2009

NPS Shock Team, Shock & Vibration Computational Laboratory

Shin, Young S.; Didoszak, Jarema M.; Lepe, Jose J.

Monterey, California: Naval Postgraduate School.

NPS Shock Team

Dr. Young S. Shin

Jarema M. Didoszak

Jose J. Lepe

DDG-81 Shock Trials

General Statements

Objective: *Accurately predict the Shock Response of a surface ship in an Underwater Explosion Event*

Research Benefits:

- *NPS work on ship shock trial modeling and simulation has been changing the Navy's direction for ship shock qualification.*
- *Computer simulation provides a viable alternative to Ship Shock Trial testing.*
- *Thesis Students: Three-four per year in Ship Shock research.*
- *Whole Ship Shock Trial Cost: DDG-53 $ 46M, DDG-81 $28M.*
- *Potential Navy savings of over $100M by replacing whole ship shock trial with ship shock modeling and simulation.*
- *Reimbursable Funding: $250K per year from NAVSEA*

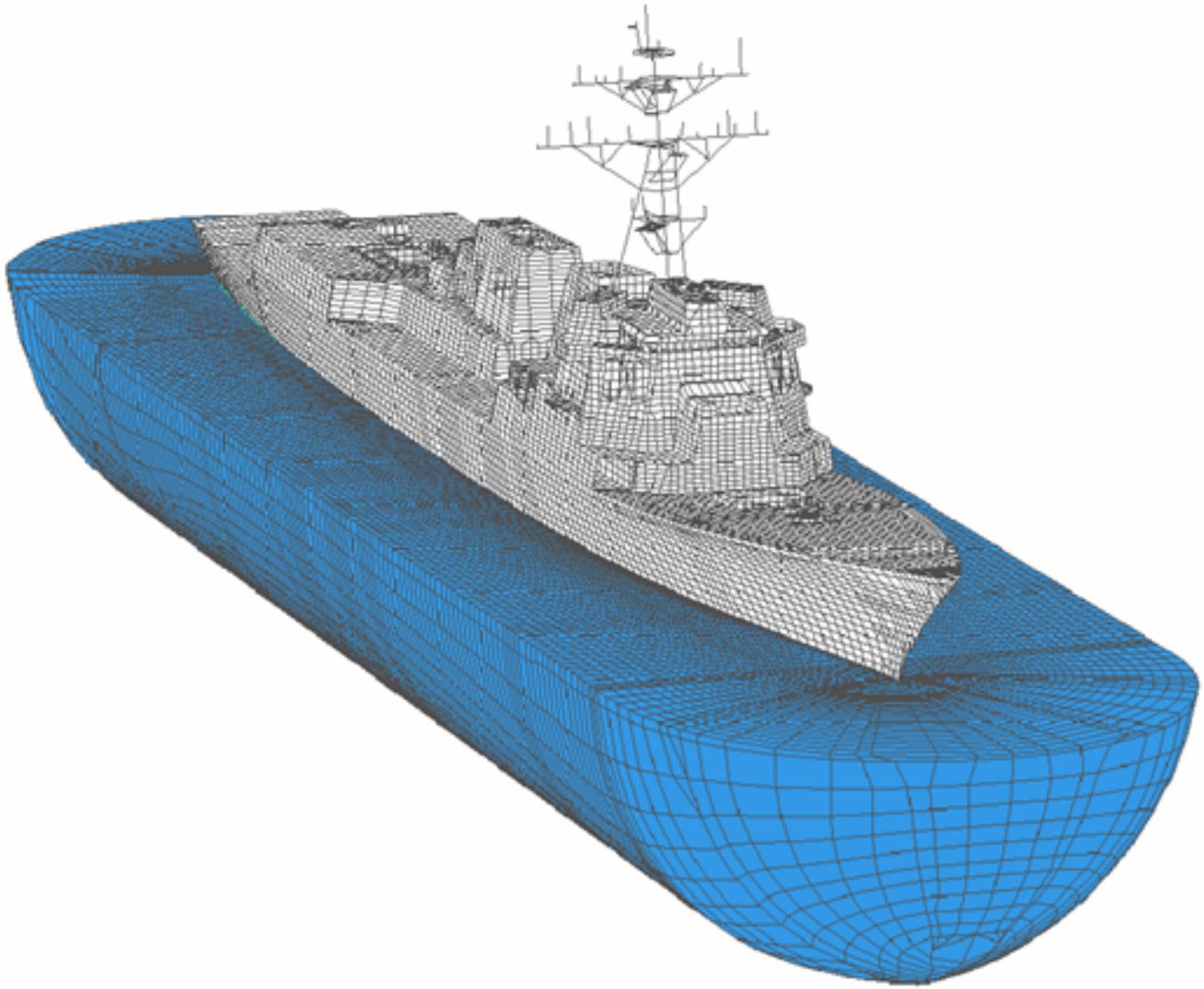
Ship Shock Trials

- Shock trials performed May-June 2001 of the coast of Mayport, Florida
- Three different shots conducted using HBX-1 high explosives
- Purpose:
  - Test the survivability of mission essential equipment
  - Assessment of design improvements from DDG 53 shock trials

