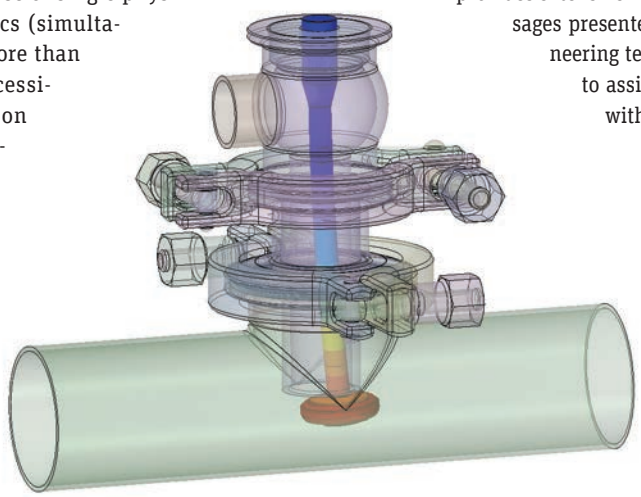
INTRODUCING ANSYS AIM: SIMULATION FOR EVERY ENGINEER

This integrated solution for simulation encompasses the breadth of ANSYS physics in a single, modern user environment.

By Steve Scampoli, Lead Product Manager, ANSYS

To develop innovative products that revolutionize industries, companies continually seek new ways to improve product design processes and increase product reliability. While it is widely recognized that deploying simulation-based guidance early in the design process allows organizations to take product designs to the next level of performance and dependability, in practice this is often difficult to achieve. Many traditional simulation tools have steep learning curves and are more suitable for simulation experts rather than for the broader engineering population. While providing engineering simulation has been an ANSYS hallmark for many years, the latest release includes a new simulation environment designed to revolutionize the simulation process. It does this by making leading single-physics, multiple-physics (sequential use of single physics solutions) and multiphysics (simultaneous, coupled solution of more than one physics) simulations accessible to every engineer. Built on the ANSYS Workbench platform, ANSYS AIM is a new, immersive simulation environment that lowers the barrier to entry for engineering simulation. AIM unifies ANSYS industry-leading solver technologies with a guided and customizable simulation process that makes simulation-based guidance accessible to entire engineering organizations.



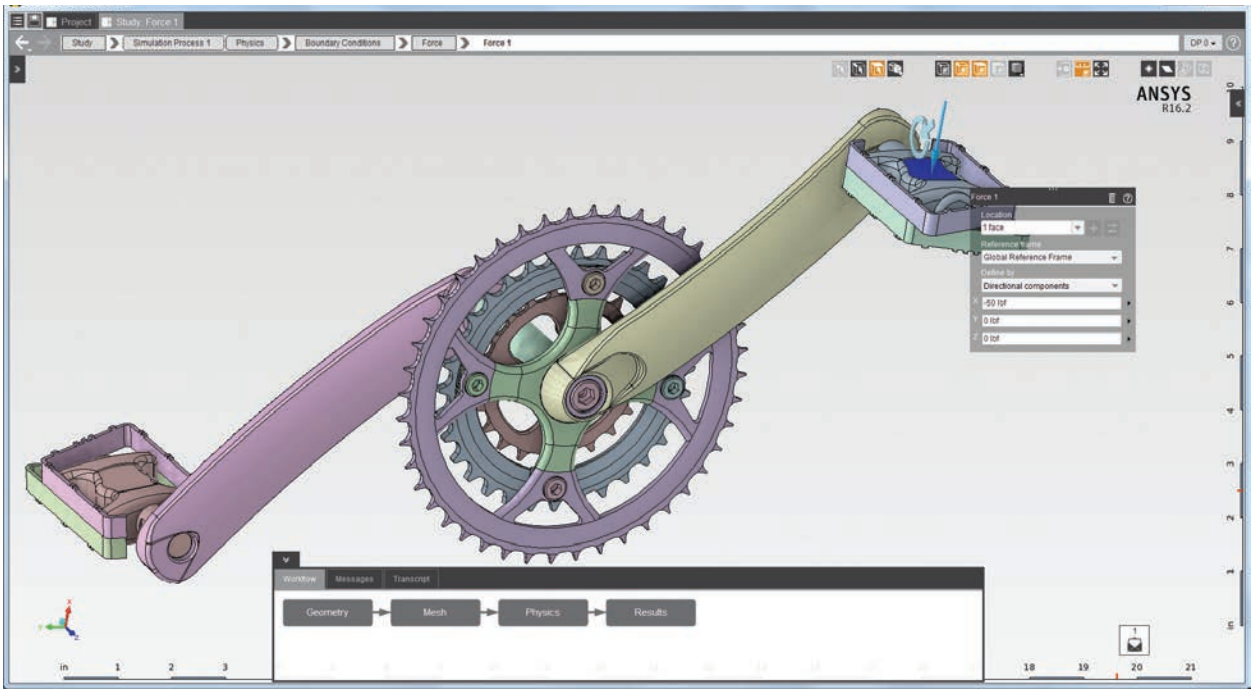
▲ Fluid–structure interaction simulation of a flow control valve. Deformation of the valve stem from fluid forces is shown.

