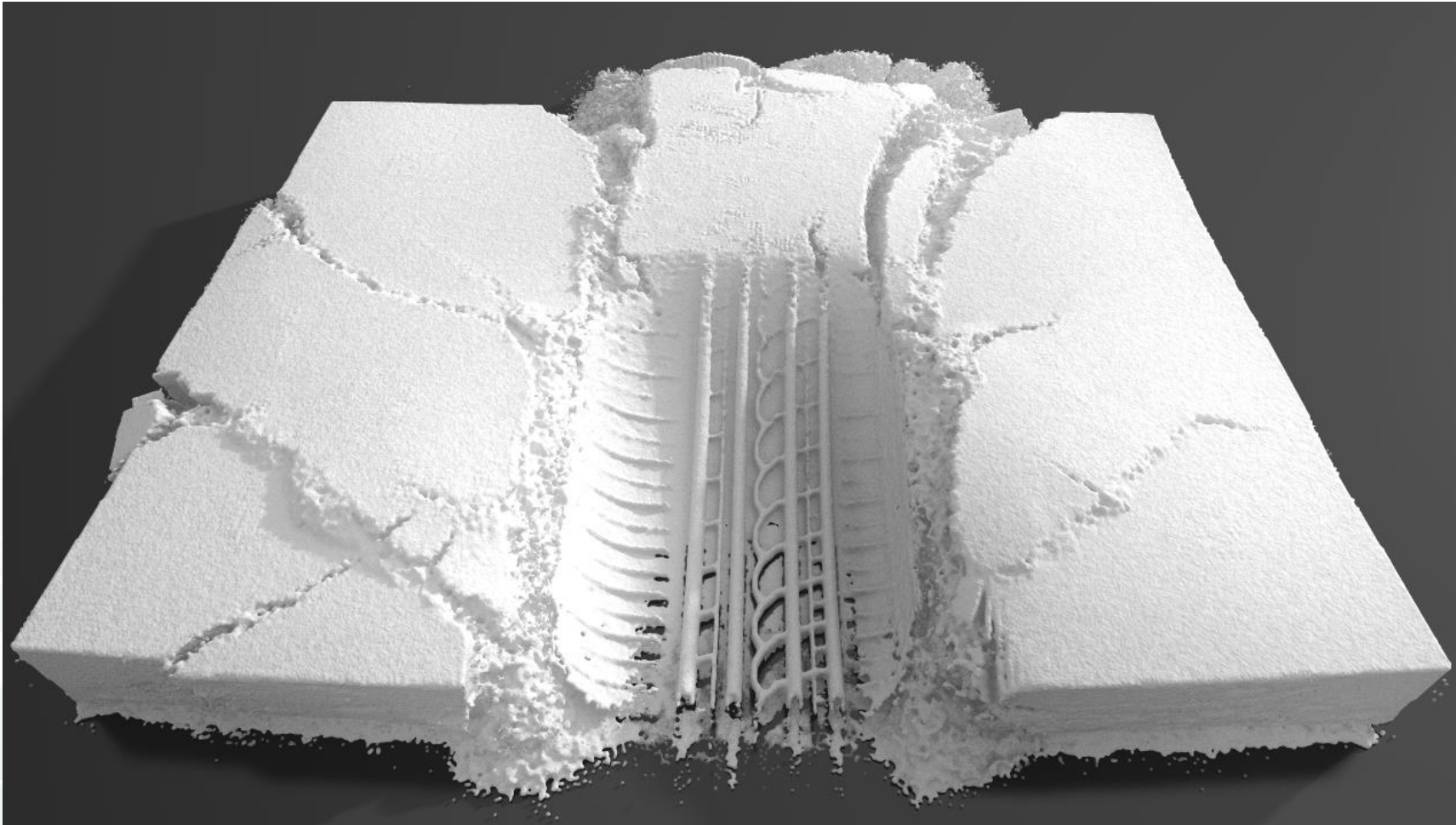


- Transient airflow import via EnSight Gold format
- Crucial for vehicle soiling
- Application areas: cameras & sensors ADAS / AD