Whole Ship Shock Live Fire Test & Evaluation

Modeling UNDEX in a Virtual Environment

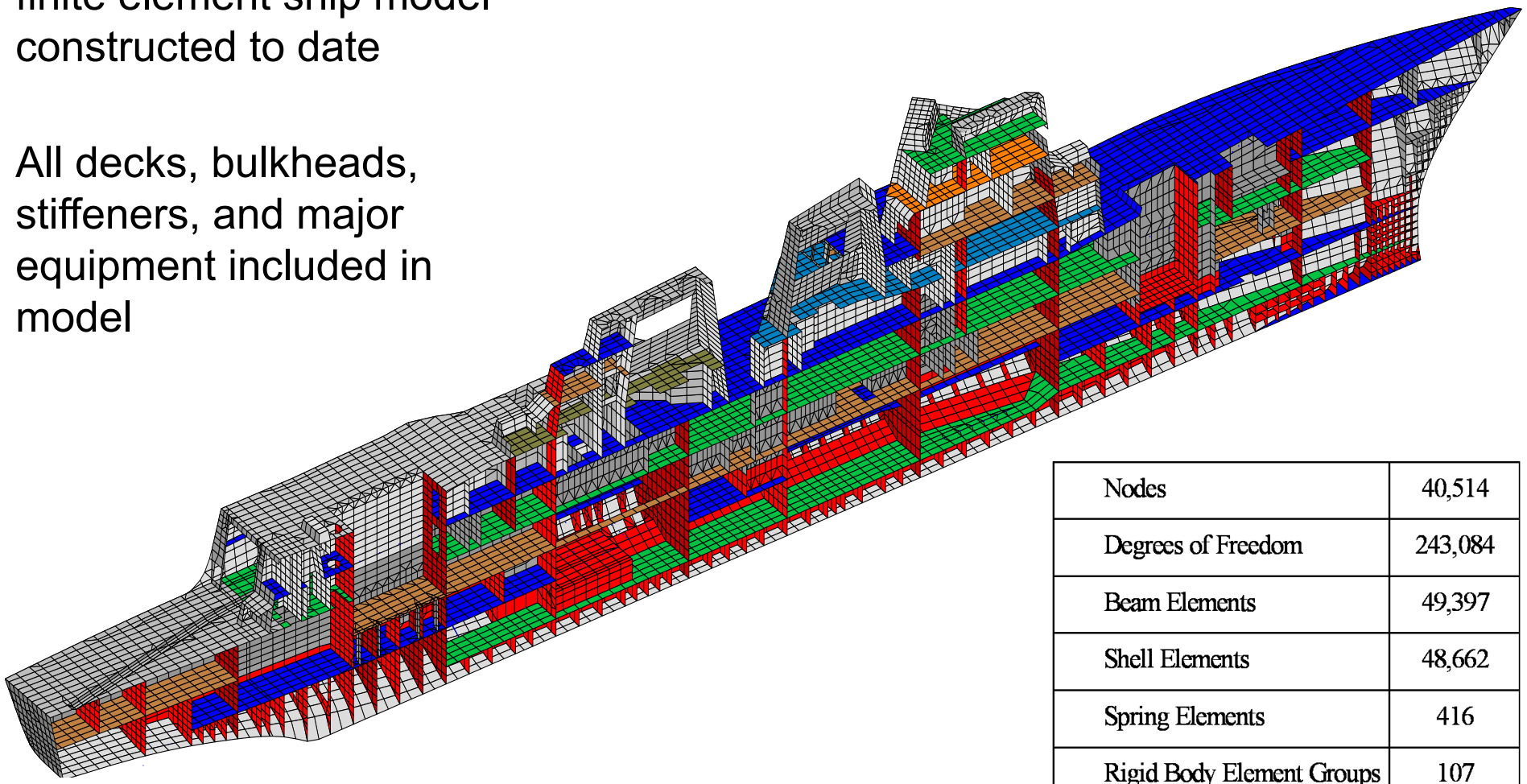
NPS Coupled Fluid-Ship Model



