The Problem

Deformation
The Problem

(catastrophic) Fail
# Reduce

## Efforts
- Produce BOM
- Determine Loads
- Find CG
- Additional Structure Needs
- Rigging Loads
- Total Loads

## Errors
- Rigging Loads
- Overall Plan
- Deformations
- Damage to Secondary Struct
The Solution

CAD

FE Model
The Solution

CAD  →  Magic  →  FE Model
Add Systems and Outfitting with Structure to provide better and accurate center of gravities for a better understanding of loading.

The Approach

- "As-Built"
- ShipConstructor 100% Outfit
- Model reduced to "As-Built" State
- Maximum Outfit: FE Model
- CAE Model reduced to "As-Built" State
- Lift Drawings
- CAD Frame Drawings w/lugs
- Stress Results
The Approach

Femap

Altair

HyperMesh
The Status

SSI
ShipConstructor
The Status

Lift Components
The Status

Lift Assemblies
The Status

Lift Assembly Output

Assembly BOM

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<tr>
<th>Item</th>
<th>Qtr</th>
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Lifting Components

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Lifting Vectors

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The Status

Enterprise Platform
The Status

ATA Engineering
Femap
What We Do

ATA Engineering’s **high-value engineering services** help solve the most challenging product design challenges.
We provide a comprehensive suite of structural analysis services.
Our R&D Services

Example: Post-Damage Kinematic Simulations for Operational Effectiveness Evaluations

Technology Explanation

- Uses FE modeling approach to simulate post-damage kinematic response of a complex mechanism (e.g., can a submarine hatch operate after explosive shock?)
- In addition to advanced modeling techniques (Abaqus) for contact and friction, the technology employs machine learning algorithms to serve as extremely fast-running surrogates for complex regions of large FEMs
- Validation via correlation with laboratory experiments

Contract Details

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<tr>
<td>Randall Goodnight (NSWCCD)</td>
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Product Benefits & Applications

- Reduces reliance on UNDEX testing and allows engineers to evaluate a multitude of postevent mechanical scenarios for hull, equipment, machinery, and platform damage
- Uses independent domains for structural and contact regions enable more control of mesh fidelity for each region
- Novel method for watertightness assessment
- Applicable to wide range of industries/Abaqus users to reduce analysis time on complex systems
Our Software Services

ATA is a **value-added** reseller for Siemens PLM Software

Siemens Value Added Reseller
www.ata-plmsoftware.com

- Software Integration
- Software Implementation
- Hotline Support
- Nastran Training Material
-Preferred Training Provider

NX, Nastran, Femap, STAR CCM+, Simcenter, Teamcenter, Solid Edge
What is Femap? Why use it here?

Powerful mesh-centric FE pre- and post-processing

- High performance simulation that significantly reduces physical testing and speeds time to market
  - CAD-independent finite element modeling
  - Proven, powerful modeling and analysis capabilities that solve the toughest engineering problems
  - The best Nastran pre- and postprocessor on the market.
    - NX Nastran is great for structural analysis of lifting loads, shock loads and DDAM, structural dynamics
  - Femap/NXN are currently in use at several shipyards

- Excellent application programming interface (API) for task automation. No changes to core Femap code needed.
  - ATA has developed several commercial software products that leverage the Femap API

Mars Rover Curiosity
Courtesy of NASA JPL

James Webb Space Telescope
Courtesy of NASA Goddard
Our Software Services - NSRP

Automation for faster structural analysis

- **2017 Panel Project: CAD to FEA Automation**
  - Partnered with Ingalls and SSI
  - Automated extraction of ship data (geometry, materials, stock data, equipment mass and inertia) from ShipConstructor
  - Automated creation of mesh-ready geometry and properties in Femap to expedite finite element modeling

- **2018 Research Announcement: LiftShip**
  - Partnering with SSI, expanding CAD to FEA panel project work to expedite FEA for ship lift configurations
LiftShip Program Status Summary

- Import from ShipConstructor to Femap
  - Complete:
    - Flat plates and stiffeners – imported as surfaces on moldlines
    - Equipment – imported as lumped masses at CG
    - HVAC & piping – lumped masses at CG & path curves
    - ID info – plate stock, material info, equipment names & mass become properties and are assigned to geometry
  - Remaining challenges:
    - Lift-specific hardware
    - Curved & corrugated plates
    - Bridging CAD needs for designers vs. analysts

