



SIEMENS

Ingenuity for life

Siemens PLM Software

STAR-CCM+

Discover better designs, faster

www.siemens.com/mdx

“Prototypes at JLR can be very expensive. If we can save a prototype, the software is paying for itself. For systems such as the defrost system, we no longer build any prototypes apart from the final model. We rely totally on STAR-CCM+ to design the system.”

Karamjit Sandhu

*Technical Specialist, Climate Control, Computer-aided Engineering
Jaguar Land Rover Limited*

Providing accurate and efficient multidisciplinary simulation capabilities



Jaguar F-Type cabin ventilation. (Courtesy of Jaguar Land Rover)

The engineering challenge

As an engineer, it is critical that you are able to predict the outcome of design changes on the real-world performance of your products. To be effective, these predictions must be delivered frequently throughout the development process, providing a constant stream of data that influences the evolution of your product.

The STAR-CCM+ solution

STAR-CCM+ software is an all-in-one solution for multidisciplinary engineering simulation, built on the philosophy that simulation should empower engineers to discover better designs, faster. It delivers accurate and efficient simulation technologies through a single integrated user interface and automated workflows. This facilitates the analysis and exploration of complex real-world problems. With STAR-CCM+, you can predict product performance at a fraction of the cost of experimental testing and get the necessary engineering data to guide your design process.

The bottom line

By using STAR-CCM+, our customers reported the following benefits:

- Improved product quality
- Met client requirements
- Realized fewer field failures
- Avoided product recalls
- Reduced number of physical prototypes
- Reduced time-to-market
- Cut manufacturing costs
- Better understood product behavior

STAR-CCM+ software facilitates innovation

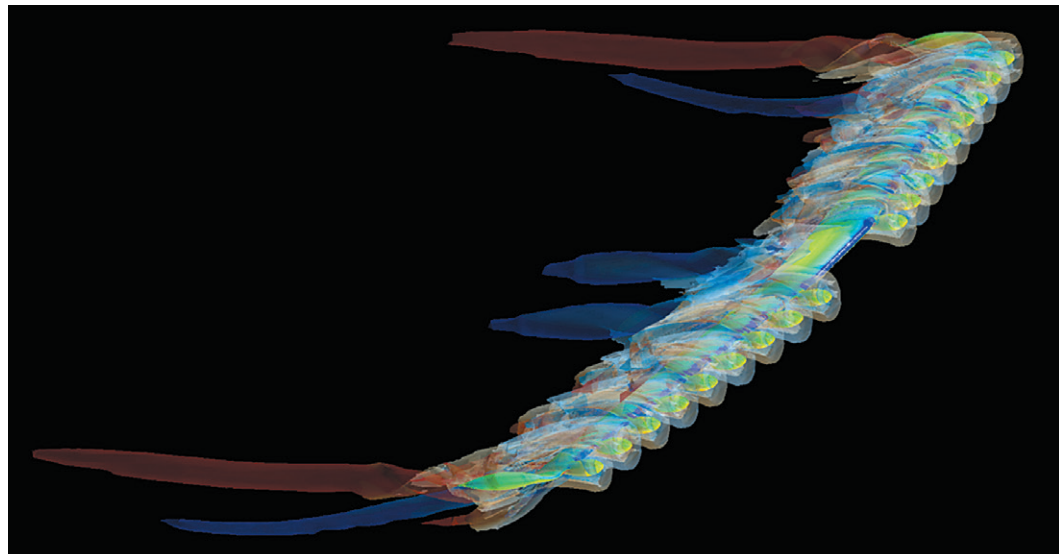
Leveraging a single integrated user interface

Using STAR-CCM+ software facilitates innovation and collaboration so you don't need to compromise between usability and functionality. It provides accurate and efficient multidisciplinary simulation technologies from an intuitive single integrated user interface. The integrated approach makes it easy for you to explore a range of configurations and scenarios involving complex geometries and spanning a variety of engineering disciplines. STAR-CCM+ provides engineering solutions for your enterprise, whether you are a new design engineer or a research and development (R&D)

