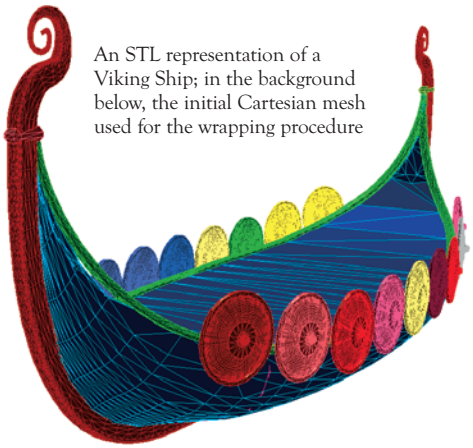
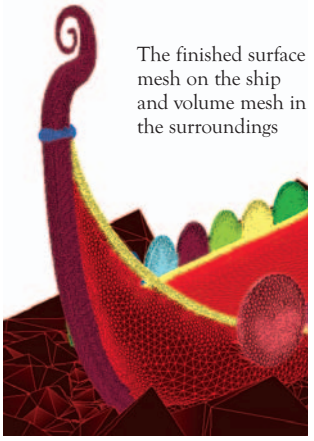
TGrid 4.0: Soon to be All Wrapped Up

By Erling Eklund, TGrid Product Manager



An STL representation of a Viking Ship; in the background below, the initial Cartesian mesh used for the wrapping procedure



The finished surface mesh on the ship and volume mesh in the surroundings

FOR COMPLEX INDUSTRIAL SIMULATIONS involving multiple geometry parts, such as automotive engine analysis, mesh generation can be extremely challenging. Often, the original geometry is only available in discrete or "faceted" form, as in STL, WRML, and D3S formats, for example. In addition to the complexity of the configuration, defects are usually present, such as discontinuous surfaces, cracks, and overlaps, and unnecessary features can be present as well. Conventional geometry-based repair (or cleanup, required for generating a watertight geometry prior to meshing) is very tedious and can consume the majority of the time and budget allocated for the project.

Surface Wrapping

The new surface wrapping technology in TGrid 4.0 allows the user to start from a very "dirty" geometry, and in the end, produce a fully connected CFD surface mesh. In principal, it is based on capturing a roughly defined volumetric region using a Cartesian grid. The grid is then intersected with the underlying geometry to form a shell, which is then projected back onto all faces of the geometry. Throughout the process, individual features can be selectively captured and certain zones can be preserved.

The surface wrapping operation is divided into five different sub-tasks: initialization, wrapping, feature selection and control, improvement, and zone separation. Prior to the initialization process, the minimum and maximum sizes of the initial Cartesian grid are specified. During initialization, all volumetric shells are created and the selected region can be inspected using several tools (panning and zooming or face tracing, for example) to ensure that there are no unwanted leaks. Fixed-, curvature- and proximity-based size functions can be used to redistribute the initial grid. Following initialization, the wrapper surface is created with a simple click of a button. Feature lines can be manually or automatically created and the wrapper surface can be imprinted onto a selected set of these features. The raw wrapper surface usually contains several problematic areas (such as self-intersection, folding, cross-over cells, or highly skew cells), which can be automatically and sequentially resolved using a single improvement operation. Before all zone names in the original model are recovered during the zone separation process, the user can display the local deviation between the original and wrapped surfaces.

Around the Wrapper

Several tools – some new, some improved – are available to help with pre- and post-wrapping operations. The selection helper can now be used to remove small parts (like bolts and nuts) and it can also quickly identify duplicate objects. All boundary modification tools are available through shortcuts and this allows high-end users to quickly remove details and close holes in the model. Meshed planes and boxes can be created and used for patching and outer domain creation. Faces can be separated in a local manner for cleanup, re-meshing, or deletion. Face-face intersection has been dramatically improved, enabling intersections of faces of largely different size, within a tolerant distance, and/or partially overlapping.

Prism layers

There are several enhancements related to the creation of prism layers in TGrid 4.0. A prism proximity/collision detection capability with automatic height adjustment has been added. Similarly, TGrid is now equipped with automatic sharp-corner prism layer handling, where prism layers can be locally peeled off. These new capabilities, in combination with non-conformal quad-split and/or prism-side remeshing, make TGrid 4.0 one of the market's top-quality hybrid meshing tools. ■

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