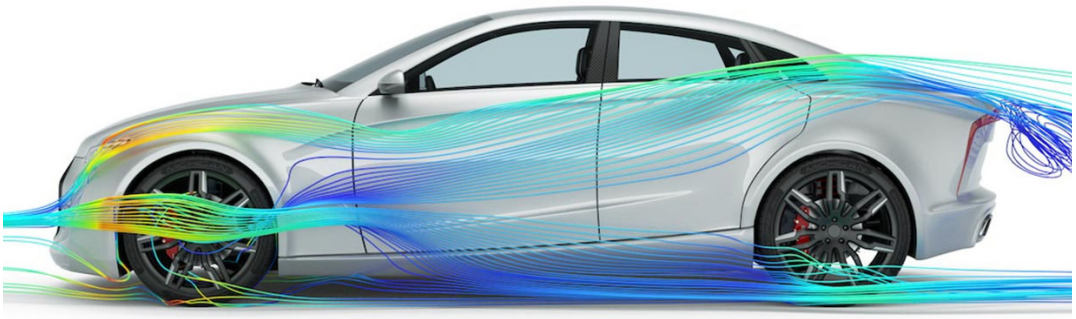
THE KEYS TO SCALABLE, COST-EFFECTIVE CFD INVESTMENT

Fluid mechanics simulation is a critical tool for late-stage failure risk mitigation, as well as a driver of design insights throughout the product development process. Used across all levels of product design and validation, from design engineers seeking to understand fluid and thermal effects on a design proposal to analysts performing advanced aerodynamic modeling, Computational Fluid Dynamics (CFD) serves a broad array of applications and a range of users with varied levels of expertise. The sometimes complex and computationally intensive nature of CFD necessitates careful consideration of the software and hardware investments required to produce accurate solutions and scale them at the speed of a company's development process.



Overview

There is no one-size-fits-all software for all of the CFD applications that a manufacturer encounters. There are a number of CFD methodologies including general-purpose Navier-Stokes (NS), Lattice Boltzmann (LBM), and Smooth Particle Hydrodynamics (SPH), and each serve a different subset of CFD applications.

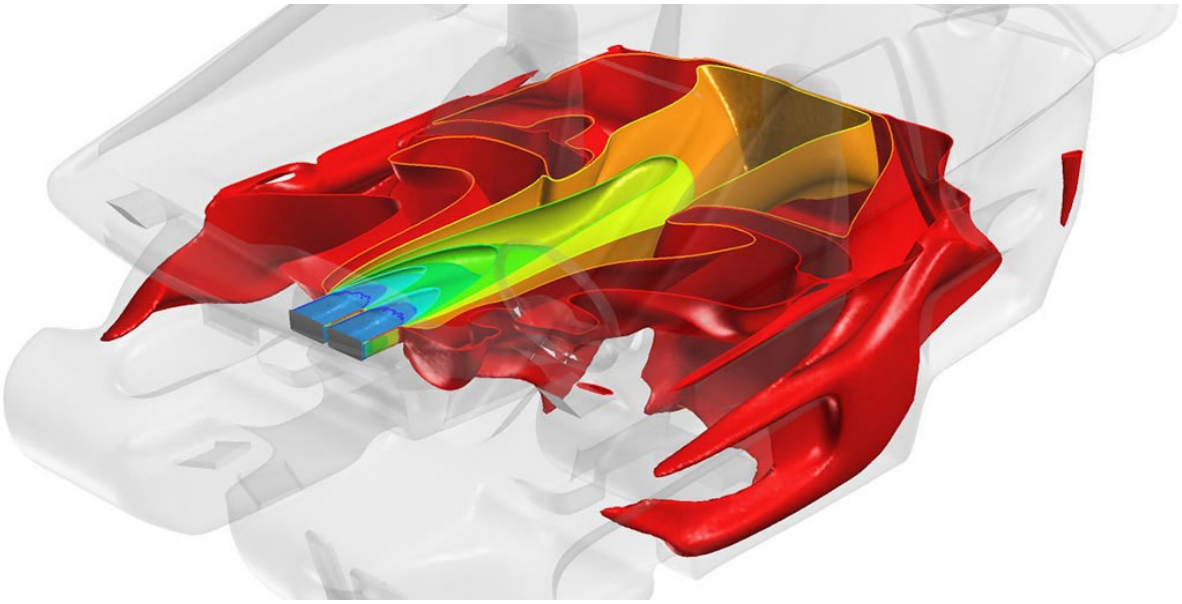
- **General-purpose Navier-Stokes:** Best for thermal and general-purpose applications
- **Lattice Boltzmann:** Excels with aerodynamics and aero-acoustic problems
- **Smooth Particle Hydrodynamics:** Ideally suited for oiling, sloshing, and mixing

One challenge many organizations face is determining how to get their engineers the right tool for the right job, while minimizing software expense. Another barrier to entry for companies looking to invest in CFD is the cost of procuring and the logistics of managing high-performance computing (HPC) resources needed to run large-scale simulations.