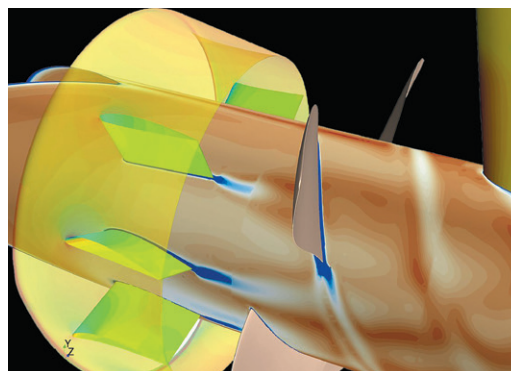
simulation expert. The single integrated user interface makes it easy to learn and deploy, facilitating the development of cutting-edge solutions.

Facilitating workflow automation

You can automate your entire simulation workflow from geometry to data analysis by using a repeatable and robust pipelined approach and Java macros. This allows you to efficiently drive design changes and achieve your engineering objectives. You can also easily deploy your best practices with tools such as the simulation assistant, eliminating analyst-to-analyst variations and giving you greater confidence in your results.



Aerodynamic simulation of leading-edge propellers of the LEAPTech wing. (Courtesy of Joby Aviation)



Vorticity magnitude inside the duct showing the effect of a rotating propeller. (Courtesy of IBMV)



The Cray XC40 Hazel Hen at the High-Performance Computing Center Stuttgart. © Boris Lehner for HLRS

Providing a true multiphysics platform

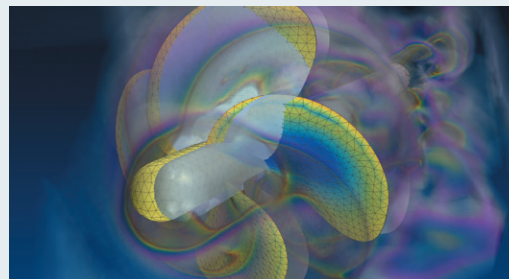
You can solve sophisticated industrial problems with a single simulation model that hosts the geometry, mesh, all required physics and the analysis results. This enables you to take into account a wide range of physics across multiple engineering disciplines.

STAR-CCM+ offers both a finite-volume and finite-element method, giving you the most appropriate numerical schemes for the physics being modeled. It can also be coupled with third-party codes (in-house, commercial) through its co-simulation application programming interface (API), bringing you the flexibility to use the right tool for the job.

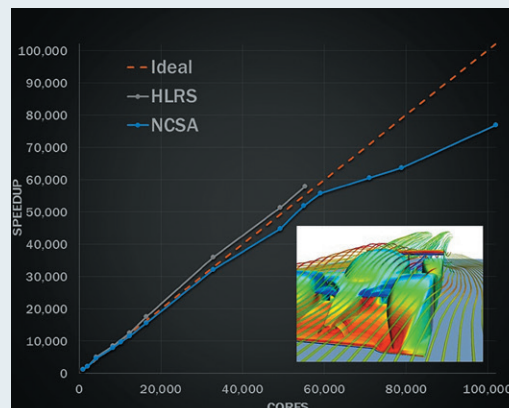
Using parallel performance to achieve quick turnaround

High-performance computing that uses simulation significantly accelerates the pace of your product design cycles. As computing power continues to grow exponentially and becomes more affordable, STAR-CCM+ is designed to make the most out of the available computational resources.

STAR-CCM+ is parallelized from meshing to solution, and it scales to hundreds of thousands of cores. This allows you to push the boundaries of your simulations, from solving single large-scale analyses to studying hundreds of variants for simulation-led design.



Fluid-structure interaction of a ship's propeller from a single integrated user interface.

