

AcuSolve™

Next Generation Technology for Automotive CFD Simulation

Automotive Industry Demands Reliable and Efficient CFD Solutions

Computational Fluid Dynamics (CFD) has played an important role in automotive design for many years, from traditional applications such as aerodynamics, aeroacoustics, and thermal management, to more recent innovations such as electric and hybrid vehicle battery systems, advanced diesel engines and wireless passenger conveniences. With the increasing demand for reliable, energy-efficient transportation, demands for CFD solutions are greater than ever. Automotive engineers continue to look for better CFD technology to solve design problems more quickly, more accurately, and more easily.

AcuSolve™: Next Generation CFD Solutions for Automotive Design

AcuSolve's Galerkin/Least-Square (GLS) finite element formulation and novel iterative linear equation solver make it a superior CFD "engine" for automotive applications. Today, new battery and hybrid technology is leading the way to drastically reduce the environmental waste of classic internal combustion engines. Similarly, AcuSolve's GLS finite element CFD solver reduces CFD "waste" by easily using unstructured tet meshes. These meshes include high aspect-ratio boundary elements with mesh quality measures that prove difficult for classical CFD finite volume solvers relying on n-dimensional polyhedra grids. The unique mesh-tolerant feature of AcuSolve's GLS methodology makes the preprocessing/mesh generation step in a CFD CAD model workflow much more efficient, while providing the geometric detail necessary for accurate automotive flow and thermal simulations.

Solving Complex FSI and CAA Problems

ACUSIM Software provides best-in-class coupling capabilities for Fluid-Structure Interaction (FSI) and Computational Aero-Acoustic Interaction (CAA), utilizing its finite element capability to overcome the errors due to interpolating flow quantities from a finer CFD mesh to a coarser FEA or CAA mesh.

ACUSIM's FSI technology is the most advanced in the CFD market. ACUSIM was the first company to offer direct-coupled FSI solutions, enabling most accurate results and best-in-class solutions for complex multidisciplinary design problems involving coupled fluid flow and structure phenomena.

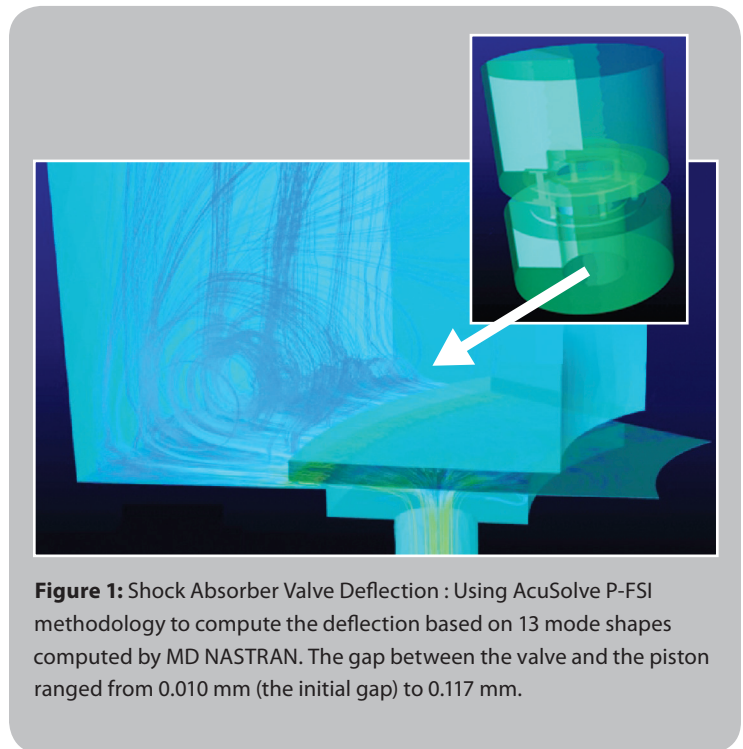


Figure 1: Shock Absorber Valve Deflection : Using AcuSolve P-FSI methodology to compute the deflection based on 13 mode shapes computed by MD NASTRAN. The gap between the valve and the piston ranged from 0.010 mm (the initial gap) to 0.117 mm.

AcuSolve provides two powerful FSI capabilities. Practical FSI (P-FSI) predicts linear solid/structural response to fluid forces; Direct-Coupling FSI (DC-FSI) predicts large deformation and non-linear solid/structural responses to fluid forces. DC-FSI is superior for transient applications exhibiting nonlinear structural response due to large deformations, material non-linearities, and complex contact. For CAA, this advanced coupling capability means accurately predicting dBA levels generated by rotating HVAC blowers and engine fans.

Ease of Use and CAE Automation

AcuSolve can be used on a standalone basis, or be easily integrated into an existing SLM/PLM workflow and it can be used by engineers and scientists with all levels of expertise. In addition to its highly efficient and tolerant automatic mesh generator, AcuSolve also has great CAE Automation capability allowing users to customize menus and functions for vertical applications, yielding highly accurate results in greatly reduced solution times.

