ANSYS

Application Brief

ANSYS SpaceClaim Direct Modeler for Beam and Shell Structural Simulation

Accurate structural analysis of large, complex assemblies has traditionally been a time-consuming and difficult study/application. Establishing a quality mesh on geometry can be difficult by itself and a long time may be required to obtain a solution. Structural analysis technology has out of necessity evolved, and users can now take advantage of the ability to mesh and solve much simpler, representative geometry. Complex models can be reduced to 1-D and 2-D elements, respectively called beams and shells. This provides a "lightweight model" representation, while still delivering accurate solutions. While significantly reducing solve time, use of beams and shells still has a number of geometry challenges that often negate the intended benefits if not adequately addressed.

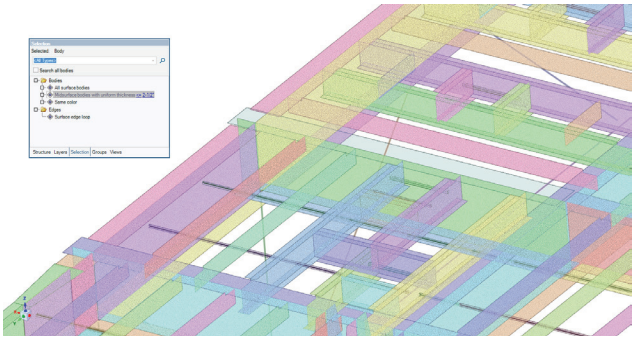

Figure 1. Advanced search capabilities in ANSYS SpaceClaim Direct Modeler allow you to organize, separate and modify bodies.

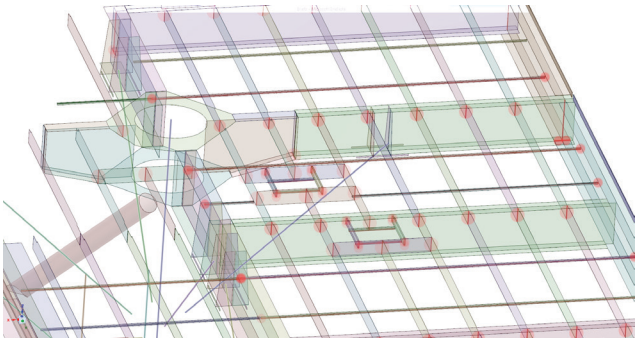

Figure 2. Automated tools find possible problem areas that affect meshing.

The first challenge of geometry simplification is the actual extraction of beams and shells, or the creation of the representative line and surface bodies. Further, some 3-D geometry may not contain walls perfectly aligned with an obvious shell (or midsurface). The automated search and extract tools built into ANSYS SpaceClaim Direct Modeler find all eligible solid bodies fitting the search criteria, and let you the user decide which ones to use to extract simplified representations. If the geometry does not have obvious shells to extract, SpaceClaim Direct Modeler will provide suggestions and give you several options for the final shell geometry. As component count in an assembly increases, and reaches the hundreds or thousands, there is an increased need for more sophisticated search and organization tools. Also included in SpaceClaim Direct Modeler are advanced searching capabilities that let you organize, separate and modify specific bodies.

After extraction, all elements must have proper junctions and intersections to ensure adequate meshing. In many cases, extraction of representative geometry is a simpler step than ensuring the necessary connections. Some models lend themselves well to minor extension and trimming of beams and shells. In those cases SpaceClaim Direct Modeler is equipped with automated tools to find possible problem areas and automate correction options. In cases where automated solutions are not desirable or practical, SpaceClaim Direct Modeler provides several other options. Manual edits are always possible where desired and are necessary at times. Still SpaceClaim Direct Modeler comes equipped with a relatively new functionality to infer connections and create imprints on geometry that does not intersect. Within the Imprint tool in SpaceClaim Direct Modeler is the ability to find edges that are nearly touching surfaces within a tolerance specified by the user. The tool will determine the correct relationship and automatically imprint an edge to the nearby face. This means perfectly mated or connected junctions, while still of benefit, are not a preprocessing requirement. This provides a time-savings advantage so analysts can focus less on geometry imperfections and more on iterating design modifications.

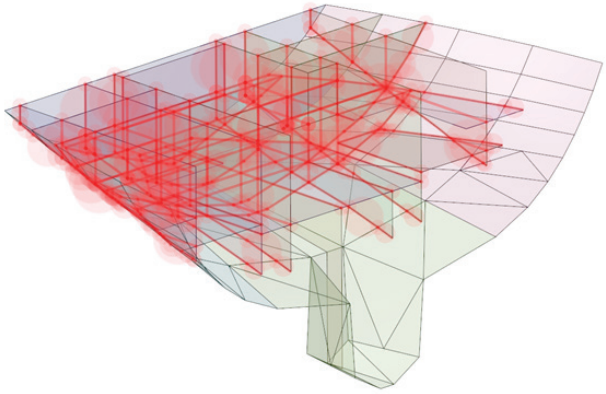

Figure 3. For a shell model, where each surface body does not necessarily intersect or imprint the appropriate nearby surface, based on tolerances specified by the user ANSYS SpaceClaim Direct Modeler will find edges that are nearly touching surfaces.

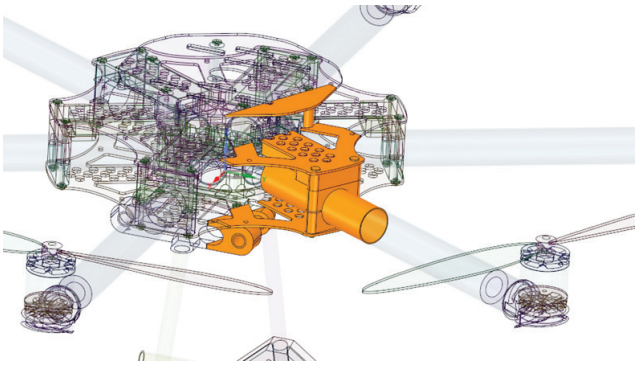

Figure 4. With ANSYS SpaceClaim Direct Modeler you can extract beams/shells, and *further extract* solid geometry from a localized region of interest.

Finally, users may often utilize beam and shell geometry to mass solve relatively straightforward load conditions. But certain areas of high stress concentration render this process inadequate. Users want the ability to quickly solve large, simple load areas using beam and shell geometry, but reserve traditional 3-D meshing for subsections with higher stresses. SpaceClaim Direct Modeler solves this multifaceted approach by letting users extract beams/shells, and *further extract* solid geometry from a localized region of interest. This extracted solid geometry within a sphere contains named selection of newly created boundaries, further saving the analyst's time by enabling rapid setup of load conditions and subsequent meshing.

Summary

Use of beams and shells in structural analysis requires a robust tool with reliable geometry extraction methods and connection capabilities. ANSYS SpaceClaim Direct Modeler employs several techniques to reduce the complexities of traditional geometry problems and further allow users focus on simulation-driven product development.

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