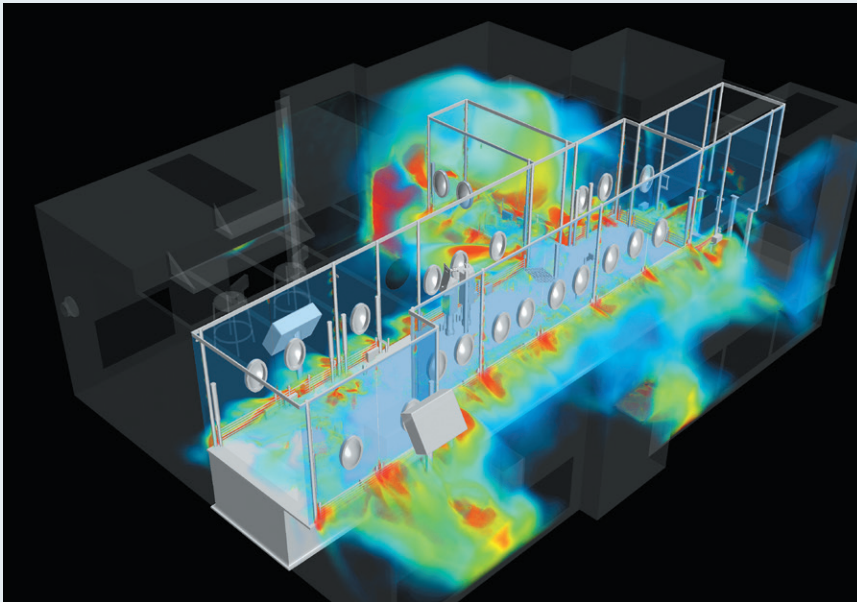


This graph shows the scalability of STAR-CCM+ on National Center for Supercomputing Applications (NCSA) and High Performance Computing Center Stuttgart (HLRS) supercomputers.

“The ease of use, robustness, efficiency and accuracy of STAR-CCM+ meshing tools and solver, proven over the years that we have been using it, makes it the core part of our highly automated design process.”

Steven Leonard
Head of Research & Development
IBMV Maritime Innovationsgesellschaft

STAR-CCM+ software helps maximize productivity



Cleanroom simulation. (Courtesy of Creaform)

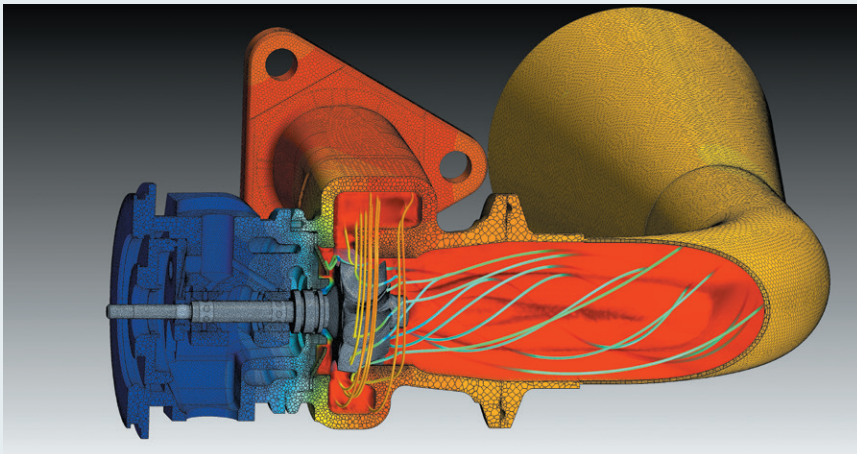
Automating geometry creation and preparation

STAR-CCM+ helps you maximize your productivity with a robust and automated workflow for ensuring complex geometries are ready to mesh:

- A fully parametric 3D feature-based modeler is used to create, modify and defeature computer-aided design (CAD) data
- A bi-directional link between STAR-CCM+ and CAD/product lifecycle management (PLM) software is used for geometry transfer and modification
- There are intuitive manual repair tools and fully automatic surface wrapping for preparation of imported geometries

