

Crash Prediction for Marine Engine Systems Presented at the 2008 Abaqus Users' Conference

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Abstract: Mercury Marine outboards, engines, and drives are designed to withstand indoor impact testing (called "logstrike") that simulates a collision with an underwater object. This test is comprised of an outboard or sterndrive device mounted on a mock boat that collides with a simulated log.

Many parts are designed with the arduous logstrike test in mind. However, it is difficult to approximate the loads each part experiences during logstrike because of the complex and dynamic nature of the event. For this reason Mercury Marine R&D created a project to develop a capability for predicting the motion and loads of a logstrike event. A staged approach consisting of progressively sophisticated Abaqus/Explicit numerical simulations, validated by physical testing, was used to work towards successful simulation of the full logstrike event. This newly developed method is beginning to support product development programs and assist Mercury Marine engineers in designing components with more knowledge about the loads they must withstand. The method also enables the evaluation of designs without the need for physical parts. This provides the opportunity for better product integrity with reduced design time.

Keywords: Crashworthiness, Design of Experiments, Experimental Verification, Impact, and Marine Engines.

1. Introduction

What happens when you are boating and hit a submerged object? Mercury Marine has dealt with this question for a long time and designs its engines and drives with this reality in mind. Impact with a submerged object can produce severe loadings in many of the parts of the outboard or stern drive. Product validation testing for this requirement used to be done on the water by having a boat with a driver run over a log. A fence was installed on the boat to protect the driver. Part recovery was difficult for large parts, as they would need to be tethered. Small parts would be lost if they became detached. Weather and seasons were issues affecting when testing could be done. Waves in the water, the height of the boat in the water, and the contact of the boat hull with the log all made it difficult to strike the log in a repeatable fashion. Instrumentation was difficult as the boat was in motion and away from shore. Log to log variation was also an issue due to differences in grain structure and water saturation.