Selecting the Right Tool for Each CFD Problem

Whether you are looking to perform thermal analysis of buildings, predict aerodynamics of vehicles, optimize gearbox oiling, reduce cooling fan noise, or develop innovative medical devices, Altair CFD™ can help.

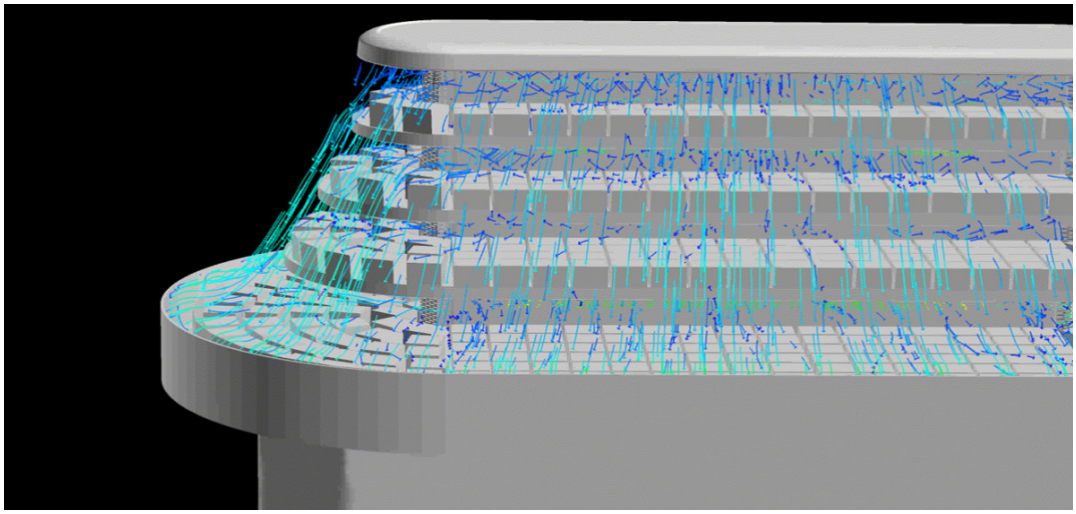
Altair CFD is a comprehensive set of tools to solve fluid mechanics problems, including complex multiphysics, and the only solution on the market that offers a range of CFD methodologies within a single license. Altair's unique, units-based licensing model is a highly cost-effective alternative to purchasing individual tools from multiple software vendors. This scalable, easily deployable, and cost-effective licensing mechanism delivers a complete range of pre-processing, solving, and post-processing tools for any CFD problem.



General-purpose Navier-Stokes Method

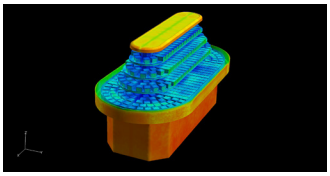
Altair CFD's general-purpose Navier-Stokes technology is a proven asset for companies looking to explore designs by applying a full range of flow, heat transfer, turbulence, and non-Newtonian material analysis capabilities without the difficulties associated with traditional CFD applications. Altair CFD is robust, scalable, and accurate regardless of the quality and topology of the mesh elements.

Hussmann Services India used Altair CFD's general-purpose Navier-Stokes solver to minimize infiltration and improve the total efficiency of an open refrigerated display case. The accuracy of the CFD simulation and excellent correlation between CFD and test lab results allowed Hussmann to minimize experimental tests, reduce the number of prototyping cycles needed, and ultimately reduce overall product development time by 20-30%.



CFD simulation of Hussmann open refrigeration system

Hussmann open refrigeration system



Thermal plot of Hussmann open refrigeration system

Particle-fluid Systems

Many industrial processes involve interaction between both fluid and particle phases. Realistic modeling of these complex systems can be done using CFD for fluids and the Discrete Element Method (DEM) for particle simulation with Altair EDEM™. Using CFD coupled with EDEM enables engineers to realistically simulate the interaction between fluid and particles and to investigate a range of complex systems such as fluidized beds, solid-liquid mixing, spray coating, filtration, pneumatic transport, and drying.