Generating flexible and repeatable meshes

- No matter how complex your geometry, the technologies in STAR-CCM+ enable you to fully automate your meshing process, yet they are flexible enough to give you fine-grained mesh control when required, including:
 - Parallel meshing to fully use available hardware resources
 - A comprehensive set of state-of-the-art meshers, including polyhedral, trimmed hexahedral and swept mesh types for a wide range of applications
 - Robust generation of prism layers, ensuring accurate capture of boundary layers
 - Automated and fully conformal meshing for multi-domain studies such as conjugate heat transfer
 - Specialized meshing for specific applications, including the thin mesher, extruder and 2D meshing



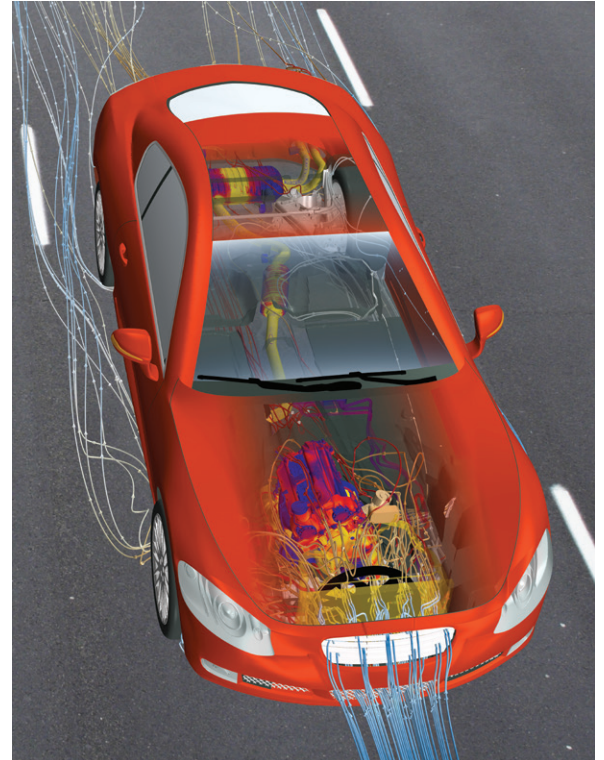
Micro gas turbine conjugate heat transfer. (Courtesy of B&B-AGEMA)

“Creaform uses STAR-CCM+ in its software arsenal as it allows us to quickly treat about any geometry, including raw scans. Our experts can work with the scans and any other available data to numerically reconstruct the geometry and then perform the CFD simulations, cutting down costs and intermediaries.”

Phillipe B. Vincent
Computational Fluid Dynamics Engineer
Creaform



Residue handling simulation on a combine using the discrete element method.
(Courtesy of CNH Belgium N.V.)



Streamlines through an engine compartment.
(Courtesy of InDesA GmbH)