Snow Solver Improvements

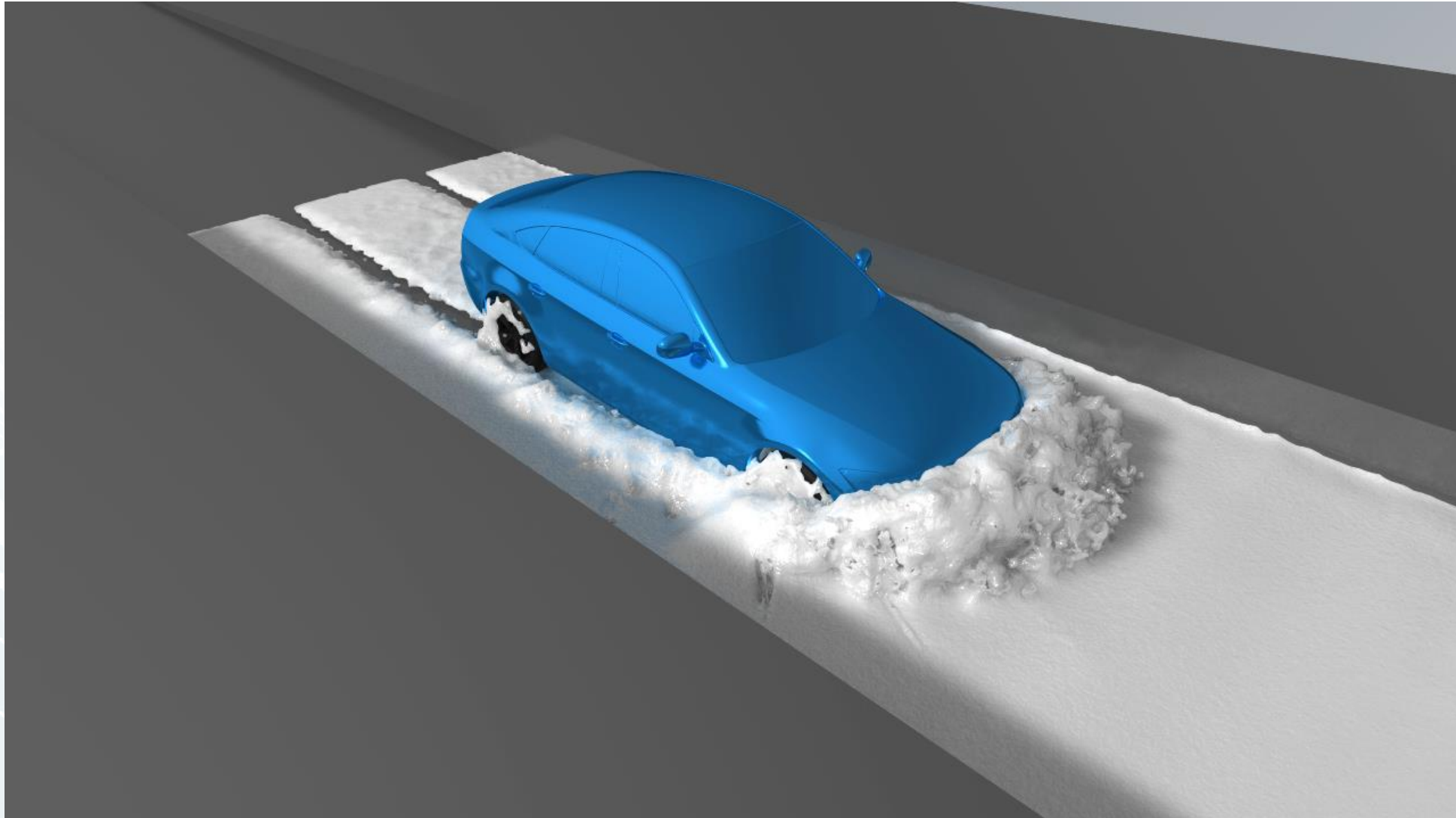


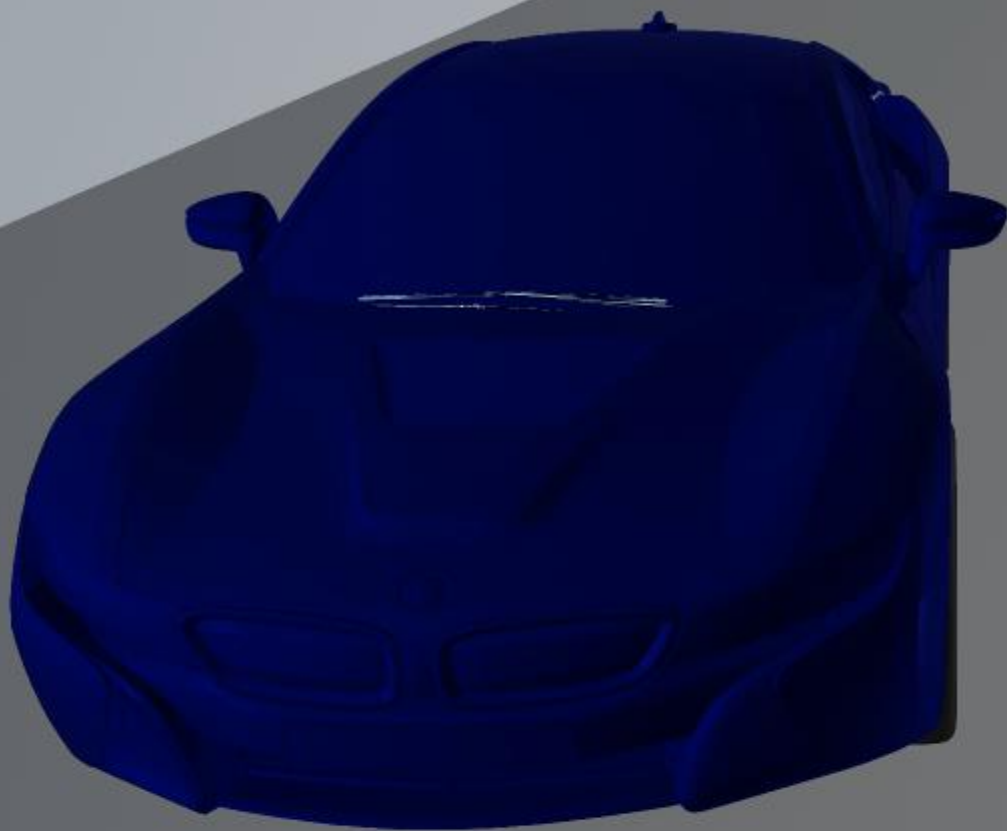
Snow – advanced rendering

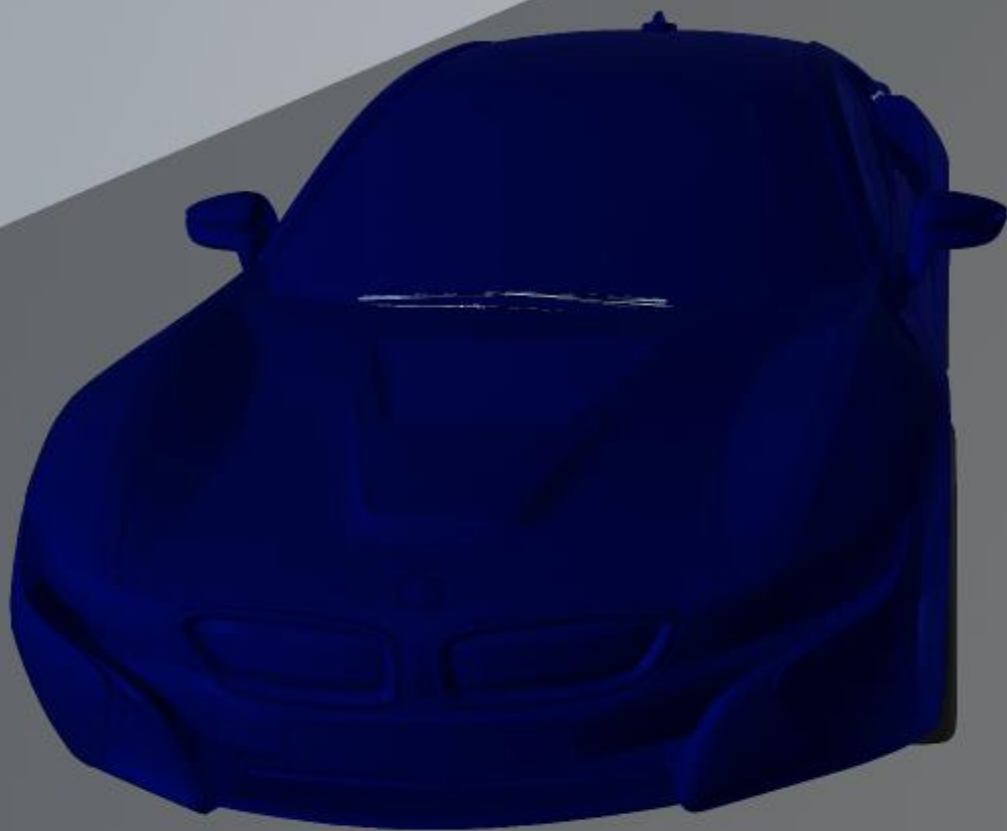


Particle-based, semi-implicit snow solver (invented by FIFTY2)
Preon renderer – new snow material and improved capabilities

Snow "wade"

