



Time averaged streamlines  
in a 4-cylinder engine



Instantaneous splashing  
of oil in a gearbox



Tank sloshing

Altair® nanoFluidX is a particle-based (SPH) fluid dynamics simulation tool to predict the flow in complex geometries with complex motion. It can be used to predict the oiling in powertrain systems with rotating shafts / gears and analyze forces and torques on individual components of the system. Utilizing the GPU technology empowers high-performance simulations of real geometries.

#### Product Highlights:

- Particle-based (SPH) fluid dynamics simulation
- Meshless method to simulating complex fluid flow
- Superior performance due to high-density GPU computing
- Well suited for elaborated powertrain applications – gearboxes, crankshafts, etc.

#### Benefits

Altair® nanoFluidX is based on a weakly-compressible SPH formulation and contains a number of exclusive features which improve accuracy and make the code a unique particle-based solution on the market.

The software is created and optimized for use on clusters of Graphical Processing Units (GPUs), making it extremely fast. It can be used to predict, for example, the oiling in powertrain systems with rotating shafts/gears and analyze forces and torques on individual components of the system or predict the sloshing in tanks with transient motions.

For such typical gear-train applications, the code can run an order of magnitude faster than a Finite-Volume code while also including less geometry simplifications.

#### Applications

The particle-based nature of the Altair® nanoFluidX code allows for an elegant and efficient approach to flows which un-

dergo high deformation during the simulation, such as sloshing, violent multiphase flows or rapid movement through complex geometry.

That makes it ideal for many applications in different industries, including:

- **General free-surface flows**  
Simulate sloshing of oil in the powertrain systems, free flowing fluids in an open environment, open or closed tanks under high accelerations and similar phenomena.
- **High-density ratio multiphase flows**  
The Smoothed Particle Hydrodynamics (SPH) method of Altair® nanoFluidX allows for easy treatment of high-density ratio multiphase flows (e.g. water-air) without additional computational effort. The fluid interfaces are a natural by-product of the SPH method and no additional interface reconstruction is required, thus saving computational time.

- **Rotating gears, crankshafts and connecting rods for powertrain**  
Altair® nanoFluidX has implemented options for prescribing different types of motion, therefore simulating rotating gears, crankshafts and connecting rods comes easy. Measure forces and torques experienced by the solid elements as they interact with the surrounding fluid.

- **Tank sloshing**  
Particularly well suited for automotive, commercial vehicles and aerospace applications, tank sloshing simulation enables an accurate measurement of the forces experienced by the tank or vehicle during drastic acceleration, like braking or sudden lane change.

#### Capabilities

Altair® nanoFluidX brings you faster pre-processing, advanced GPU technology for minimum simulation time, and easy post-processing.

- **GPU Computing**  
GPU computing provides a significant performance advantage and power savings with respect to their more cumbersome CPU counterparts. GPU revolution in scientific and engineering computing is rapidly progressing and Altair® nanoFluidX is one of the pioneering commercial software packages which utilizes this technology, bringing significant speed to the overall product development.

Standard Finite Volume CFD codes encounter enormous difficulties when tackling complex geometries, often failing to initialize. Even when they do, the pre-processing times would take weeks and the computational cost of such a simulation would be prohibitively large.

- **Simplified pre-processing**  
Mesh in a classic sense is not needed. Import the geometry, select the

element and generate the particles. No more hours of pre-processing and devising a good-enough mesh.

- **Rigid body motion**  
Besides the rotation motion, the Altair® nanoFluidX code allows for element trajectories prescribed by an input file. Study the interacting of an arbitrary translationally moving solid and the surrounding fluid.

#### Hardware Requirements

The Altair® nanoFluidX team recommends NVIDIA Tesla V100, P100 and K80 accelerators, as they are well-established GPU cards or scientific computing in data centers and Altair® nanoFluidX has thoroughly been tested on them. The code also has dynamic load-balancing ensuring optimal hardware utilization and can run on multi-node clusters as well.

*“As a contributing resource for understanding lubrication flow inside a NuVinci product, Altair® nanoFluidX has been of value to our project. The software offering, HPC and nanoFluidX makes this simulation method approachable for the non-expert user like Fallbrook Technologies, and I would recommend it as a viable option for further simulation tasks.”*

**Brad Pohl, Chief Engineer, Advanced Engineering  
Fallbrook Technologies Inc.**