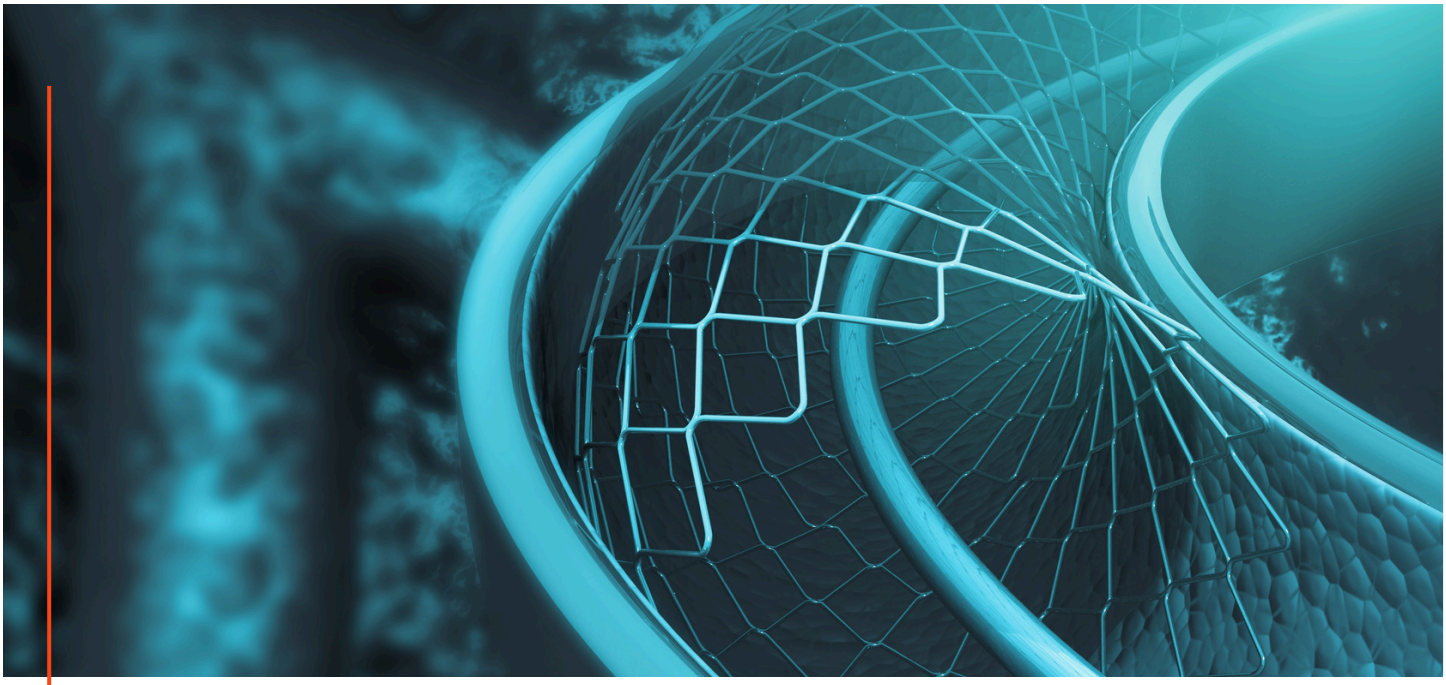


INCREASING EFFICIENT MEDICAL DEVICE AND IMPLANT DESIGN

Millions of people rely on medical devices to improve and protect their daily living. Whether it's an injector or an implant, these devices are transformative, making it imperative that they are designed with safety and cost-effectiveness in mind. For businesses, device performance, regulatory compliance, and time to market are essential for success. Thus, organizations must look to silico modeling to optimize device designs and reduce clinical trials while maintaining patient safety and needs.

Altair® HyperWorks® delivers its simulation-driven ethos to engineers designing medical devices so they change people's lives for the better. Altair® HPCWorks® provides a robust, optimized high-performance computing (HPC) infrastructure to manage compute environments that deliver better results, faster. Here, we explore how these industry-leading capabilities and solutions improve medical device design.

Concept Level Design and Analysis

Simulations serve an invaluable purpose in designing cost-effective medical devices that meet manufacturing and regulatory requirements because they accurately model real-world uses and stressors. Design teams also rely on simulations to help develop medical devices that withstand the structural and operational requirements associated with normal use and accidental drops – all while taking weight and cost into consideration. Solutions like Altair® Inspire®, Altair SimSolid®, and Altair® SimLab® empower designers to simulate structural, thermal and fluid properties, vibrations, electromagnetics, and manufacturing constraints in an integrated multiphysics environment. This ensures the medical devices that transform people's lives are accessible and function properly.

