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Shock & Vibration Computational Laboratory, brochure

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Frequently Asked Questions

WHY USE MODELING & SIMULATION?

The use of finite element method ship models allows us to couple a fluid mesh to the ship structural model and accurately predict the dynamic response of the entire ship system to an underwater shock event. By doing this in a “virtual environment”, there are many real-life benefits. Some of these are:

- Substantial cost saving over traditional at-sea shock testing
- Allows for a greater diversity in explosive shot scenario geometries
- Removes inherent risk to the crew, ship structure and equipment
- Alleviates operational demands on commissioned ships used in testing
- No negative environmental impact

MODELING & SIMULATION: A REPLACEMENT FOR LFT&E?

While Modeling & Simulation (M&S) provides excellent results in the prediction of ship system dynamic response, it is intended as a design tool to be used in conjunction with Live Fire Testing & Evaluation (LFT&E) events and other shock testing methods in order to validate the shock survivability of a new class of ship. Moreover, future implementation of M&S in place of whole ship shock trial testing will free up limited LFT&E resources so as to permit the specific testing and further investigation of the ship system’s response in more realistic threat scenarios such as near field explosions.

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Shock and Vibration Computational Laboratory

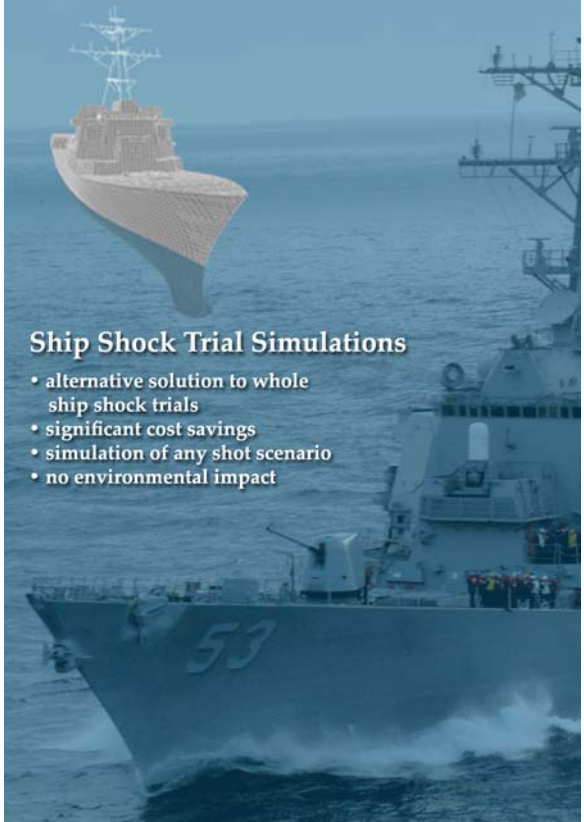
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www.nps.edu/Research/ResTopics/ShipShock.html

NAVAL POSTGRADUATE SCHOOL



Shock & Vibration Computational Laboratory



Ship Shock Trial Simulations

- alternative solution to whole ship shock trials
- significant cost savings
- simulation of any shot scenario
- no environmental impact

SURFACE SHIP SHOCK TRIAL SIMULATION

RESEARCH OBJECTIVE:

Our goal at the Naval Postgraduate School Shock and Vibration Computational Laboratory (SVCL) has been to develop a viable alternative to at-sea Ship Shock Trial testing through the use of computer modeling and simulation methods.

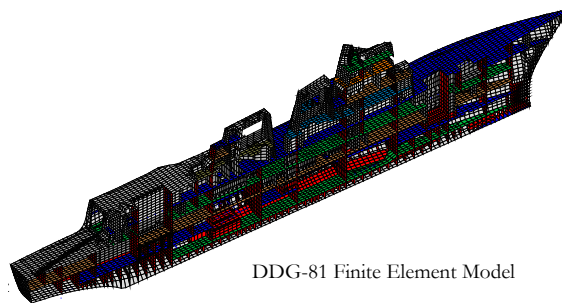


WHY STUDY UNDEX?

As early as the mid-1800's, the use of underwater explosions (UNDEX) in Undersea Warfare was known to be a genuine threat to surface ships. However it was not until World War II, that naval leaders took notice of a new destructive phenomenon that was responsible for sending scores of ships to the ocean bottom without ever taking a direct hit from a mine or torpedo. Ships sank as a result of explosives detonating beneath their keels, breaking the back of the ship as they were lifted up and then slammed down once again into the water void left by the explosion.

Research into this field started in earnest after the war, spurred by the new guidelines set forth by the Navy aimed at insuring shock hardening of shipboard equipment and systems.

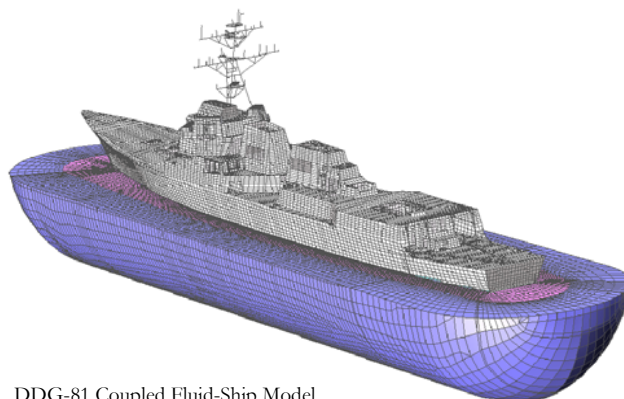
... Surface ships must be capable of operating in the combat shock environment



DDG-81 Finite Element Model

The SVCL has participated in many Navy sponsored research programs throughout its 20+ years existence. Some of the more recent ship shock simulation projects that the SVCL Shock Team has been involved in are:

- **DDG-53 USS John Paul Jones**
- **DDG-81 USS Winston S. Churchill**
- **LPD-17 USS San Antonio**



DDG-81 Coupled Fluid-Ship Model

SHOCK SIMULATION PROJECTS

In addition to the ship shock trial simulation work conducted by the SVCL staff, graduate students from the Mechanical Engineering Department here at the Naval Postgraduate School have extensively researched the underwater shock phenomena and its damaging effects.



Investigations have included computer modeling and simulation, biomechanical specimen testing, explosive model testing and vibration panel testing, in both the classified and unclassified formats. Some of the past thesis topics include:

- **Ship Structure Transient Response**
- **Biodynamic Response of Crewmen**
- **Ship System Damping**
- **Effects of Explosive Charge Scaling**
- **Ship Whipping Phenomenon**