Lattice Boltzmann Method

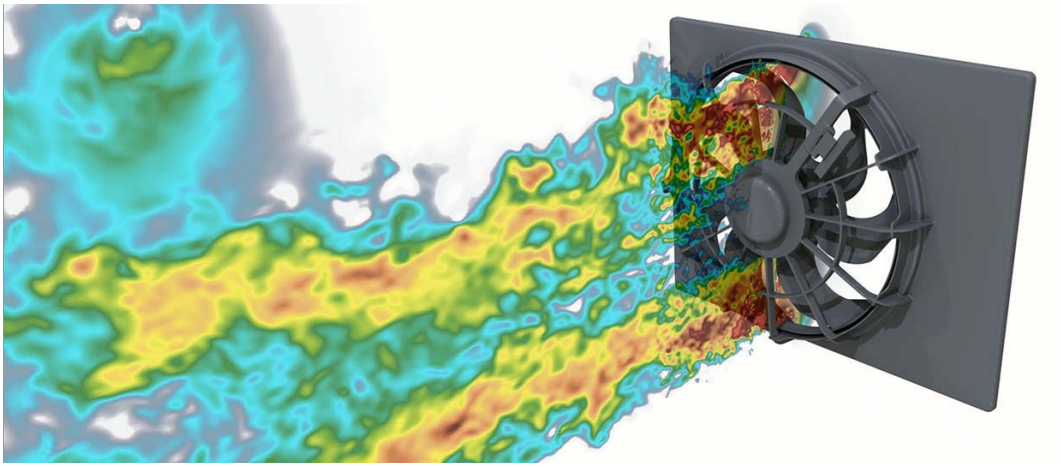
LBM simulation in Altair CFD provides ultra-fast prediction of aerodynamic properties in passenger and heavy-duty vehicles, and for building and environmental aerodynamics. Engineers can resolve highly transient aerodynamics simulations overnight on a single server.

From ground transportation vehicles, architecture, engineering, and construction structures to individual customer applications, Altair CFD enables designers to understand fluid dynamics and investigate innovating structures to improve efficiency, increase users' comfort, and deliver safe projects, on time.

Guangzhou Automobile Group Co. (GAC) R&D center used Altair's LBM solver to perform hundreds of transient simulations on design changes with high accuracy. Using NVIDIA's Tesla-V100 GPUs to increase computing efficiency, these simulations helped shape the design of the GAC GS4 coupe, which became one of the highest aerodynamic efficient vehicle designs in its class. These tools helped GAC realize model preparation time savings of 60% and simulation cost savings of 70%.

Read the Customer Story

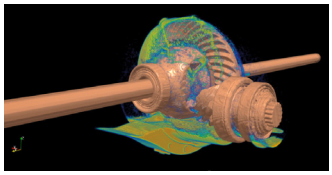
In addition to assessing the aerodynamics of vehicles, LBM is particularly adept at fan noise and other aero-acoustic calculation. With the ever-increasing cooling requirements across industries, fan noise has become one of the important factors that drives design decisions in product development. Altair CFD includes a Lattice Boltzmann solver that enables accurate calculation of aero-acoustic noise in fans. This provides a solution for installed fan acoustics by directly calculating the convective field. This virtual method can significantly reduce risk of failure leading to development cost savings and mitigation of timeline overshoot.



Aero-acoustic noise prediction in an industrial fan

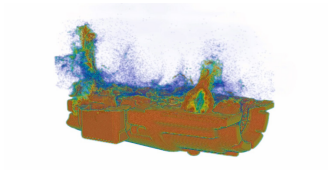
Smooth Particle Hydrodynamics Method

The SPH simulation tool in Altair CFD is used to predict fluid flow around complex geometries while in complicated motion. It is used for a variety of applications such as simulating oiling within conventional high-performance or electric vehicle powertrain systems comprising rotating gears, analyzing forces on individual components of the system or water management (wading, sloshing…). It enables engineers to optimize efficiency by reducing friction or heat losses, improve reliability and safety, while limiting mechanical stress and hot points, or reduce fatigue.



Tata Motors transmission oiling

Tata Motors faced the challenge of optimizing oil flow and oil volume to provide adequate lubrication to the bearings in its transmission system. Typically, this process requires multiple physical trials, which expend a great deal of time and resources.