INTUITIVE USER EXPERIENCE

ANSYS AIM provides a modern, intuitive user experience that empowers all engineers to make design decisions based on simulation throughout the entire product development process. This user environment streamlines the setup, execution and results evaluation of simulations involving single and multiple physics as well as multiphysics for both new and occasional users of simulation. At the core of AIM's simulation workflow are simulation process templates that define task-based workflows for both single physics and applications involving multiple physics simulations. Templates enable novice and infrequent users to rapidly learn and leverage simulation to guide design decisions. The AIM user interface also provides many visual cues to lead users through the steps of the simulation process, and to model inputs that require user attention. Throughout the simulation process, AIM's integrated help system provides extensive video content and informative messages presented in easily understandable engineering terms. The help system is designed to assist users to become more familiar with simulation.

CUSTOMIZATION OF SIMULATION WORKFLOWS

Based on the readily customizable Workbench platform, the ANSYS AIM user environment provides tools to script and customize this environment to automate simulation workflows. For many companies with large design groups, a CAE methods group will



▲ ANSYS AIM's task-based workflow guides the simulation process for static analysis of a bicycle crank assembly. Immersive menus enable quick specification and editing of model inputs and results.

define simulation best practices and standard engineering simulation workflows. To more easily enable the deployment of simulation to design groups, AIM allows the creation of custom templates that can be tailored to follow an organization's specific simulation process. Custom templates and automated workflows empower CAE methods groups to capture their engineering simulation knowledge and provide expert guidance to design groups using simulation in their design process. Distributing simulation to an entire design group can speed product innovation and time to market, resulting in robust and innovative products.

ANSYS AIM OVERVIEW
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AIM's customization is based on native journaling and scripting via IronPython, an open source implementation of the Python programming language. Using journaling and scripting capabilities, all simulation steps can be recorded and easily customized to create customized templates. With these templates, CAE methods experts can capture engineering simulation best practices and define standard simulation workflows for their organizations. The AIM user interface can be further tailored via user interface extensions so that custom data panels, workflows and end-user documentation can be created. AIM also includes a powerful expression language that allows variable boundary conditions and other model inputs to be defined via expressions. The customization tools, expression language and scripting syntax are used across all aspects of the simulation physics spectrum. Employing AIM's customization capabilities, CAE methods groups can successfully deploy consistent engineering simulation best practices and automated workflows to the broader engineering organization.

MODELING REAL PRODUCT ENVIRONMENTS

Real-world product environments inherently include multiple physical effects — fluid forces, thermal effects, structural integrity and electromagnetic radiation can all impact product performance. To maximize product performance and reliability, engineers routinely consider how multiple