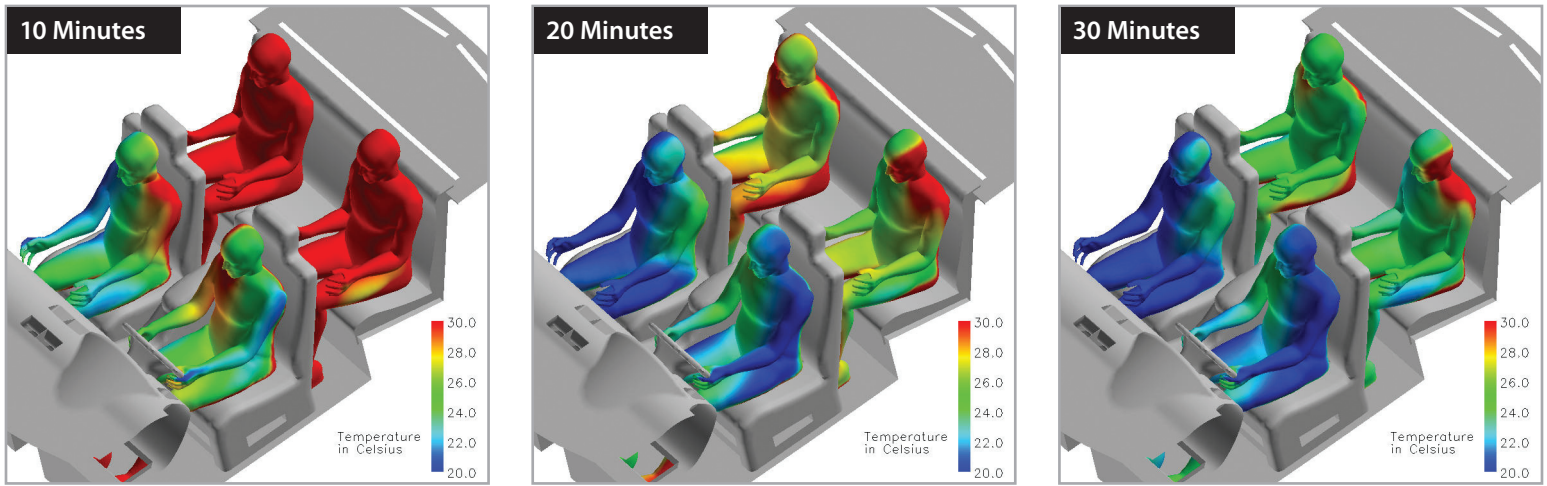


Figure 2: Passenger Car Occupant Comfort

Highly Validated Solutions

Since 1994, automotive engineers have applied AcuSolve's wide ranging functionalities to many CFD challenges.

- Ten to 50 million element automotive models to capture important geometry and flow features are routine with AcuSolve, easily handled with its massively parallel software architecture.
- State-of-the-art turbulence models ranging from Spalart/Allmaras turbulence models for steady state calculations, to Detached Eddy Simulation (DES) turbulence modeling for accurate transient simulations.
- Multiple Reference Frame (MRF) and Moving Mesh capabilities for rotating devices such as engine cooling fans and HVAC blower wheels.
- Fast parallel view factor solver for automotive enclosure radiation effects such as exhaust manifold and exhaust shielding, under hood cooling—even behind the IP thermal effects due to the density of hot multi-media and other electronic devices.

- Boussinesq density model for subtle buoyancy-driven thermal flows in low convection or trapped air spaces.
- Specialized porous media, heat exchanger, annulus fan and line source models to properly aggregate friction and heat effects of small scale details such as heat exchanger fins and tubes, complex shaped engine fans, etc.
- Solar radiation and heat source models for occupant comfort modeling and hot weather vehicle testing.
- Multiplier functions, user defined functions, and additional scalar advective/diffusion equations to handle numerous other design problems ranging from defogging headlamps to providing the torque curve of an HVAC blower wheel.

The successes of computational fluid dynamics will continue to propel the use of CFD in automotive design. ACUSIM will continue to be at the forefront of this industry, providing a technology leading and versatile CFD solution to solve more and more applications in this field.

About ACUSIM Software, Inc.

ACUSIM Software provides engineers and scientists with superior Computational Fluid Dynamics (CFD) solutions. ACUSIM's products are used globally in a wide variety of industries such as automotive, electronics, chemical, bio-medical, consumer products and energy, as well as national labs and universities.

Headquartered in Mountain View, California, ACUSIM Software markets its flagship product, AcuSolve™, and its associated pre-processor, AcuConsole™, post-processor, AcuFieldView™, and desktop solution, AcuDesktop™, through direct sales and distributor channels.

ACUSIM Software, Inc.
2685 Marine Way, Suite 1421
Mountain View, CA 94043
USA

USA Tel +1 (650) 988-9700
Website: www.acusim.com

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