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Simcenter STAR-CCM+ Hull Performance Workflow

Providing a productivity tool for naval architects

Benefits

- Provides naval architects with a streamlined, GUI-driven process to simulate vessel motion
- Enables computational fluid dynamics (CFD) analysis with no experience required
- Full power of Simcenter STAR-CCM+ software is still available for users of all levels

Features

- Add-on to Simcenter STAR-CCM+ software, specifically designed for naval architects
- Simulates vessel motion in calm water
- Guides user from CAD import through mesh generation and physics setup to results
- Analyzes multiple hull speeds in one simulation
- Exports results to PowerPoint

Summary

In order to cope with difficult market conditions and meet increasingly stringent safety and environmental restrictions, naval architects have been forced to rethink their approach to the design of vessels.

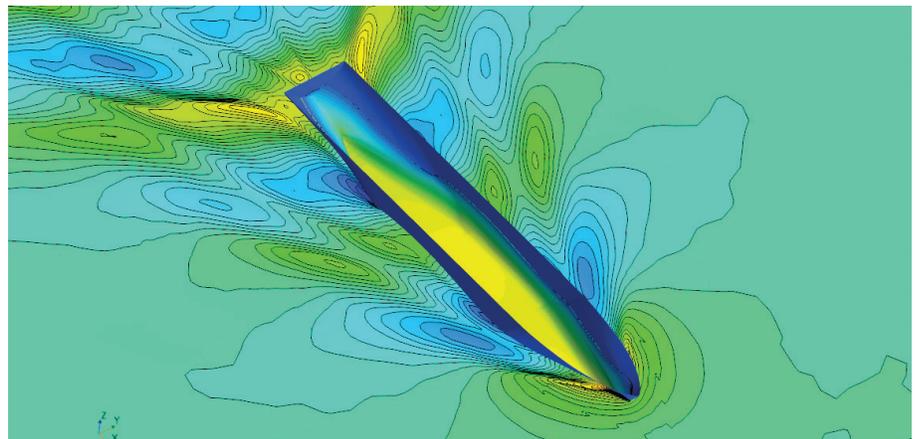
This tool gives users the ability to examine powered vessel motion over a range of speeds, using the full 3D ship geometry. With its intuitive user interface,

automatic setup using best practices and state of the art visualization and reporting, this workflow enables naval architects to produce detailed analyses with short turnaround times, helping them to create better designs, faster.

About Hull Performance Workflow

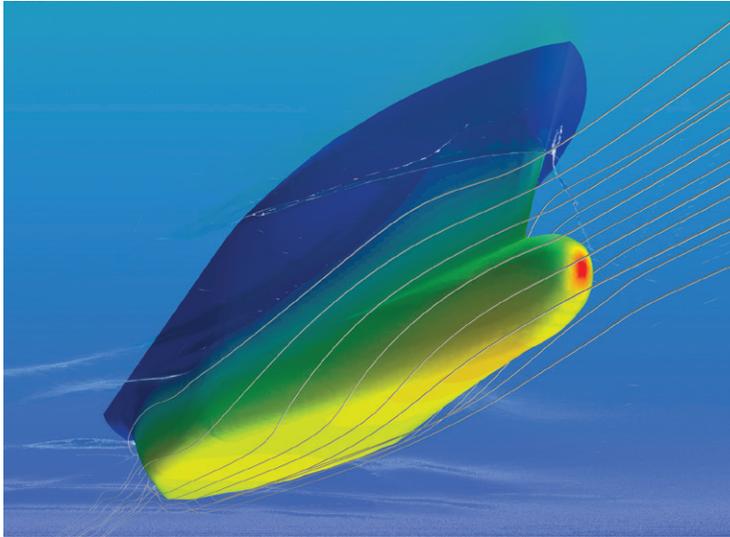
Simcenter STAR-CCM+ Hull Performance Workflow is an add-on to Simcenter STAR-CCM+™ software that provides a dedicated user interface to guide you through simulations of ship hull motion in calm water. The workflow is currently designed for analyses of displacement hulls and partially submerged vessels.

The intuitive interface guides you through each step to set up and run a hull performance simulation, from CAD import and a solution for single or multiple speeds in one session, to automatically generating a PowerPoint presentation software report with images and results.



Analyze data on hull and water surface.