DDG 81 Finite Element Model

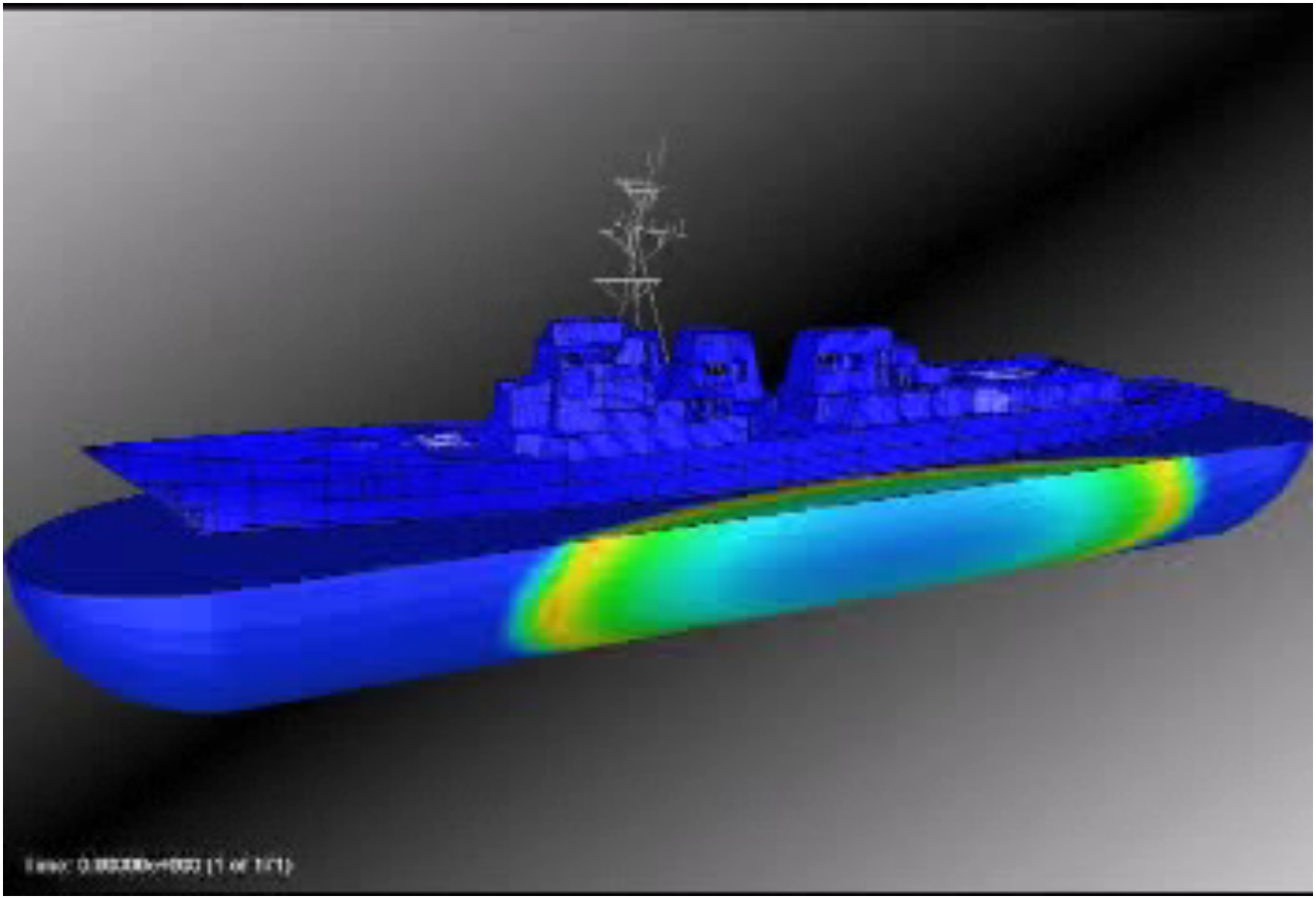
Most complex and detailed finite element ship model constructed to date