- Geometry Prep for Meshing
  - Complete:
    - Intersection of contacting surfaces to assume welded connection
    - Trimming or extension of intersected surfaces
SSI Assembly Example

55 seconds to import and prep geometry from PublisherLT

ShipConstructor

FEMAP
Import of Equipment

Lumped masses are created at equipment CG
SSI Assembly Example

Names and data are preserved from the ShipConstructor database
Creation of Femap Properties

Geometry is joined and **mesh-ready**
Creation of Femap Properties

3 minutes 50 seconds to import and prep geometry from PublisherLT
SSI Assembly Example

Choices on preparation of cutouts and details

ShipConstructor

Femap
Catching “Leaky” Geometry
Bridging the divide between designers & analysts

- ATA uses SC construction geometry directly (no export/import of STEP)
- SC allows designers to create plate geometry with small inaccuracies
  - Open boundaries on faces
  - Gaps between parts
- These inaccuracies can result in invalid geometry in Femap during import
- Invalid geometry is flagged and grouped for correction
Taming Curved Plates

Ongoing work to determine the best solution
The Status

Altair Engineering
HyperMesh

Altair
Our vision

Altair transforms design and decision making by applying simulation, machine learning and optimization throughout product lifecycles.
ALTAIR AT A GLANCE

- Founded 1985
  Headquartered in Troy, MI US

- 69 offices
  in 24 countries

- $333M
  2017 Revenue

- 50+
  ISV partners under our unique, patented licensing model

- 2000+
  Engineers, scientists and creative thinkers

- 5000+
  Customer installations globally

- 60,000+
  Users
## 5,000 CUSTOMER INSTALLATIONS WORLDWIDE

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## OUR BUSINESS

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<th>Software</th>
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<tr>
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<td><strong>PBS Works</strong>&lt;br&gt;ACCELERATING INNOVATION IN THE CLOUD™</td>
<td><strong>toggled®</strong>&lt;br&gt;lighting optimized™</td>
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Long-term ongoing engineering, design and development expertise.
HyperWorks - THE Power of Modeling and Visualization

Cloud & HPC

Solvers

Direct Interfaces to All CAD
CAE Model Build
Multiple Solver support
Process Automation
Results Visualization

PLM / CAD / Simulation Data Management

MANUFACTURING SIMULATION
PERFORMANCE VALIDATION
PERFORMANCE OPTIMIZATION
CONCEPT DESIGN
SYSTEM DESIGN
BROAD PORTFOLIO OF SOLVERS ACROSS MULTIPLE PHYSICS TYPES

Interconnected, smart products demand optimization across multiple physics to create cutting-edge designs.

Altair is driving the multiphysics optimization opportunity.
HyperMesh based ‘LiftShip’ solution Overview

- Altair HyperMesh based toolset for ‘LiftShip’ finite element analysis
- Automates the process of FE model generation and analysis of lifting large ship structures
- Generates high fidelity FE models
- Produces meaningful results (e.g. stress, yield, factor of safety report) such that Go or No-Go for lifting is given
Data Exchange between ShipConstructor and HyperMesh

Part Models (STEP IGES)

- Property XML
- Material XML
- Loading XML
- CG XML

Part (GUID)

Property (XML)

Material (XML)

- Assembly Hierarchy
- Material Name
- Young's Modulus
- Poisson's Ratio
- Density

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'LiftShip' FEA in HyperMesh

Engineer’s decisions:
• GO-NoGO
• Make design updates
• Add supporting structures
• Reanalyze
• ...........
‘LiftShip’ FEA in HyperMesh

Contour Plot
Element Stresses (2D & 3D)(vonMises, Max)
Global System
Advanced Average
5.66E+04
4.93E+04
3.21E+04
2.30E+04
1.41E+04
6.17E+03
2.85E+03
1.19E+03
7.73E-01
Max = 5.66E+04
Grids 33376
Min = 7.73E-01
Grids 51336
'LiftShip' FEA in HyperMesh
Thank You
Pat David - SSI, Ray Deldin - Altair
Elliot Haag - ATA Engineering