Simcenter STAR-CCM+ Hull Performance Workflow



Visualize hull pressures and water flow.

You can create a test matrix for your simulation to examine a range of hull speeds in one session. Using the hull performance workflow tool automatically enables you to produce marine-specific graphs and images of the results for each hull speed, even using your own PowerPoint template for reporting.

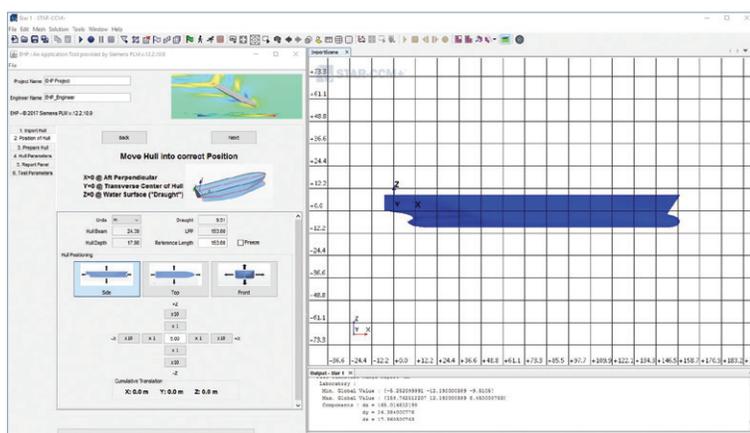
Knowledge of CFD is not required in order to use the tool. The user interface consists of several panels that you work through sequentially in setting up a simulation. In the background, the

workflow tool defines the models and parameters that are required for the analysis in the Simcenter STAR-CCM+ simulation tree. If required, you can also access the full functionality of Simcenter STAR-CCM+, for example, for simulating more complex scenarios. Sven Enger, vice president of worldwide business development at Siemens Digital Industries Software, comments: "We have spent a lot of time getting the hull performance workflow tool to be as user-friendly and intuitive as possible. This is a naval architecture-focused tool."

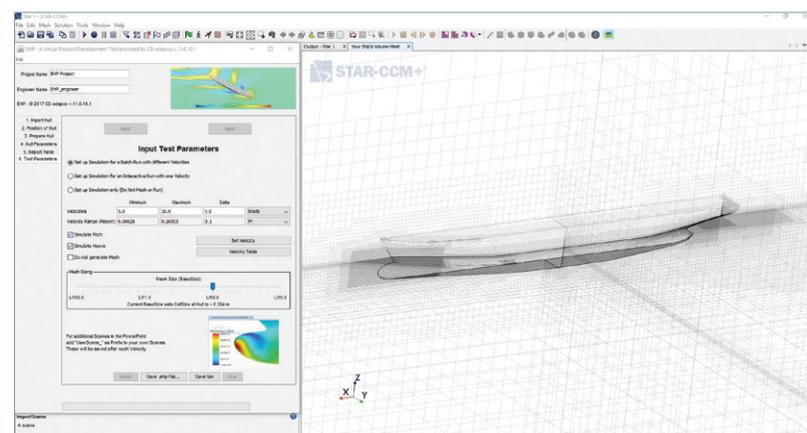
Inside the Hull Performance Workflow

The workflow interface guides the user through each step in setting up a hull performance simulation. It sets up the simulation parameters based on best practices from marine experts. These include:

- Extent of the computational domain
- Speed-dependent refinements of the volume mesh near the water surface and around the hull
- Transient simulation settings and time step size
- Physical runtime



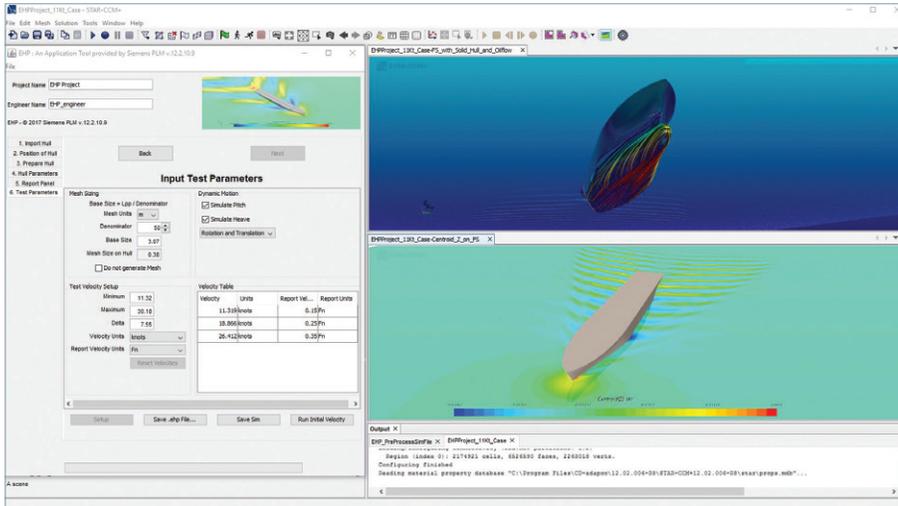
Interactively import and position hull geometries.