Tata Motors transmission oiling

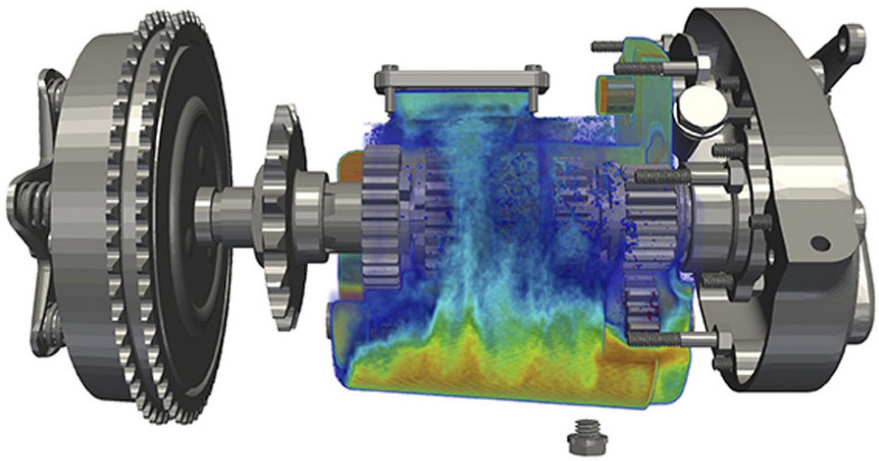
Altair CFD's SPH solver enabled Tata Motors to predict the oil flow through complex rotating transmission geometries with high accuracy. This helped optimize the housing design to provide adequate lubrication for the system and significantly reduced the design iteration time compared to physical trials. This simulation-driven process helped Tata Motors define the optimum oil level and volume, optimize oil flow through oil galleries, and improve the overall efficiency of their transmission system.

Boost Solver Processing with GPUs

Graphics processing units, or GPUs are gaining popularity among companies looking to increase their CFD solver throughput and obtain design and performance insights faster. A single GPU offers the compute power of up to 100 CPUs, enabling scientists to solve problems that were once thought impossible.

All of Altair CFD's solvers are optimized for use on clusters of GPUs, making them extremely fast and scalable. For instance, in a typical SPH gear-train simulation, without the need to simplify geometries, simulations can run an order of magnitude faster than a finite volume code.

Utilizing GPUs to accelerate CFD simulation means more opportunities to explore and fine-tune designs and make decisions faster based on more accurate results. Multiple physics can be accurately simulated on GPUs, realizing an elastic-hybrid environment – on-premise or in the cloud – to explore and evaluate alternatives overnight and significantly speed up design workflows.



Oil management simulation in gearbox

A Flexible Approach to Cloud and HPC Infrastructure and Administration

CFD analyses are often compute-heavy simulations, and HPC helps to speed up analysis times of these large and complex jobs. But many businesses still see HPC as prohibitively expensive in terms of both capital expense and IT resources.

All-in-one Appliances
Altair's turnkey, state-of-the-art on-premises and cloud-based appliances box up software, system administration, and infrastructure as a service, delivering unlimited use of a wide range of Altair software. They require little setup or administrative effort, and each appliance is customizable, ranging from starter nodes for small businesses to large-scale, enterprise-level options, accommodating the computing needs and budget of any organization.

Cost predictability and flexibility are imperatives for any IT team. Rather than incur the upfront costs and ongoing maintenance of purchasing HPC infrastructure outright, Altair offers yearly and multi-year appliance lease options so businesses can plan and upgrade hardware on their schedule.

Hybrid Computing
Companies that already leverage HPC sometimes exhibit irregular or unpredictable cadences of job submissions, which can have a choking effect on job scheduling efficiency, budget, and IT resources. If your company only requires extra compute power infrequently, scalable, pay-as-you-go virtual HPC appliance options offer a more cost-effective option than buying and managing additional dedicated compute clusters.

No waiting in queues or fighting for licenses. When on-premises workload volume peaks, burst to your favorite cloud provider – or multiple cloud providers – to handle fluctuating workloads with ease. For end users, advanced remote visualization and intuitive job submission portals make leveraging HPC and cloud resources possible from anywhere.

Simulate, Collaborate, and Run Jobs in the Cloud
Altair One makes it easy to access the tools of innovation on any device, run jobs and visualize data anywhere, and accelerate engineering with HPC, all in one platform. Users get a collaborative experience and administrators keep the needle moving forward with a single view into the entire computing infrastructure.

All from this unified simulation and computing platform, companies can provision scalable resources in the cloud or on-premises through a single pane of glass, run cloud version Altair CFD and other Altair data analytics and simulation software, and run jobs in the cloud.

Working with Altair

Altair CFD provides an unparalleled breadth of CFD solutions under a single license. This collection of powerful, intuitive, and scalable simulation tools, combined with the technology democratization of the unit-based licensing model, make Altair uniquely positioned to address the challenges of enterprises looking for holistic and cost-effective fluid mechanics solutions.

With Altair's flexible HPC and cloud computing resources, companies can deliver CFD results to their engineers faster to empower simulation-driven design methods, enable greater access and collaboration via simulation in the cloud, and reduce IT scheduling and administration associated with CFD computing jobs.

To learn more, visit altair.com/altair-cfd