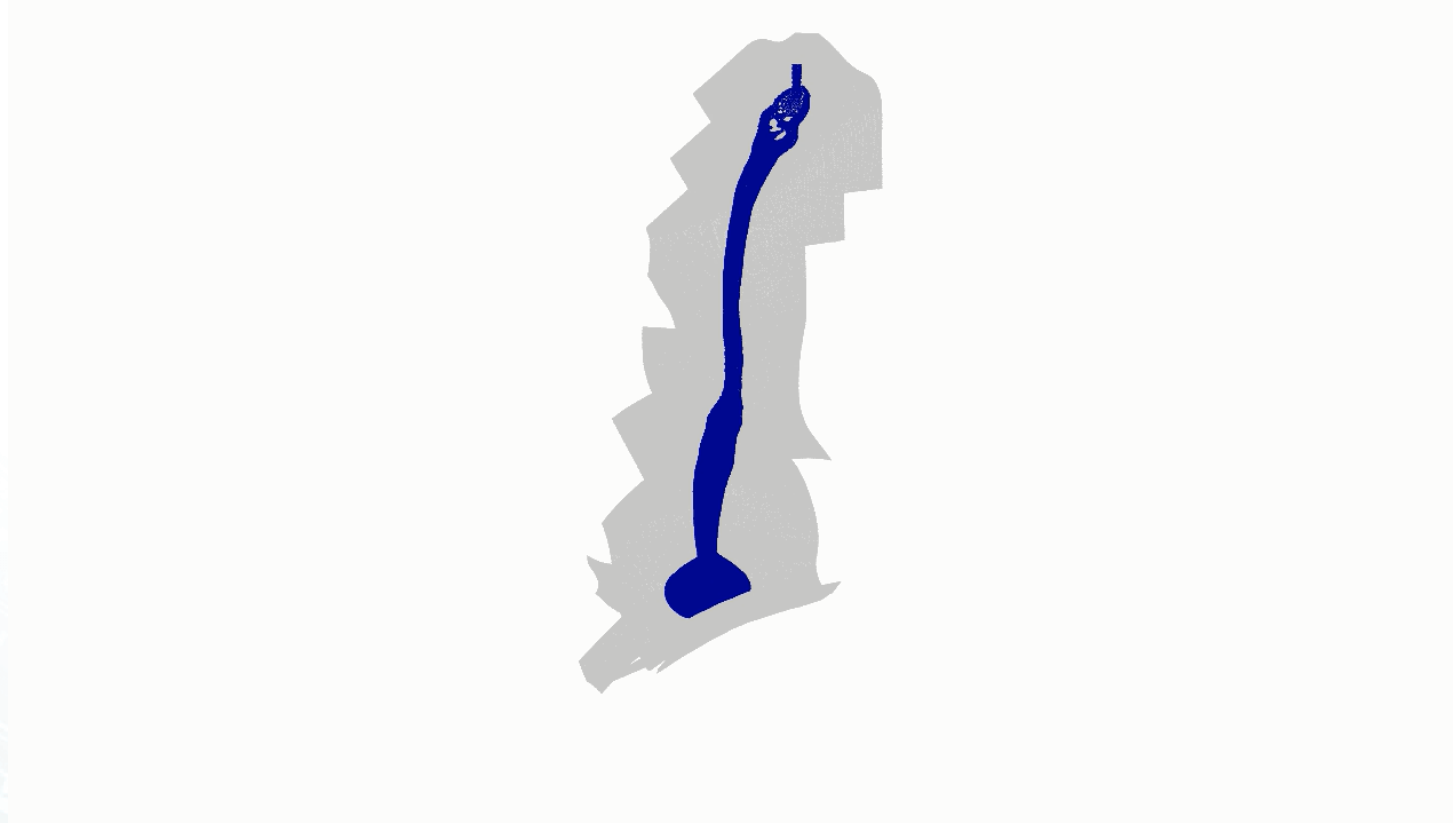








Dynamic sampling

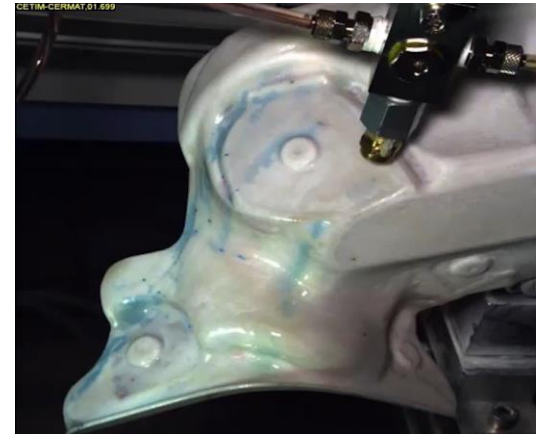


- Solids are only sampled in proximity of fluid
- Saves computation time and memory for most applications