All decks, bulkheads, stiffeners, and major equipment included in model

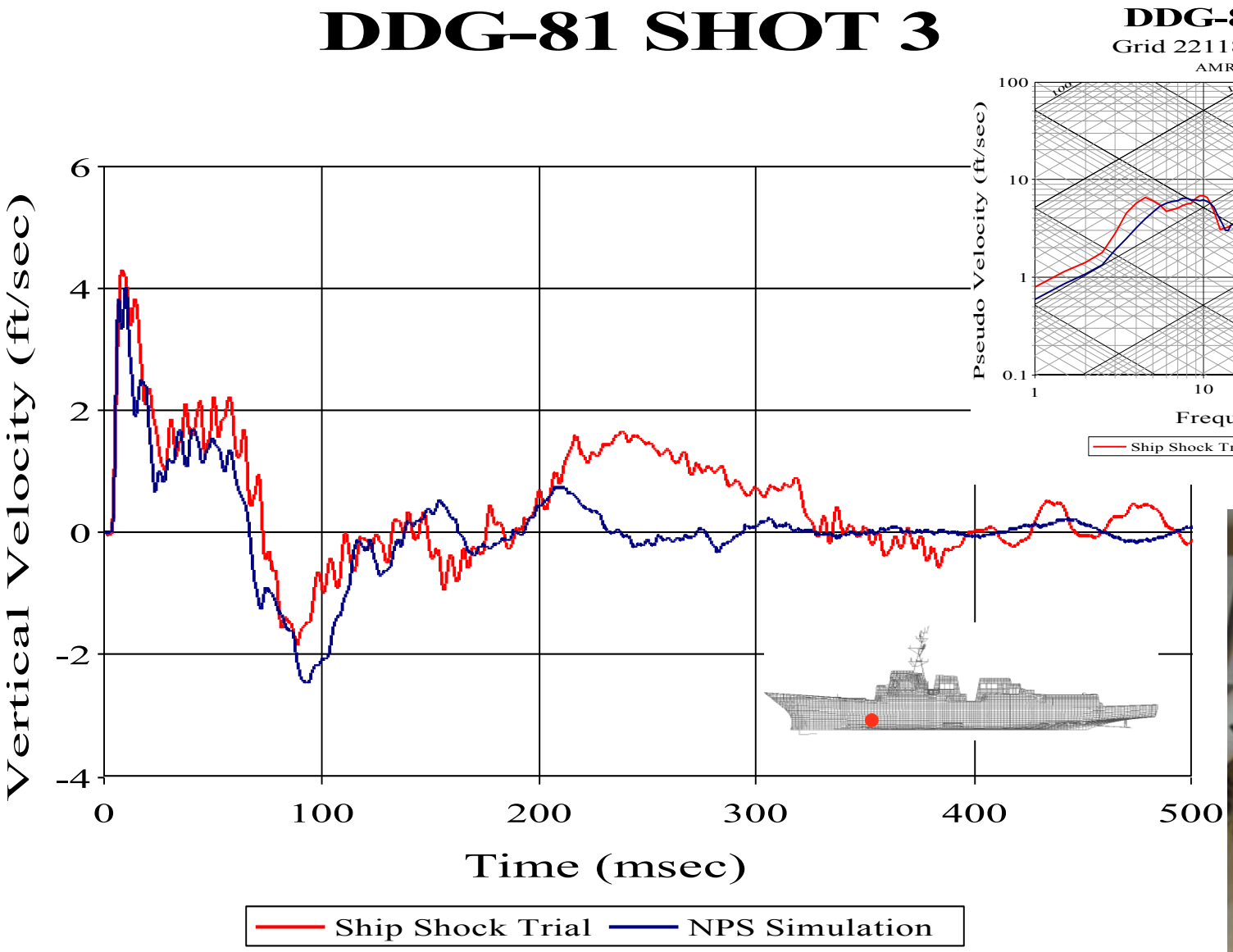


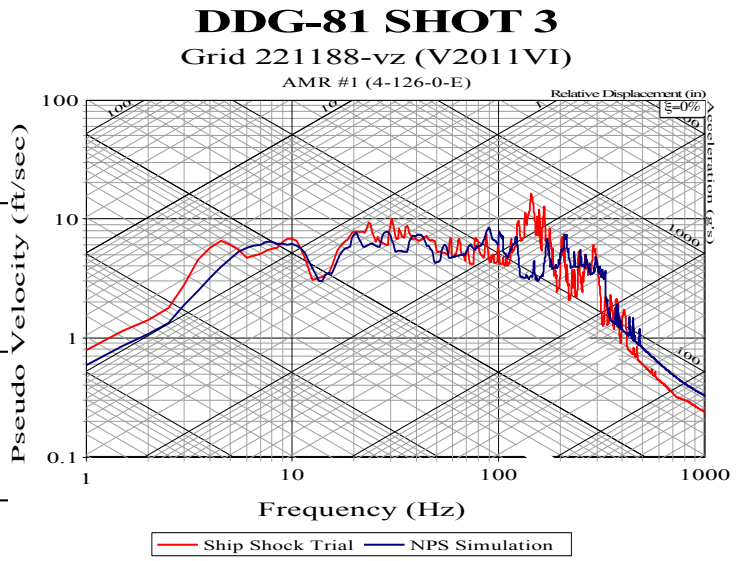
Nodes	40,514
Degrees of Freedom	243,084
Beam Elements	49,397
Shell Elements	48,662
Spring Elements	416
Rigid Body Element Groups	107
Lumped Masses	92,541

