

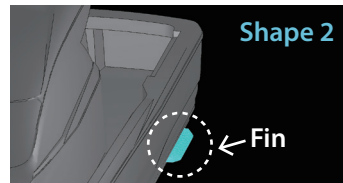
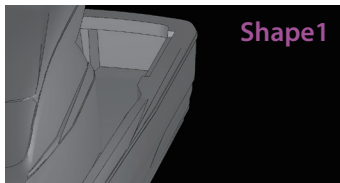
# Evaluation of Small Cruising Vessel Posture using Free Surface Analysis

Case Study for Yamaha Motor Co., Ltd.

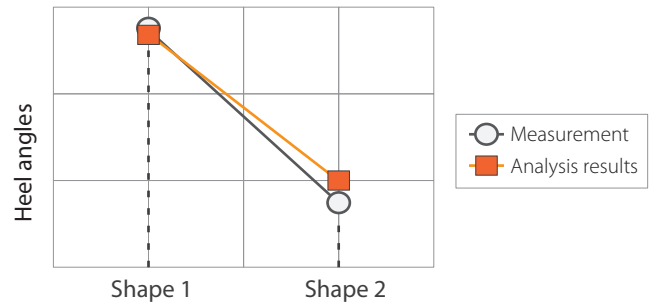
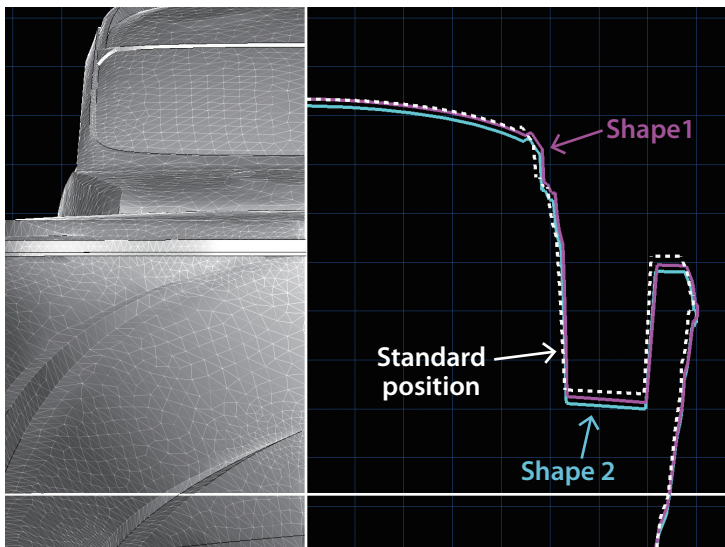
Analyzing posture of a cruising ship using free surface and dynamical functions

## Analysis Objectives

Analyses were performed to evaluate ship stability while cruising. The VOF (Volume of Fluid) method was used to simulate free surface motion and the dynamical function was used to calculate ship movement. To evaluate ship posture, two ship configurations were considered: one without a fin (shape 1) and the other with a fin on each side of the vessel (shape 2). Heel (sideward inclination) of the ship was compared for the two configurations as the ballast was moved away from the center of gravity.



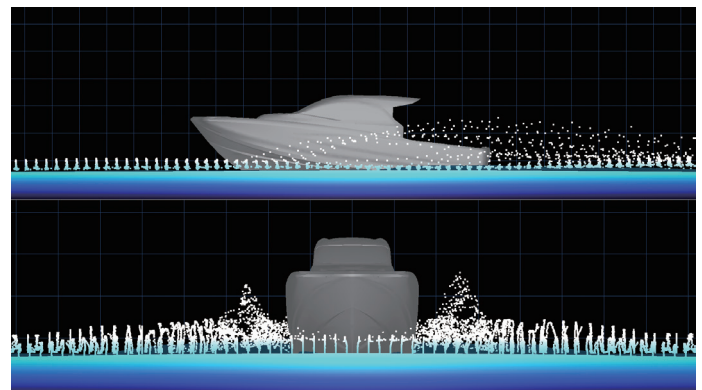
## Comparison between Analysis Results and Measurement



The figure on the left visually compares analysis results for heel when moving the ballast. The standard position shown in the figure represents the position of the ship when the heel angle is 0 [deg.]. The graph above compares the measured and calculated heel angles. These analysis results included stabilizing fins and confirmed the effectiveness of the fins on the vessel posture. The calculated results correlated well with measurements.

## Using particles to simulate water splash

The VOF (Volume of Fluid) method, is often used to simulate free surface movement by the transport of the volume fraction of the fluid. But the VOF alone was not well suited for simulating water splash onto the ship surface. For this study, mass particles were used to simulate the water splash created by waves. The figure show particles and the interface from two directions for a VOF value = 0.5. Particles successfully simulate water splash that cannot be captured by the VOF method alone.



## Customer Comments

SC/Tetra was used to simulate the posture of a small cruising vessel and to evaluate ship stability. Analysis results illustrated the effectiveness of fins attached to the sides of the ship. Calculated heel angles correlated with measurements. Future analyses could be performed with trim.