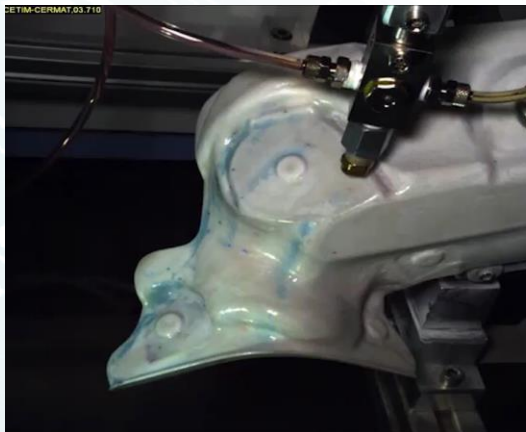
Leakage



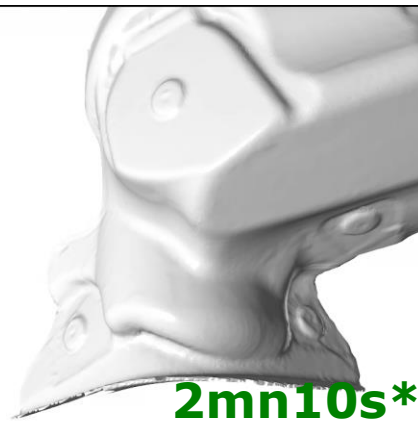
Time: 0.0000s



Time: 0.0000s



Time: 0.0000s

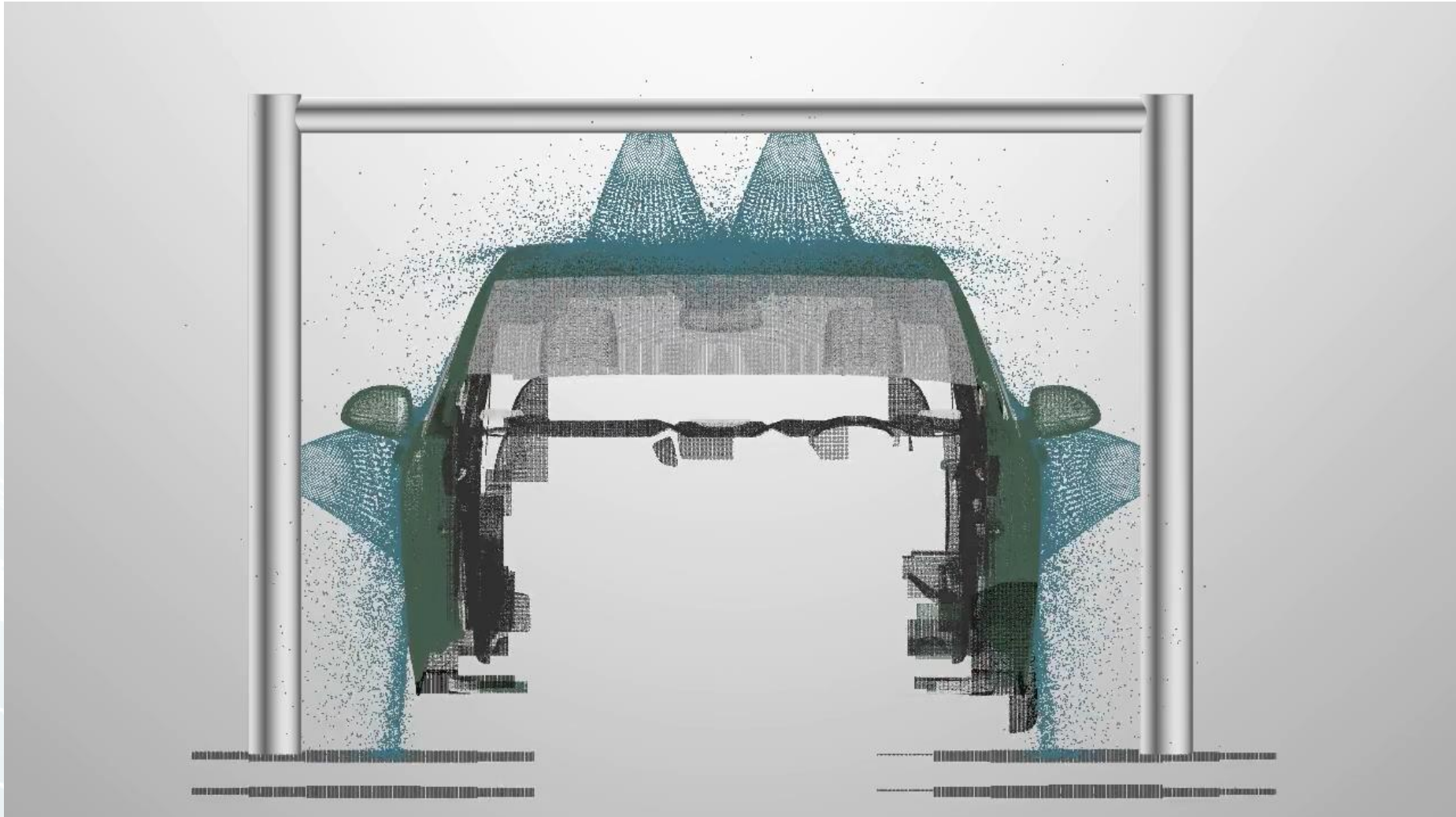


Oil flow path is correctly recovered by PreonLab simulation

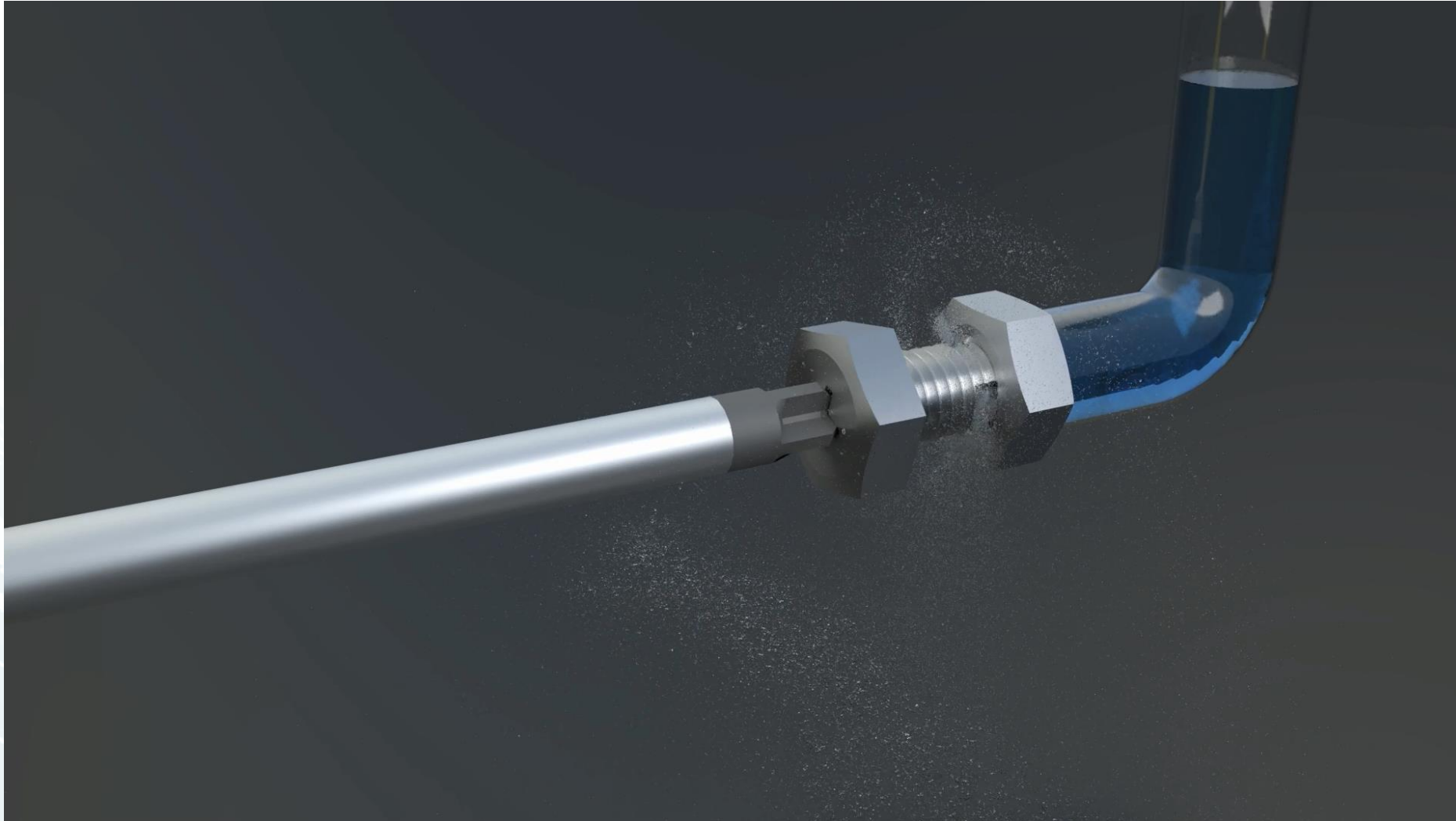
Calculation time much faster than other solutions, even other SPH

*Wall clock time using 48 CPU's.

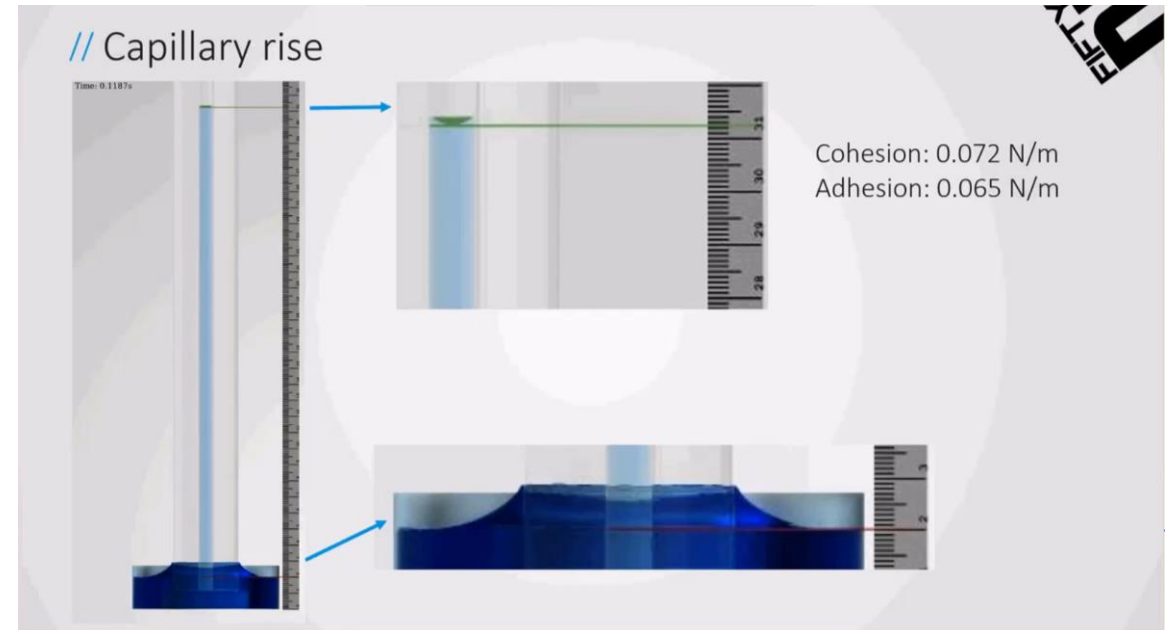
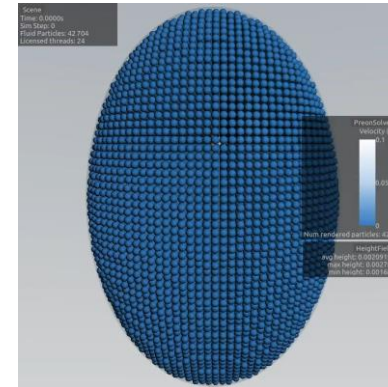
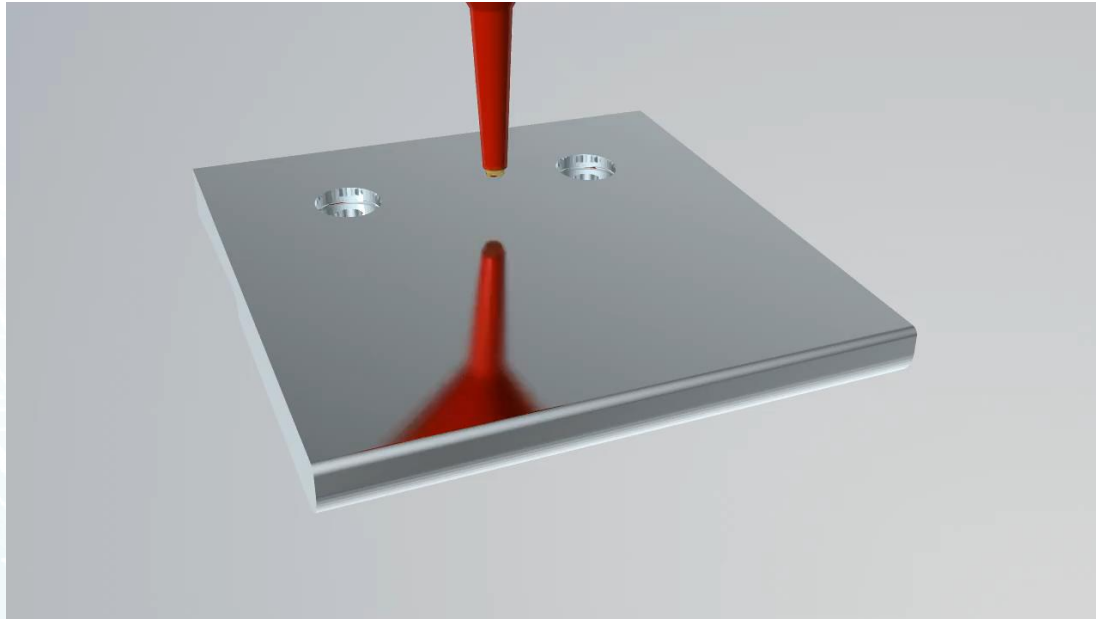
Dynamic sampling



