

Altair Extends the Inspire Environment for Simulation-Driven Design with SimSolid

CIMdata Commentary

Key takeaways:

- *The use of advanced physics-based simulation tools starting early in conceptual design and development provides proven business impacts for new product innovation, product development process efficiency, time to market, and product cost minimization.*
- *Increasing product complexity means engineers must now design components and sub-assemblies within a “system perspective.” Market leading companies can no longer develop innovative new products with disconnected engineering silos across design, simulation and validation, and manufacturing.*
- *The drive to “democratization of simulation” is leading to new software tools that can be used effectively by both simulation experts as well as design and manufacturing engineers to perform rapid “what if” design studies with an acceptable level of accuracy for conceptual design and development.*
- *Altair’s integration of Altair SimSolid™ technology within the Altair Inspire™ Simulation-Driven Design environment provides rapid evaluation of complex 3D product assemblies and enables interactive feedback for collaborative concept development across design, simulation, and manufacturing.*
- *While offering the potential to significantly expand the usage of analysis to design engineers, the use of Inspire with the SimSolid technology also has high value to simulation and CAE specialists who do not typically use 3D CAD tools.*

Today’s Market Drivers and the Need for Change

Manufacturing enterprises are facing many new business and product development challenges that require changes in long established business and engineering processes to remain competitive and viable in today’s globally connected environment:

- Enterprise level Digital Transformation & Digital Thread business initiatives
- New business challenges and revenue opportunities in the context of Industry 4.0 and the emergence of physics-based Digital Twins being applied to manufacturing and in-service operations
- Increasing product complexity of “smart connected”, cyber-physical systems (hardware, electronics, software, sensors, controls, etc.)
- The design and development of such complex “smart” systems requires well integrated capabilities for cross-disciplinary design, simulation, analysis, and optimization including structural analysis, thermal analysis, multi-body dynamics, materials, and shape optimization
- New generative design approaches driven by the availability of advanced manufacturing processes (both additive and subtractive) and new hybrid materials are leveraging the latest technologies in performance simulation and topology optimization to create innovative and highly cost-efficient products but the industry use case applications and software tools have been primarily focused to date at the sub-system and component design levels

The Inspire and SimSolid Integration: Delivering on the Altair Vision

Altair's vision is that modeling and simulation should drive 3D design rather than just be a final verification of a robust design. Mr. Jim Scapa, Altair CEO and co-founder, has summed up this vision to be transforming engineering decisions from the very beginning of concept development. Altair has pursued this goal for over three decades and has recently expanded their application suite to include new technologies for rapid analysis of CAD geometry including assemblies (SimSolid), advanced data analytics (Datawatch), and PCB/electronics simulation and design (Polliwog), and is hosting their applications in the cloud.¹

Altair has long been a recognized leader in mechanical design optimization with their Altair OptiStruct™ technology and the application of high-performance computing (HPC) for state-of-the-art multi-physics simulation. The robust exploration of potential design spaces to create new product innovations continues to drive the need for advanced modeling and simulation solutions leveraging and supported by affordable and scalable software solutions for the engineering desktop, for the cloud, and for HPC environments.

While SimSolid will continue to be available as a standalone product, the latest release of the Inspire environment incorporates the groundbreaking new SimSolid analysis capabilities. This integration expands upon the Altair generative design approach to embrace an overall assembly-level view of 3D product design that enables engineers to interactively analyze and identify alternative assembly configurations and determine optimal component design concepts. SimSolid's unique multi-pass adaptive analysis technology replaces the traditional FEA approach and provides superior solver performance metrics for both computational time and memory footprint that allows very large and/or complex 3D assemblies to be solved quickly on desktop class PCs.²