Mesh generation based on inbuilt best practices.

"The tool speaks the language of the naval architect. Using the experience of many of our naval industry customers, as well as experts inside of Siemens with specific naval architecture backgrounds, we have developed a tool that uses the Simcenter STAR-CCM+ software's full functionality, applies all our in-house best practices, but is as easy to use as any simplified prediction method."

Sven Enger
Vice President, Worldwide Business Development
Siemens Digital Industries Software



Define all test parameters within the hull performance workflow interface.

Geometry

Hull geometries can be imported in any common format, either from CAD data or tessellated surfaces. The hull performance workflow then guides you through positioning and orienting the surface ready for meshing. The tool automatically creates a block around the geometry: This defines the computational domain as a virtual towing tank. The extent of this computational domain are set automatically and depend on the hull's length between perpendiculars (LPP).

Volumetric mesh refinements

The hull performance workflow generates a volume mesh with automatic refinements around the hull and water surface. The locations and sizes of these refinements are based on best practices to ensure a high level of accuracy in the solution with a minimum cell count. Near the ship hull the mesh is automatically refined to accurately capture the turbulent near-wall flow (automatic $y+$ meshing). In the wake the mesh resolution is defined to capture the free surface based on the Kelvin angle.

Model setup

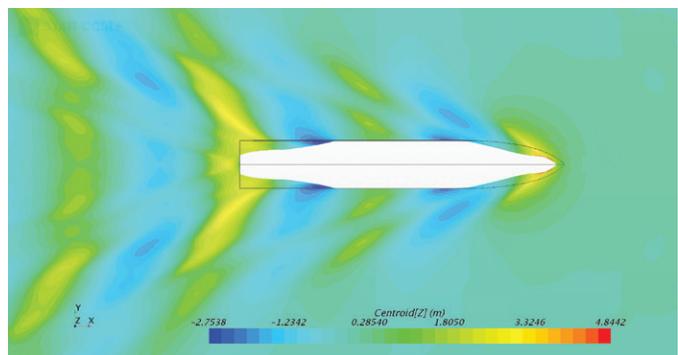
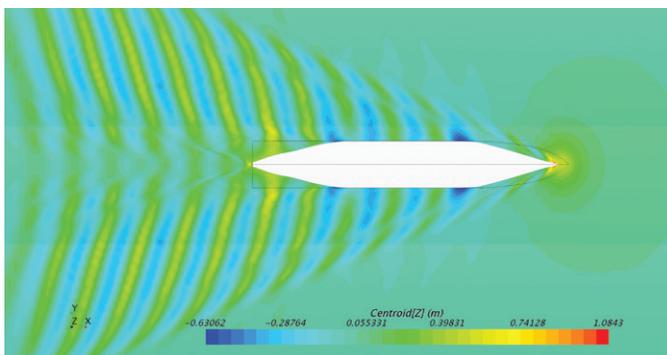
The hull performance workflow defines the simulation as a transient turbulent multiphase simulation. To solve for the development of the free surface, the phase interface between water and air, the tool uses the volume of fluid (VOF) method. The $k-\epsilon$ model accounts for turbulence. The implicit unsteady solver uses an automatically calculated time step, based on the Courant number and hull size.