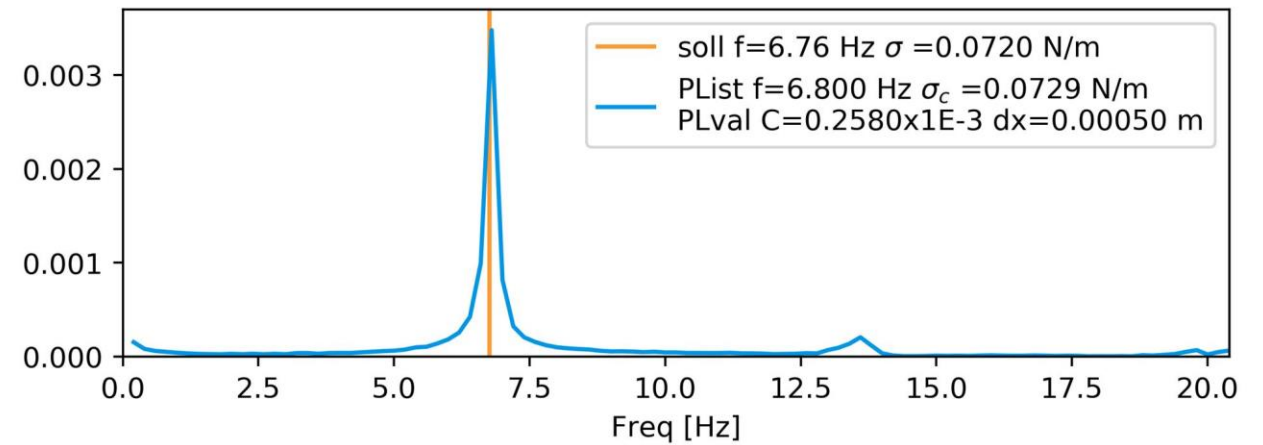
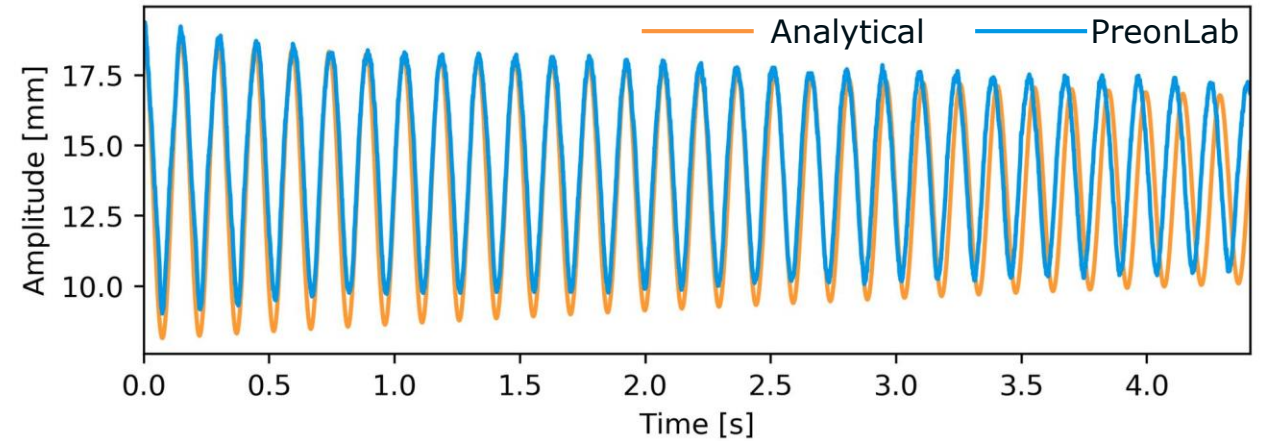
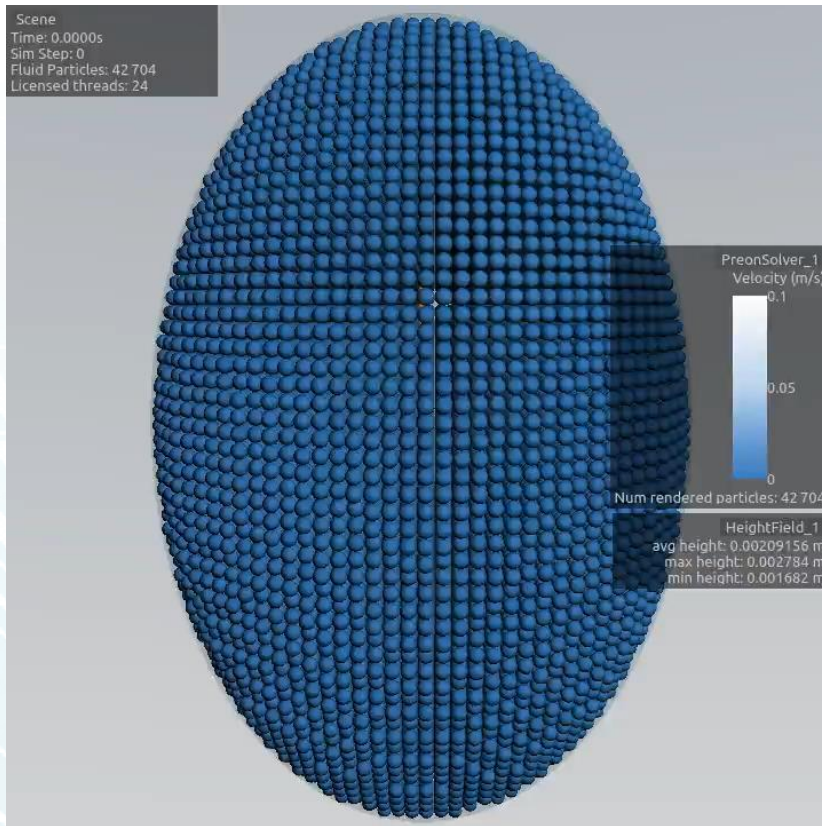
Rigid-body solver MPI