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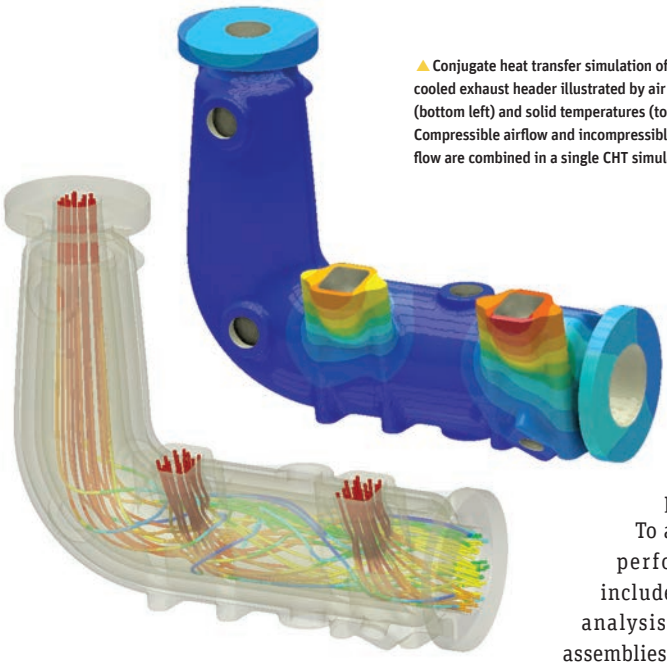
The underlying solver and meshing components are based on proven ANSYS technologies that have been developed and validated for the world's most demanding customers.



▲ Conjugate heat transfer simulation of a water-cooled exhaust header illustrated by air streamlines (bottom left) and solid temperatures (top right). Compressible airflow and incompressible water flow are combined in a single CHT simulation.

physics interact with the in-service uses of the products they are developing. AIM enables engineers to simulate multiphysics interactions to ensure that product designs will perform in real-world product environments.

AIM includes the essential multiphysics simulation capabilities required to solve a wide range of product design challenges across many industry applications — and the breadth and depth of AIM capabilities will increase rapidly through frequent releases each year. To evaluate fluid and thermal performance of product designs, AIM includes steady-state fluid flow and heat transfer to assess both laminar and turbulent flows, conjugate heat transfer (CHT) to determine fluid and solid temperatures, fluid buoyancy effects to examine natural convection, and compressibility effects for modeling high-speed gas flows. AIM's fast and robust fluid solutions accurately determine key design parameters such as fluid velocity, pressure drop, and lift and drag coefficients to predict the fluid and thermal behaviors of product designs. To assess structural performance, AIM includes static stress analysis of parts and assemblies, including nonlinear contact and large deflection, modal analysis to determine natural frequencies and vibration characteristics, and durability analysis to compute fatigue life of components and assemblies.

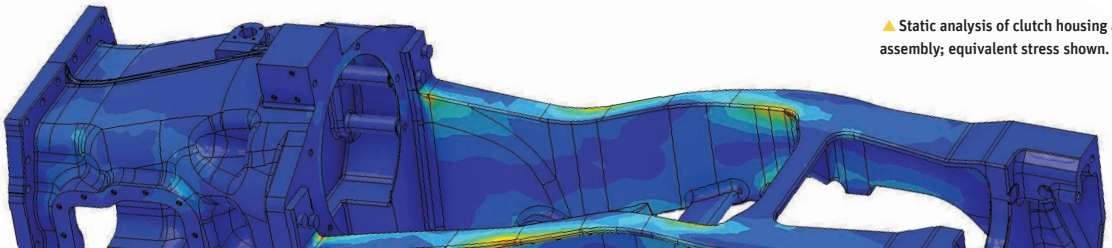
Fluid and structural physics can be coupled through one-way fluid–structure interaction, which provides an accurate transfer of fluid forces and solid temperatures to a structural simulation to evaluate the structural response to fluid and thermal loads. To determine electrical performance, AIM includes direct current electric conduction analysis, so that current distribution, power loss and voltage drop of product designs can be determined. AIM's many options for multiphysics simulation also include fully coupled thermoelectric–stress analysis, which allows power loss to be used as a heat source to compute temperatures — and subsequent thermal deformation and stress — of product designs.

The multiphysics simulation capabilities of AIM enable simulation across a broad range of industry applications, such as the fluid and structural performance of valves, flow control devices and process measurement instruments; wind and fluid loads on structures; temperature and stress in heat exchangers, engine components and electronic devices; and current distribution, temperature and stress in fuses and busbars. These examples are just some of the applications requiring multiple physics that can be conducted with ANSYS AIM to determine how product designs perform in real-world environments.