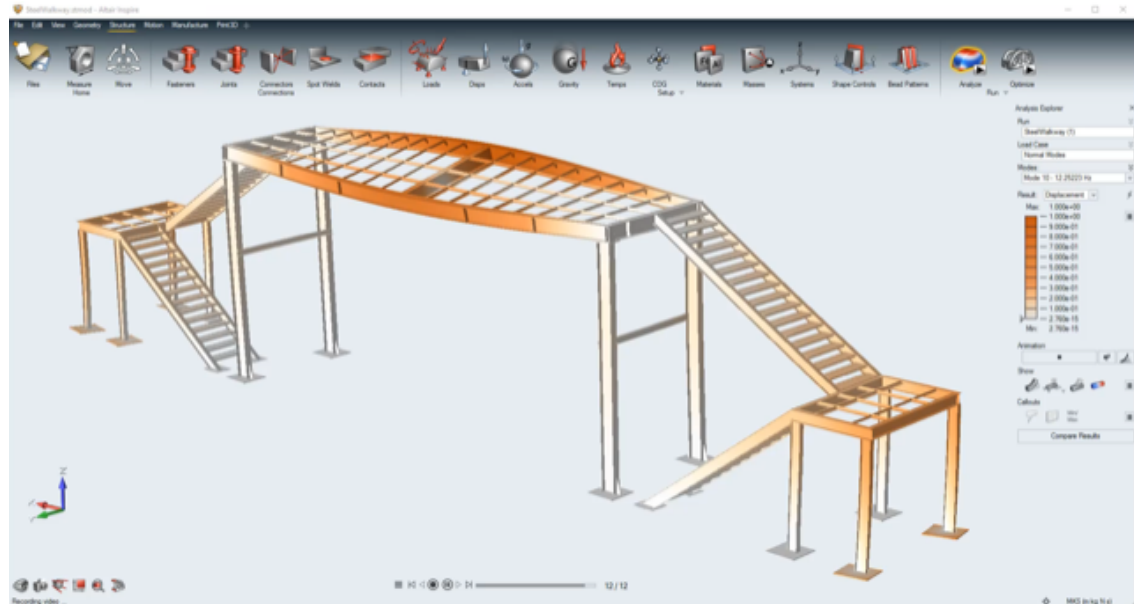


Figure 1—Modal Analysis Results on a 393-Part Assembly in the Inspire Simulation-Driven Design Environment
(Courtesy of Altair)

¹ Research for this Commentary was partially supported by Altair Engineering

² See Altair SimSolid technical paper: <https://www.altair.com/resource/altair-simsolid-technology-overview>

The Inspire and SimSolid Integration: A Focus on Design Innovation and Engineering Productivity

The detailed geometry representations created in 3D CAD tools appropriate for use in design and manufacturing applications are fundamentally far more complex than is needed or appropriate for doing evaluations of the design performance versus functional requirements. Widely used 3D simulation approaches such as finite element analysis (FEA) require a much more simplified form of the CAD geometry to create a discretized mesh that is used by the FEA solver to calculate the desired analysis results in terms of stresses, strains, natural frequencies, range of kinematic motion, etc. These geometry abstractions, simplifications, and meshing activities can take up to 70% of the total modeling and analysis process time, depending on the product complexity and type of analysis required.

The hard reality is that the “CAD geometry to FEA mesh” process requires many subjective modeling assumptions; is manual and labor intensive in nature; and is therefore error-prone. The vast majority of engineers do not possess the expertise in using 3D CAD tools as well as the knowledge of FEA theory and proficiency in using simulation tools which are required to accurately perform analyses. In addition, the disparity between the 3D CAD models created by designers and the FEA geometry and mesh models typically created by CAE specialists in different tools often means it takes far too long to provide rapid feedback to the product design team, especially as the fundamental design concepts are evolving and the design geometry changes. And these design changes are often happening at both the assembly level as well as at the individual component or sub-system level. When significant design changes occur; the entire meshing and analysis process often needs to be repeated from scratch.

The result is that the effective use of simulation and analysis today is still far too limited to CAE specialists in larger companies with complex and expensive analysis workflows focused primarily on final product verification and validation. The effective use of simulation is rarely well integrated within the conceptual product design and development process.

Inspire combined with SimSolid eliminates these two most time-consuming and expertise-extensive tasks of geometry simplification and meshing and also provides a single, easy to use environment where design, simulation and even manufacturing engineers can interactively collaborate to analyze many design concept alternatives and even optimize product designs using Altair’s OptiStruct® technology—at the assembly, sub-assembly and component levels.