New Cohesion Model



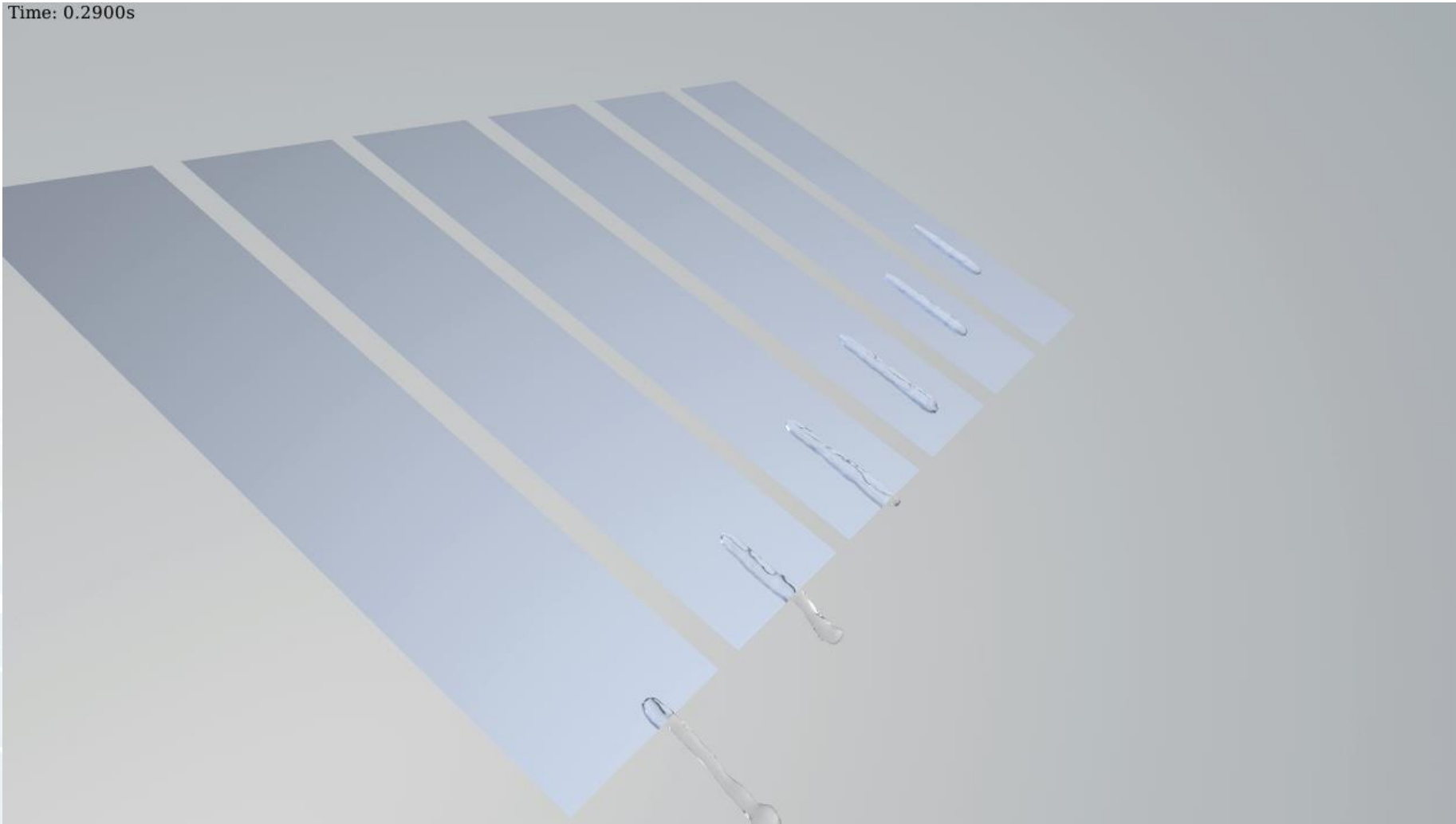
Improved surface tension - Oscillating droplet



- droplet diameter 14 mm
- 42.000 particles (0.5-1 mm)