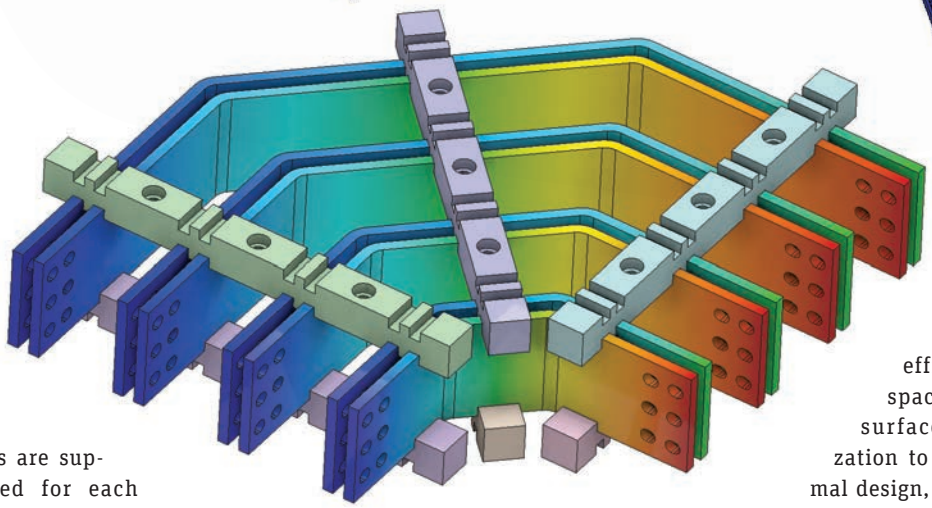
PROVEN, HIGH-PERFORMANCE SIMULATION

In today's fast-paced product design environment, design cycles are short, and companies demand accurate simulation results quickly. ANSYS AIM addresses this by delivering proven, accurate and scalable technologies for engineering simulation. While AIM's graphical user interface and user experience are new, the underlying solver and meshing components are based on proven ANSYS technologies that have been developed and validated for the world's most demanding customers.

All components of the AIM simulation workflow — mesh generation, solution and post-processing — take advantage of parallel computing to maximize the speed and throughput of the entire simulation process. Using parallel computing, AIM enables teams to perform rapid turnaround of multiple design alternatives and evaluate high-fidelity simulation models, including large assemblies and highly detailed geometry. To rapidly generate a high-quality mesh for complex geometries, AIM uses parallel part-by-part meshing to leverage multiple CPU cores for mesh generation. Engineering teams can combine individual physics and multiphysics solutions using multiple CPU cores to increase solution speed. Two CPU



▲ Static analysis of clutch housing and frame assembly; equivalent stress shown.



▲ DC electric conduction simulation of a busbar; electric potential shown.

cores are supported for each solver by default; for large-scale simulations, the software can access additional CPU cores by taking advantage of ANSYS HPC for greater simulation throughput. AIM post-processing also takes advantage of parallel computing; it includes both GPU- and CPU-accelerated post-processing for all physics for rapid evaluation of both quantitative and qualitative results. When using AIM to evaluate the performance of product designs, engineers never have to compromise on speed, robustness or accuracy.

EVALUATION OF DESIGN ALTERNATIVES

Engineers routinely evaluate multiple design alternatives to make informed decisions to optimize products. To provide a more detailed understanding of a product's design space, AIM includes pervasive parameterization to evaluate multiple design alternatives. Virtually any model input or output — a geometric dimension, material property, boundary condition or result quantity — can be defined as a parameter and used as part of a parametric simulation. Once parameters are defined, the parametric simulation model is employed to rapidly explore design alternatives and to develop a more thorough understanding of the design space. AIM also includes options for design of experiments (DOE) to efficiently assess the design space and develop response surfaces, goal-driven optimization to help determine the optimal design, and six sigma analysis to ensure that product designs are robust. The parametric simulation and optimization capabilities of AIM enable engineers to develop higher-performing product designs and deliver greater product innovation.

The multiphysics simulation capabilities of AIM enable simulation across a broad range of industry applications.

SIMULATION-BASED GUIDANCE BECOMES ROUTINE

By solving single and multiphysics (both sequential and directly coupled) applications combined with efficient and intuitive workflows, ANSYS AIM allows engineers to proficiently and routinely leverage simulation guidance across a wide range of industries. AIM's simulation process templates and guided workflows give engineering teams simulation direction early in the design processes to improve product performance and reliability. AIM's automation and customization capabilities enable automated simulation workflows specific to an organization's engineering methodology to be successfully deployed across engineering organizations — making simulation accessible to every engineer.