The SimSolid computational technology works directly on fully featured CAD assemblies without requiring modified or simplified CAD geometry. And SimSolid does not need to create a mesh of the geometry to perform the analysis. The result is that SimSolid can rapidly analyze large assemblies that contain discrete connectors such as welds, bolts and nuts, and rivets. It can also deal with complex parts such as thin walled structures that are often not practical to analyze from a conceptual design process time and cost perspective with traditional FEA tools.

The SimSolid analysis process is transparent to the user who imports the geometric model from a 3D CAD system; inputs the basic parameters for the type of simulations desired; and then reviews the subsequent analysis results within the Inspire user environment. Because SimSolid is so much easier to learn and use, SimSolid was initially targeted at design engineers who are not experts in FEA and CAE. But the extremely fast and almost interactive SimSolid computational solver has also led to early adoption by traditional CAE simulation specialists. Altair customers such as Don-Bur Ltd. which produces a range of commercial vehicle trailers

confirms the design analysis process improvements that SimSolid is delivering.³ And the SimSolid technology has recently been benchmarked and validated by NAFEMS⁴ as providing very acceptable levels of analysis accuracy for conceptual “what if” type simulations in much shorter analysis solution times when compared to traditional FEA tools.

SimSolid works best on materials with well-known and homogenous or continuous properties—so it is not yet appropriate for composites or other types of advanced hybrid materials. While the range of solution options is adequate for first level conceptual analysis (linear static, modal, thermal properties, along with more complex coupled, nonlinear, transient dynamic effects), the SimSolid analysis solutions are not as broad or deep as is currently available in the other Altair HyperWorks™ solution suite applications nor in other advanced FEA solutions such as ANSYS™, ABAQUS™, and Nastran™.

Altair plans to continue to expand upon the scope of analysis solution options that can be addressed with the SimSolid technology as well as the range of new assembly connection types and different material types that can be evaluated.

Altair projects that more CAE specialists will use SimSolid now that it is integrated within the Inspire environment to collaborate with design and manufacturing engineers during the concept development stage and that more design engineers will also get comfortable doing their own baseline CAE analyses before they release a design concept to a simulation expert for more detailed analysis and final validation (as required) or to manufacturing engineering.

Conclusion

CIMdata believes that the availability of next generation simulation technologies integrated within 3D conceptual design environments such as Inspire is a major step forward in the long industry quest for the “democratization of simulation.” This quest began back in the 1990s with the integration of advanced simulation tools within the high end 3D CAD environments such as I-deas and CATIA and the subsequent introduction of analysis capabilities integrated within the mid-range CAD tools such as SolidWorks and Autodesk. While somewhat successful in making simulation technologies more readily accessible with 3D design geometry on the design engineer’s desktop UI, this approach has not addressed the key democratization issues of:

1. The analysis training and expertise required to safely and accurately perform even standard types of structural and mechanical analyses and
2. The time required to perform realistic analyses of large 3D assemblies as well as parts with complex 3D geometry

For selected types of analysis at the conceptual design stage, the Inspire and SimSolid integration directly addresses both of these key issues today. And because of the highly interactive and collaborative nature of the Inspire/SimSolid environment, we expect Altair’s technology to enable increased product innovation through better collaborative decision making across product teams consisting of design, analysis, and manufacturing engineers. As such, we believe that the Inspire environment augmented with the SimSolid technology has the potential to be a major positive factor in achieving the PLM industry’s quest for democratization of simulation and the long promised business benefits of simulation-driven design.

³ See Don-Bur video: <https://www.altair.com/resource/SimSolid-drives-down-analysis-time-at-don-bur>

⁴ See Altair web site: <https://www.altair.com/resource/nafems-SimSolid-benchmark>

Note: CIMdata advocates that easy-to-use conceptual design analysis tools are a viable means to achieve innovative and more capable "first-time right" designs. However, they do not obviate the need for final design validation through detailed analyses of the final "as built" product, typically performed by qualified CAE specialists in concert with the appropriate level of physical test and evaluation.

About CIMdata

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