Droplet run off

Time: 0.2900s



Planes just differ in adhesion, all other properties same, fluid is water

Validation – Lid Driven Cavity 2D



Validation Benchmark

Lid-driven Cavity

Validation – Planar Poiseuille Flow



Validation Benchmark

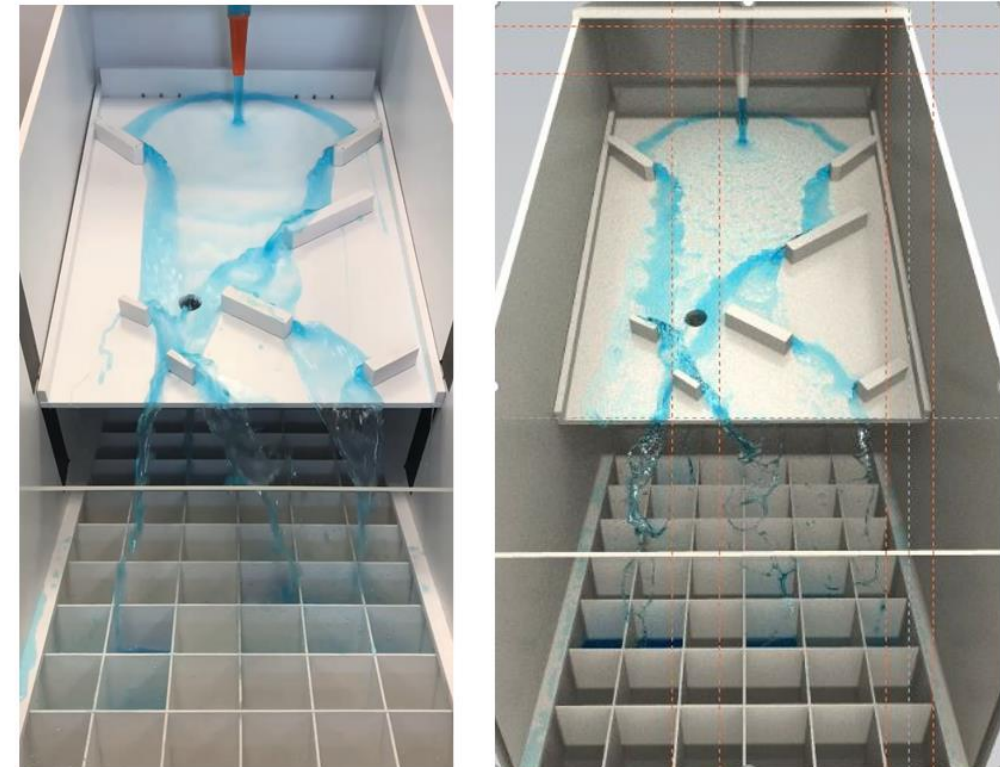
2-D Poiseuille Flow

Incline Plane Benchmark

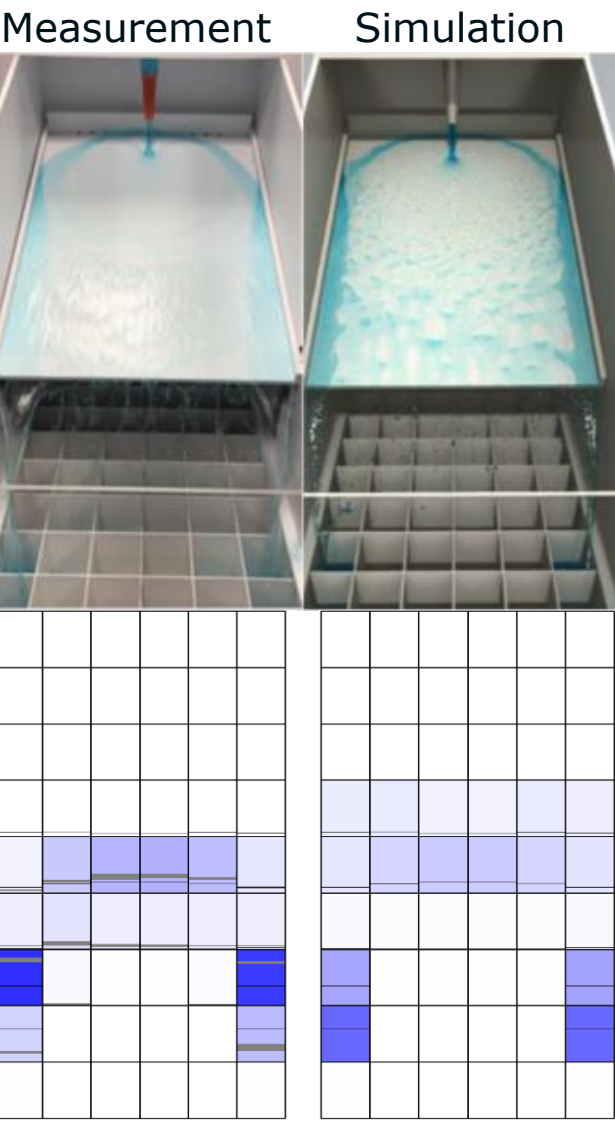
Fazit

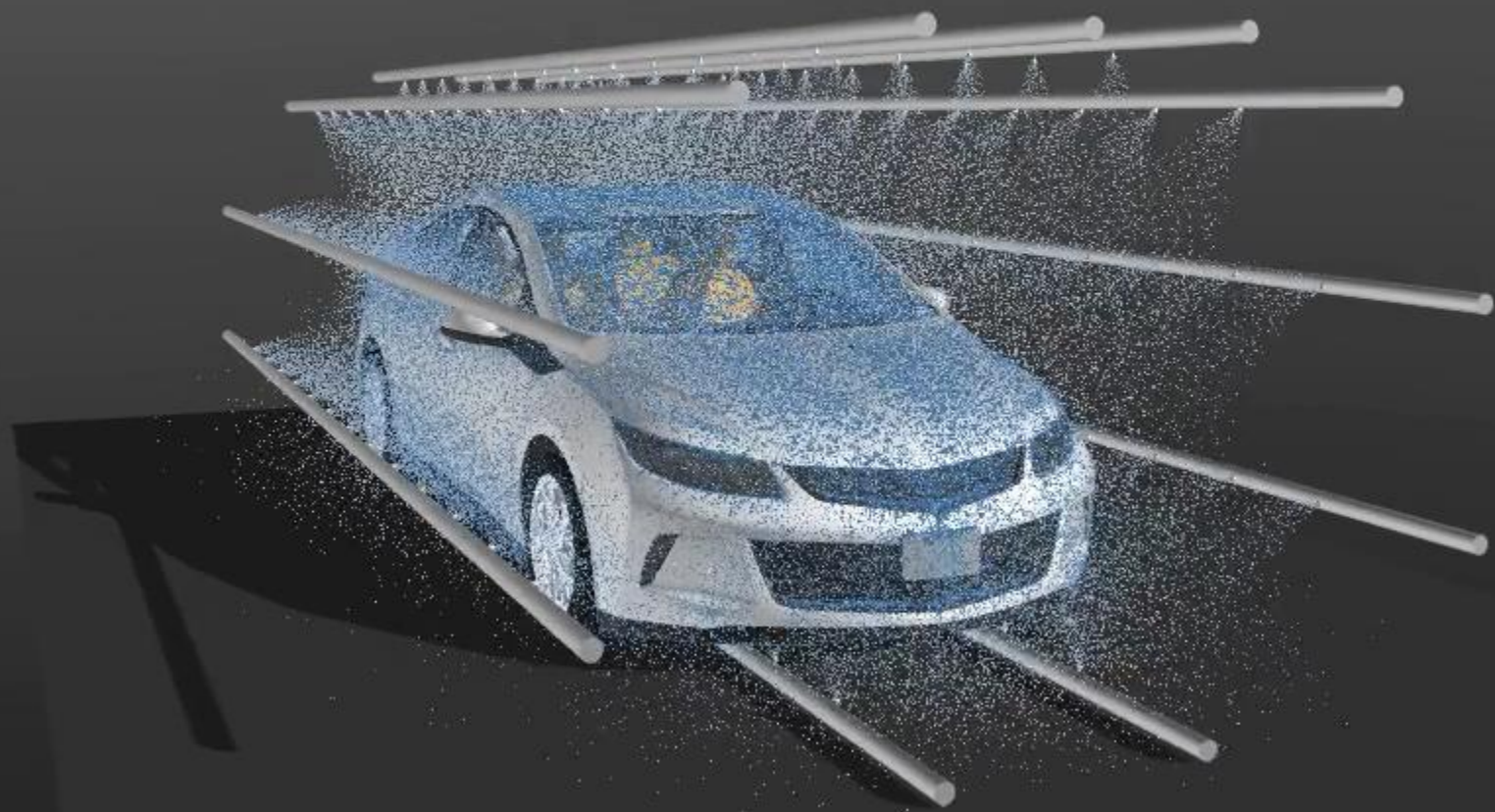
- Ergebnisse der Simulation stimmen mit Versuchsergebnissen in vielen Bereichen sehr gut überein
- korrekte Darstellung der Wellenausbildung des Wassers im Wasserbecken
- täuschend echte Darstellung des Fließverhaltens auf den Ebenen
- realistische Wiedergabe der Einschnürung der Wasserströmungen durch abnehmenden Wasserdruck
- Verteilung in der Kaskade zeigt nur geringe Abweichungen zu den Messdaten
- sehr geringe Berechnungszeit bei einem Einsatz von 96 CPU pro Simulation