Accurately predicting the real-world performance of products

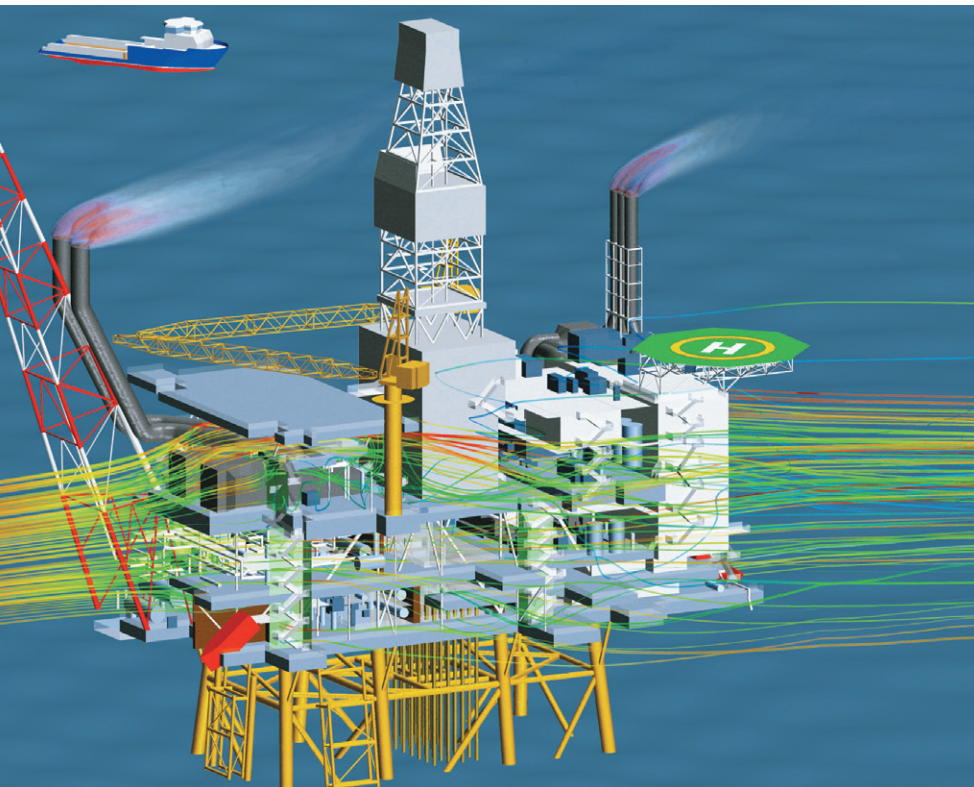
The integrated multidisciplinary approach of STAR-CCM+ enables physical phenomena to be studied in a fully coupled manner. This reduces approximation, giving you confidence that the predicted behavior of your designs will match the real-world performance of your product. The single integrated user interface helps you cover your complete application scope with:

- A broad range of validated models to simulate disciplines and physics including: computational fluid dynamics (CFD), computational solid mechanics (CSM), heat transfer, multiphase flow, particle dynamics, reacting flow, electrochemistry, acoustics and rheology
- Simulation of rigid and flexible body motions with techniques, including mesh morphing, overset meshes and six degrees-of-freedom (DOF)
- The ability to combine the various physics and motion models in a single simulation to cover your specific application

“The ability to effortlessly read CAD data, mesh a geometry, select boundary conditions and set up physics models in STAR-CCM+ has tremendously sped up our design process. We’ve been able to deepen our analysis and drive engine designs faster and more effectively with the same resources as before.”

Jeff Schlautman
Group Leader, Airflow and Combustion Analysis
General Motors

STAR-CCM+ accelerates decision-making and multidisciplinary design exploration



Consequence modeling analysis of safety-related issues on an offshore platform.
(Courtesy of Atkins)