Ship motion

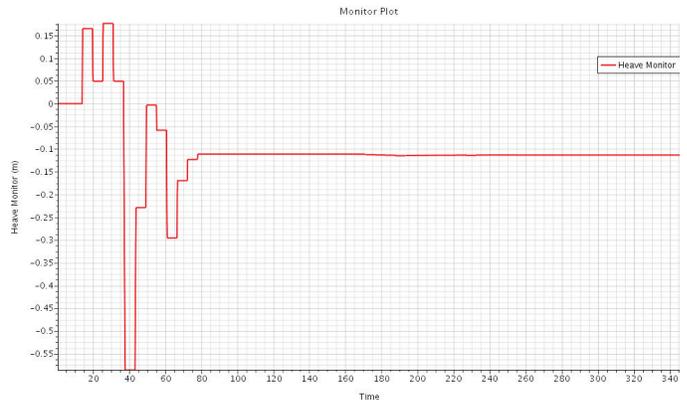
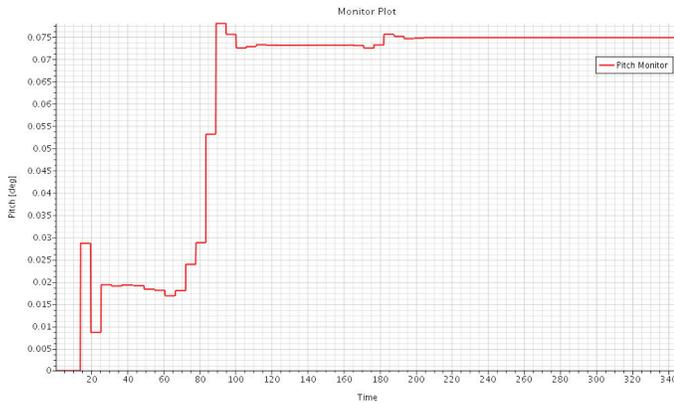
The hull's equilibrium position at any speed depends on its interaction with water. Simcenter STAR-CCM+ uses an equilibrium dynamic fluid body interaction (DFBI) model to determine the sink and trim and final position of the hull: The ship can have up to six degrees of freedom. As the simulation runs, the hull moves within the specified directions according to a numerical iterative procedure until the forces and moments in these directions are balanced.

Physical runtime

The physical runtime of the simulation is determined automatically. For each hull speed, the tool monitors the average resistance of the hull. If the oscillation of the resistance over time is smaller than a set value then the run stops. If this stopping criterion is never fulfilled, the simulation stops after a maximum number of time steps.



Results are generated for each point in the test matrix.

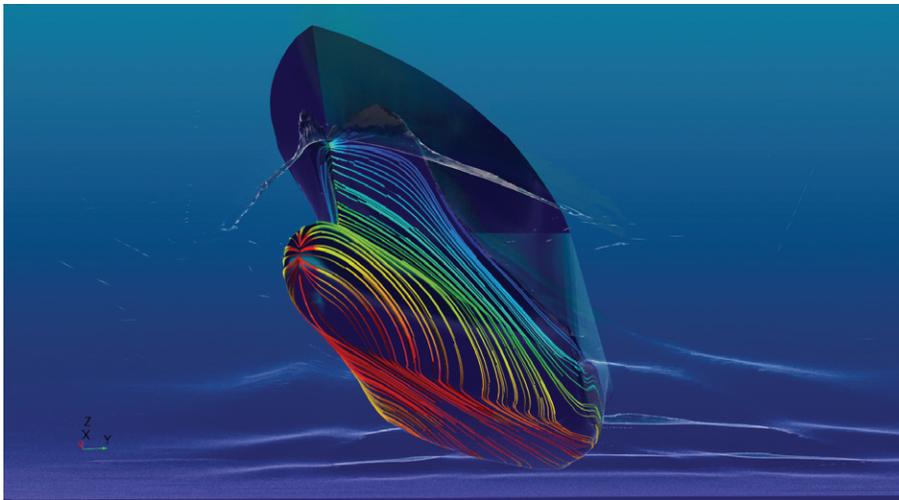


Standard reports automatically exported to PowerPoint.

Results reporting

At the end of the simulation, the hull performance workflow automatically generates a PowerPoint report showing results from each point in the test matrix (ship speed). Many standard reports are available, including trim, sinkage and resistance versus time and free surface (wave height) images. You

can choose which results are included in the report, and also define your own results and images for export. A standard PowerPoint template is included, or you can use your company template. The full Simcenter STAR-CCM+ simulation file is also saved, giving access to the complete simulation data if additional analysis is required.



Access to Simcenter STAR-CCM+ for additional post-processing if required.

Siemens Digital Industries Software
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