Ausschnitt aus Lastfall 3



Incline Plane Benchmark





Benchmark total vehicle



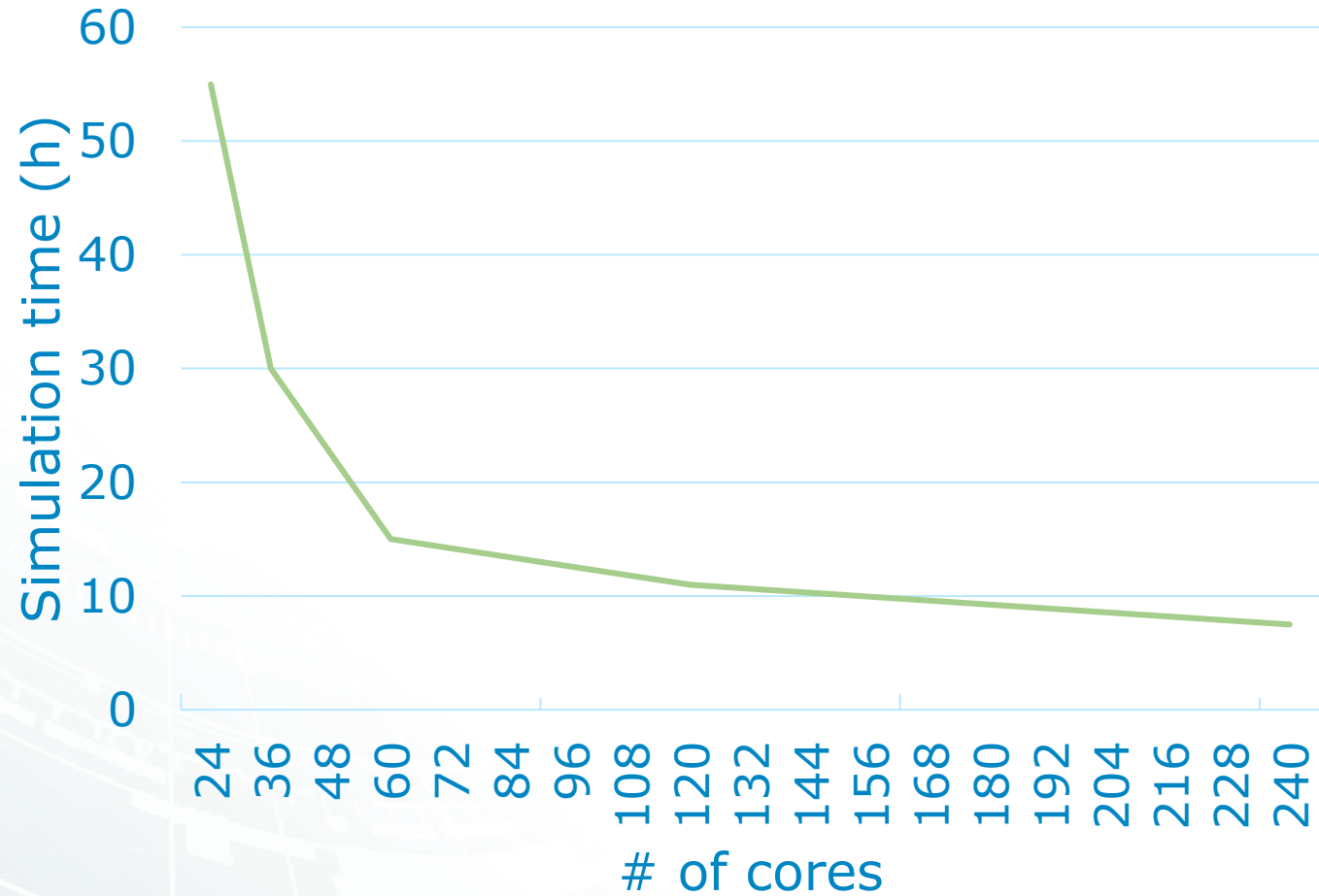
Number of nozzles	143
Flow rate per nozzle	80mL/s
Simulation resolution	2mm
# fluid particles	4.5 mio
Physical time	30 s



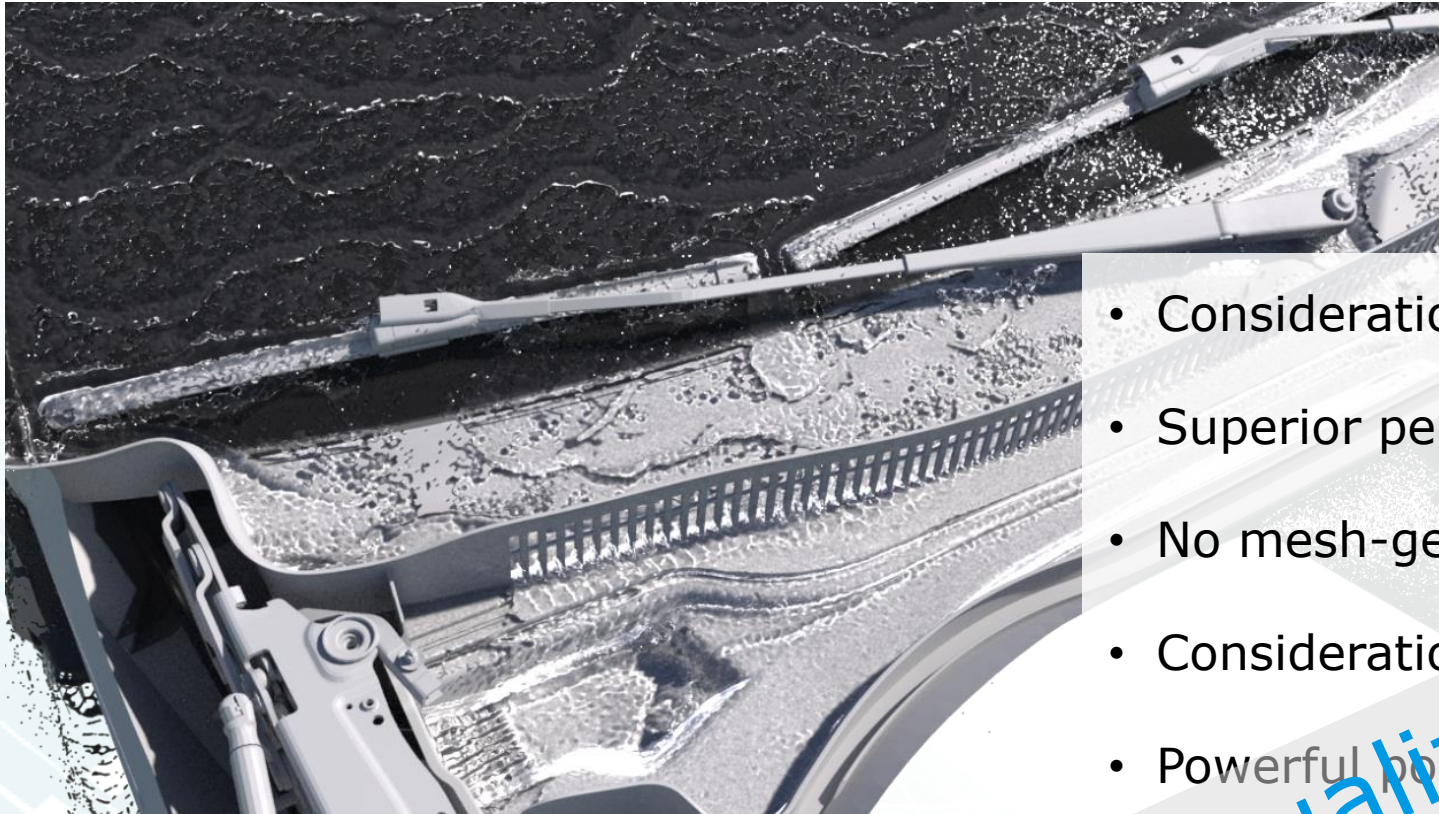
High-Performance Computing Center | Stuttgart

Sandy Bridge (E5-2670)
 12 physical cores per node
 64 GB RAM per node
 Infiniband interconnection

Benchmark total vehicle



Summary



- Consideration of full geometrical complexity
- Superior performance
- No mesh-generation
- Consideration of complex rigid body kinematics
- Powerful post-processing and visualization

Virtualization Approved



Thank You



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