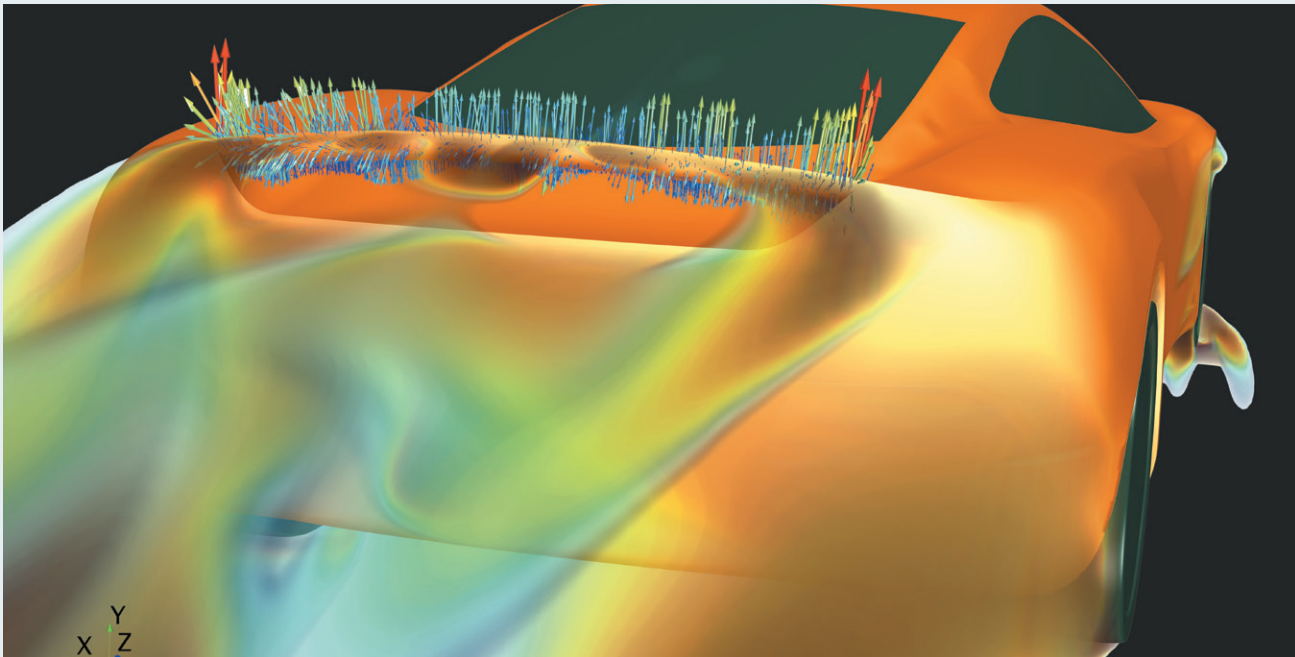
Making design decisions with confidence

The keystone to effective engineering analysis is the ability to easily understand and communicate your simulation results to colleagues and customers. STAR-CCM+ can be used to integrate a range of powerful analysis and visualization tools to help your team arrive at critical design decisions quickly and with confidence. It delivers:

- Live processing of solution progression, enabling on-the-fly assessment of results and changes to design and analysis parameters
- Quantitative data analysis for reporting and monitoring of engineering data
- High-impact qualitative visualization to better understand and communicate your results
- Collaborative decision-making tools to review and share your design results across the organization and with customers and partners

“With an intuitive interface, powerful automation capabilities, integrated meshing, pipelined process and comprehensive postprocessing abilities, STAR-CCM+ is a powerful and efficient solution. This has helped Atkins play a key role in advancing the use of simulation for technical safety studies for oil and gas operations across the globe.”

Ian Cowan
Technical Director
Atkins



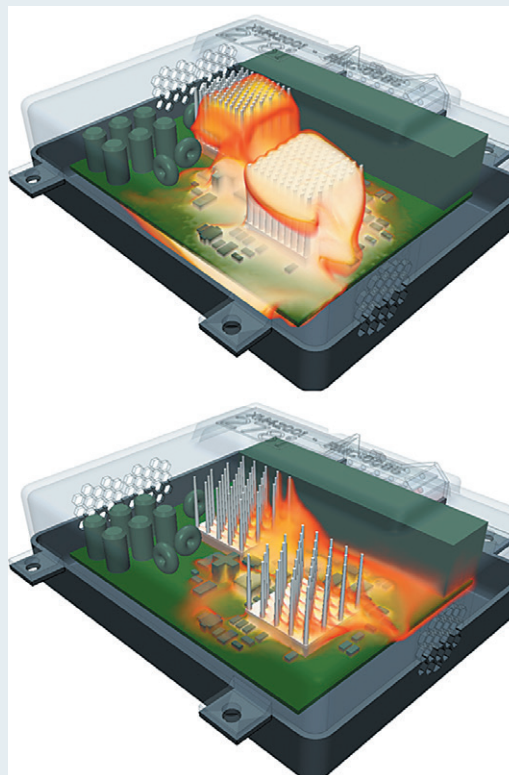
Adjoint sensitivities for the rear wing of a car