NPS Computer Simulation

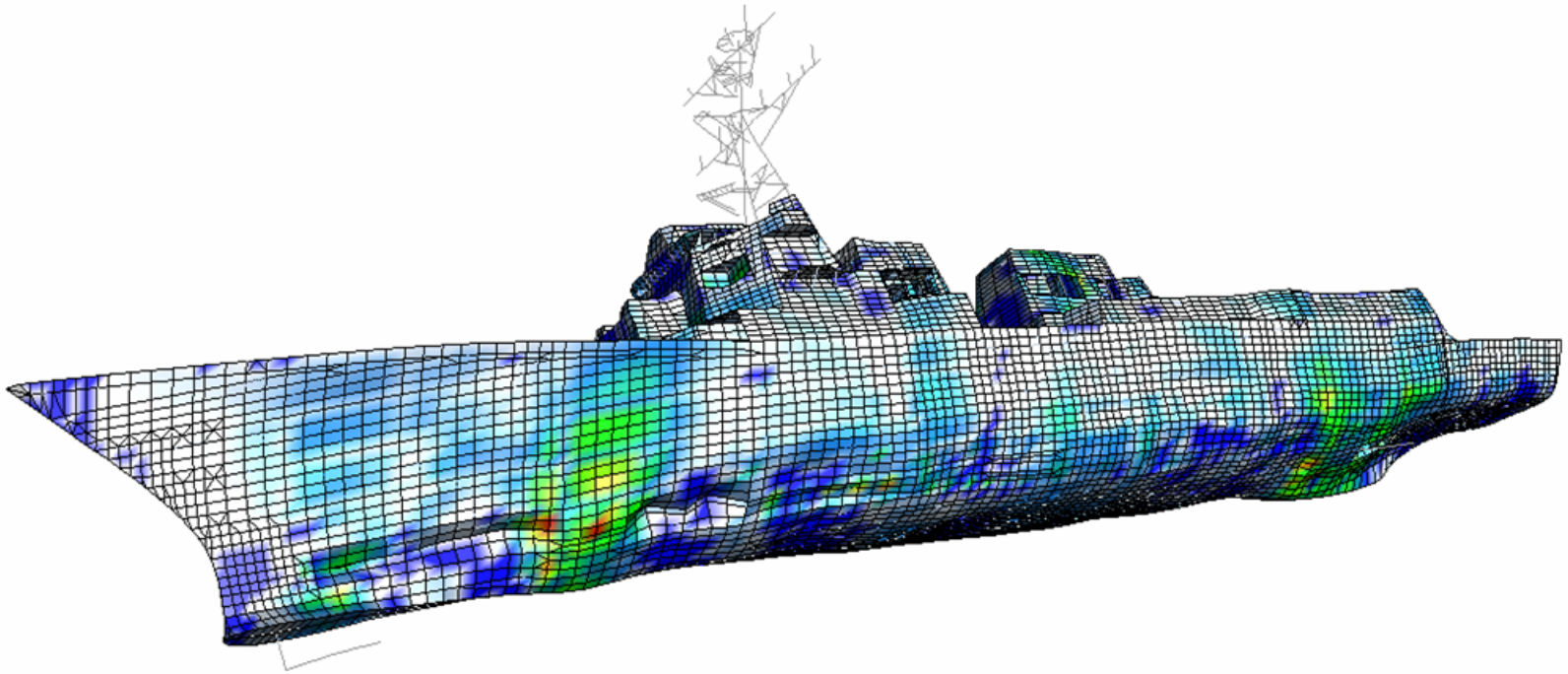


Vertical Velocity Response Comparison



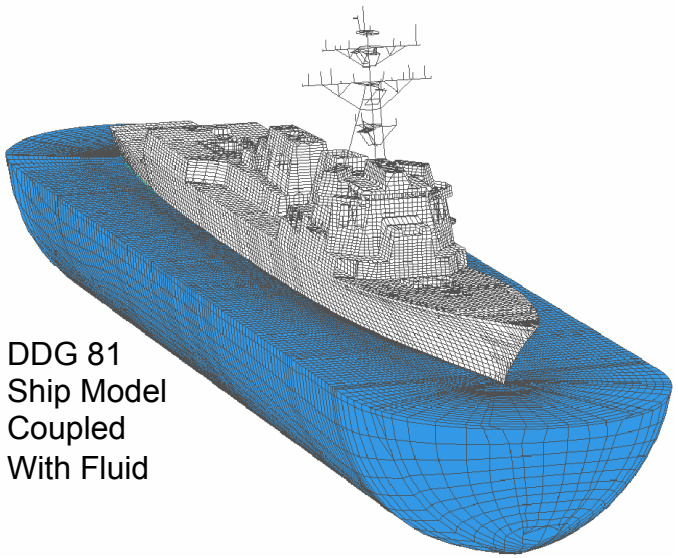


Prediction of Potential Damage



Underwater Explosion Research at NPS

DDG 81 Ship Shock Trial, June, 2001



DDG 81
Ship Model
Coupled
With Fluid

Navy Relevance:

Predictions of Potential Damage Areas & Assessment to Underwater Explosions

Assessment of Vulnerability and Survivability of Surface Ship & Submarine to Underwater Explosion

Navy Fleet Support Activities:

3-D Ship Shock Modeling & Simulation of Ship Shock Trials:

- DDG-53, USS John Paul Jones – FLT I (Completed)
- DDG-81, USS Winston S. Churchill – FLT IIA (Completed)
- LPD-17, USS San Antonio – (in-Progress)

Research Topics:

- Underwater Explosion and Its Effect on Ship & Submarine
- 3-D Ship Shock Modeling and Simulation
- Ship Shock Vulnerability and Survivability Studies
- Ship System Damping: Energy Dissipation Mechanisms

Research Sponsors: NAVSEA, NSWC-CD

For Further Information, Contact Professor Young S. Shin, Email: yshin@nps.edu Phone (831) 656-2568