Pre-Processing Medical Devices

The human anatomy poses an immense challenge due to biological complexity and variability. To accurately model medical devices, organizations must contend with complex systems and geometry. Altair® HyperMesh® streamlines importing, geometric cleanup, meshing, and surface modeling of complex anatomical structures. Designers and engineers rely on HyperMesh to model human bodies, coupled with mechanical structures, implants, and safety devices. For patient-specific modeling, sizing, and testing, HyperMesh imports and creates structural models based off medical images. This ensures that even custom medical devices function properly.

> Altair's modern integrated approach for streamlining design for manufacture of injection molded components covers initial design of the part, understanding the injection molding process...material mapping of reinforced engineering polymers, to efficient analysis and optimization of the structural and fatigue performance all within a single, integrated environment.
>
> Patrik Ingvarsson, Manager TDC EU, Nolato Medicalast

Structural Design

Once concepts have been finalized, engineers and designers shift focus to the details of a given device design. Engineers and designers must take into consideration where implants must exist biologically to produce custom solutions for patients. Designers begin to simulate for intricacies like sizing, fit, tolerances, thermal, fluids, stress points, and more. Altair offers an integrated multiphysics environment to simulate structural, thermal, fluid properties, vibration, electromagnetics, and manufacturing constraints. Solvers like Altair® OptiStruct®, Altair SimSolid, and Altair® Radioss® deliver advanced solutions for analyzing structural integrity and durability.

Topology Optimization

Additive manufacturing and topology optimization offer the medical device industry expanded opportunities for design flexibility and customization, without many of the limitations of traditional manufacturing processes. Topology optimization uses physics and spatial algorithms to produce optimized structures based on given loads, objectives, and the design space. It performs especially well within a framework that leverages implicit geometry and lattice generation to refine designs into smooth, manufacturable structures. Engineers rely on topology optimization solutions like Altair® Inspire™, OptiStruct, and HyperMesh to design patient-specific, lightweight products, that do not compromise strength while ensuring comfort fit, and function. It has become an invaluable tool in medical applications like dental, orthopedic implants, prosthetics and orthotics, 3D printed anatomical modeling for surgical planning, patient education, and clinical training.

AI in Engineering

Artificial intelligence (AI) adoption is growing in the field, and with good reason. AI can manage labor-intensive tasks, leaving engineers and designers with more time to test new ideas, and reach new heights. Training models on existing simulation and test data is easier than ever with Altair® PhysicsAI™. The models it produces deliver fast physics predictions (often 1000x faster than traditional solvers) without the need for parameterization. It identifies the relationship between shape, performance, and physics. Altair® romAI™ streamlines complex computational simulations, saving time to optimize system performance. It uses reduced order modeling and AI tools to optimize and study system-level performance.

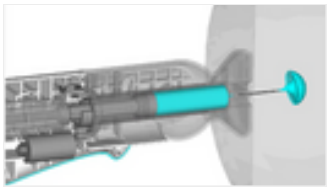
Customized Workflow Automation and Implementation

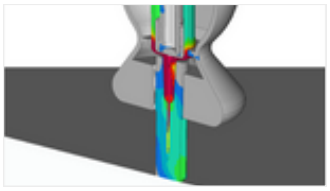
Altair users can develop customized automated workflows tools that eliminate time-consuming manual tasks and streamline engineering design processes. Altair's team of consultants can also build an integrated system, with customer-specific requirements, to integrate new and legacy processes. With Altair's open architecture, consultants can build several workflows from modeling stents, converting CT scans to 3D meshes, automating validation reports, and more.

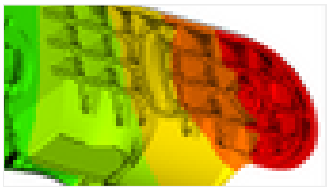
Enterprise HPC Backbone

Running vast, intricate simulations requires sufficient compute power to deliver results quickly and efficiently, reducing time to market. Effective workload management takes into consideration CPU nodes, cloud bursting, licenses, GPUs, storage, and power to set users up with the resources they need to succeed. Whether they're on-premises or in the cloud, HPC environments require an optimized workload manager to schedule jobs for maximum resource utilization and match workloads to the right resources. Confidently burst to the cloud during peak-demand times using Altair® NavOps®, a solution designed to automate workloads without overspending. With these combined tools, researchers and engineers can access critical results faster, helping deliver safer products to the people who depend on them.

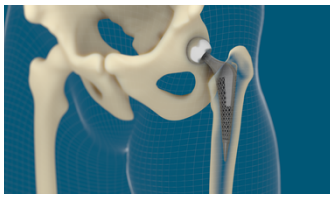
To learn more, contact us at altair.com/contact-us







Autoinjector simulations. Top: coupled motion and fluid simulation. Middle: drop test simulation. Bottom: warpage simulation after injection molding.



A series of 3D images showcasing a hip joint replacement designed using Altair solutions.

Auto-injector designed using Altair solutions.