Enabling you to discover better designs, faster

STAR-CCM+ gives you direct access to design exploration and optimization technologies, making iterative design studies seamless and efficient. The robust and repeatable pipelined workflow in STAR-CCM+ is a key enabler of multidisciplinary design exploration using the Optimate add-on:

- Automated process for setting up, executing and postprocessing design studies, including parameter sweeps, design of experiments and single and multi-objective design optimization
- Efficient hybrid adaptive optimization algorithm with a blend of search strategies, leveraging the best methods and simultaneously exploring the design space locally and globally
- Offers an adjoint solver for shape optimization and economical sensitivity analysis:
- Shape optimization: Gain insight and morph the geometry to improve your designs
- Uncertainty quantification: Understand how uncertainties affect your solution
- Inverse problems: Recognize which part of the geometry has the greatest influence on your results

Optimate and the adjoint method in STAR-CCM+ can be used together to get the most out of your design exploration. Users can start their multidisciplinary design exploration with Optimate to develop an initial design and continue to fine-tune it using the adjoint approach.



Thermal control module design with Optimate.

Continuously delivering state-of-the-art solutions

Every release of STAR-CCM+ provides exciting new features and enhancements. Our aggressive development schedule ensures we continuously deliver innovative technologies to broaden your application scope and respond to your evolving simulation needs. As a Siemens PLM Software customer, you have the ability to influence the development of STAR-CCM+ through the IdeaStorm innovation forum, which enables you to submit, vote and comment on new product development ideas.

Backed by a team of global experts

All STAR-CCM+ users are assigned a dedicated support engineer who is tasked with understanding their simulation goals and helping them maintain productivity. Support queries are managed through our online customer support portal, which also gives you access to a comprehensive knowledge database.

Offering innovative and affordable licensing options

With multidisciplinary design exploration becoming the norm, it is critical that license costs don't limit your engineering ambitions. Our power licensing gives you access to the full multidisciplinary capabilities of STAR-CCM+ at a much lower cost than traditional licensing plans. We offer three innovative licensing options, giving you unlimited cores for a single fixed price (power session), enabling you to run on the cloud (power-on-demand) and making design exploration affordable (power tokens).

Serving a wide range of industries and applications

Aerospace: aerodynamics, propulsion, thermal, aeroelasticity, aeroacoustics, icing, store separation, environmental control systems (ECS)

Energy: gas and steam turbines, compressors, combustion, pumps, balance of plant (BOP) renewable energy, nuclear energy, energy storage systems (ESS)

Oil and gas: drilling, erosion, offshore wind studies, reservoir modeling, well containment, green water loading, subsea thermal, separator analysis

Marine: aerodynamics, hydrodynamics, propellers, sloshing, mooring, liquefied natural gas (LNG) evaporation, fluid-structure interaction (FSI)

Ground transportation: aeroacoustics, aerodynamics, thermal heat protection, powertrain, manufacturing, cabin comfort

Chemical process: mixing and stirred reactors, particulate flow, combustion, cyclone separation, packed-bed reactors, Safety and environment

Electronics: natural convection cooling, forced convection cooling, conduction cooling, liquid cooling

Life sciences: mixing, respiratory, particle interaction microfluidics, blood flow and hemodynamics



About Siemens PLM Software

Siemens PLM Software, a business unit of the Siemens Digital Factory Division, is a leading global provider of product lifecycle management (PLM) and manufacturing operations management (MOM) software systems and services with over 15 million licensed seats and more than 140,000 customers worldwide. Headquartered in Plano, Texas, Siemens PLM Software works collaboratively with its customers to provide industry software solutions that help companies everywhere achieve a sustainable competitive advantage by making real the innovations that matter. For more information on Siemens PLM Software products and services, visit www.siemens.com/plm.

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