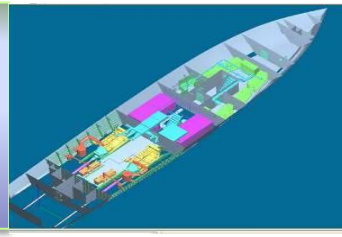
LEAPS

CREATE
Computational Research & Engineering Acquisition Tools & Environments

ASSET
NSWCCD

Rapid Design and Integration (RDI)



Distribution Statement A: Approved for public release, distribution is unlimited

Product Description

The vision for the CREATE-SHIPS Rapid Design and Integration (RDI) effort is to create a high-end toolset that integrates ship design generation tools with physics-based analysis tools that enables the user to:

•DESIGN – hundreds of ships by running ship design generation tools to create a rich design space

•ANALYZE – hundreds of ship designs using physics based analysis tools, adding to the knowledge captured in the design space.

•OPTIMIZE – using the knowledge in design space, cost benefit trades are performed to find a low cost, low risk, robust design solution.

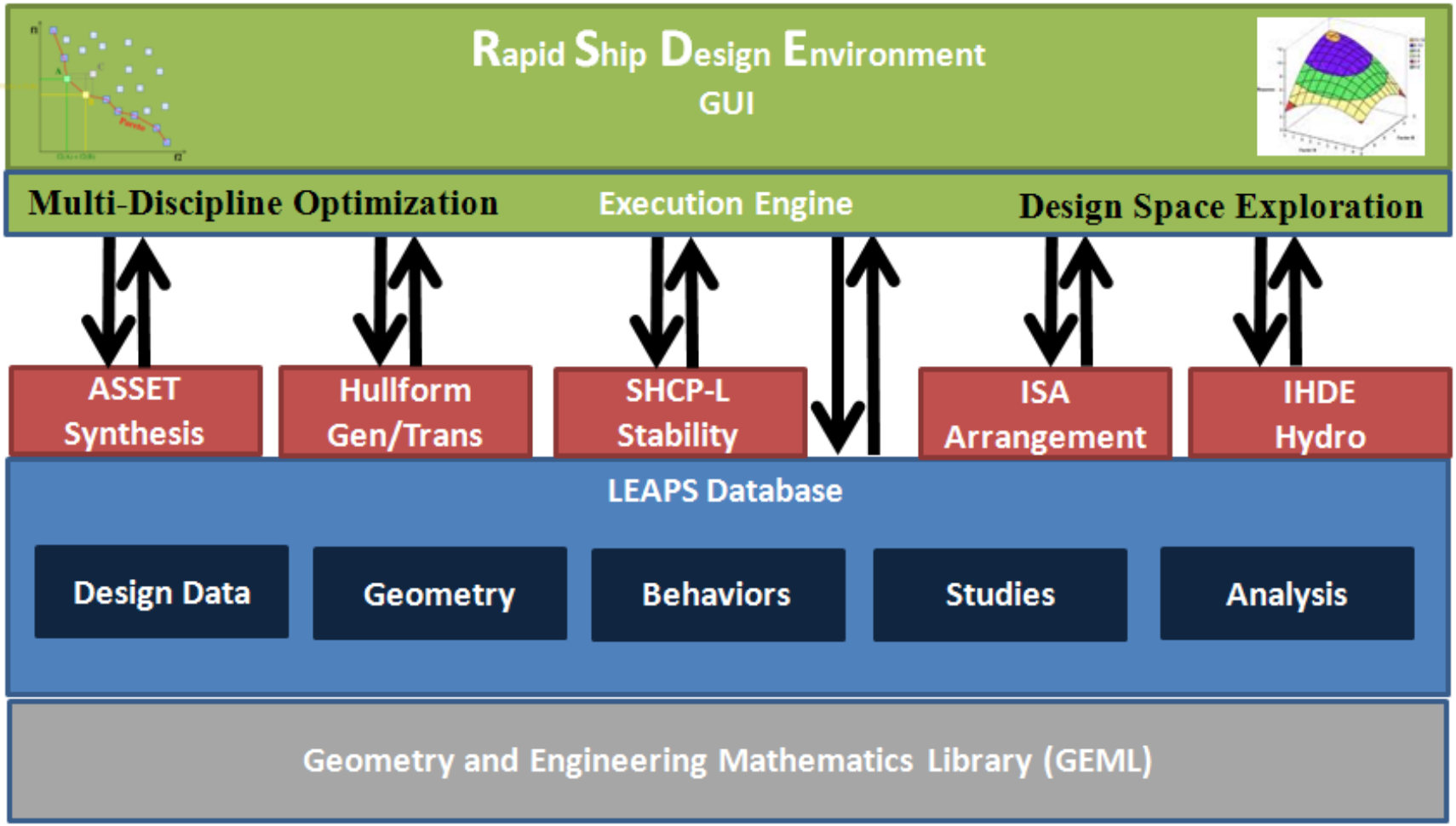
RDI will use high performance computing resources to reduce the time required to perform these activities, so that they can be completed within the decision cycle of early stage design or mid-life upgrade studies.

Product Architecture

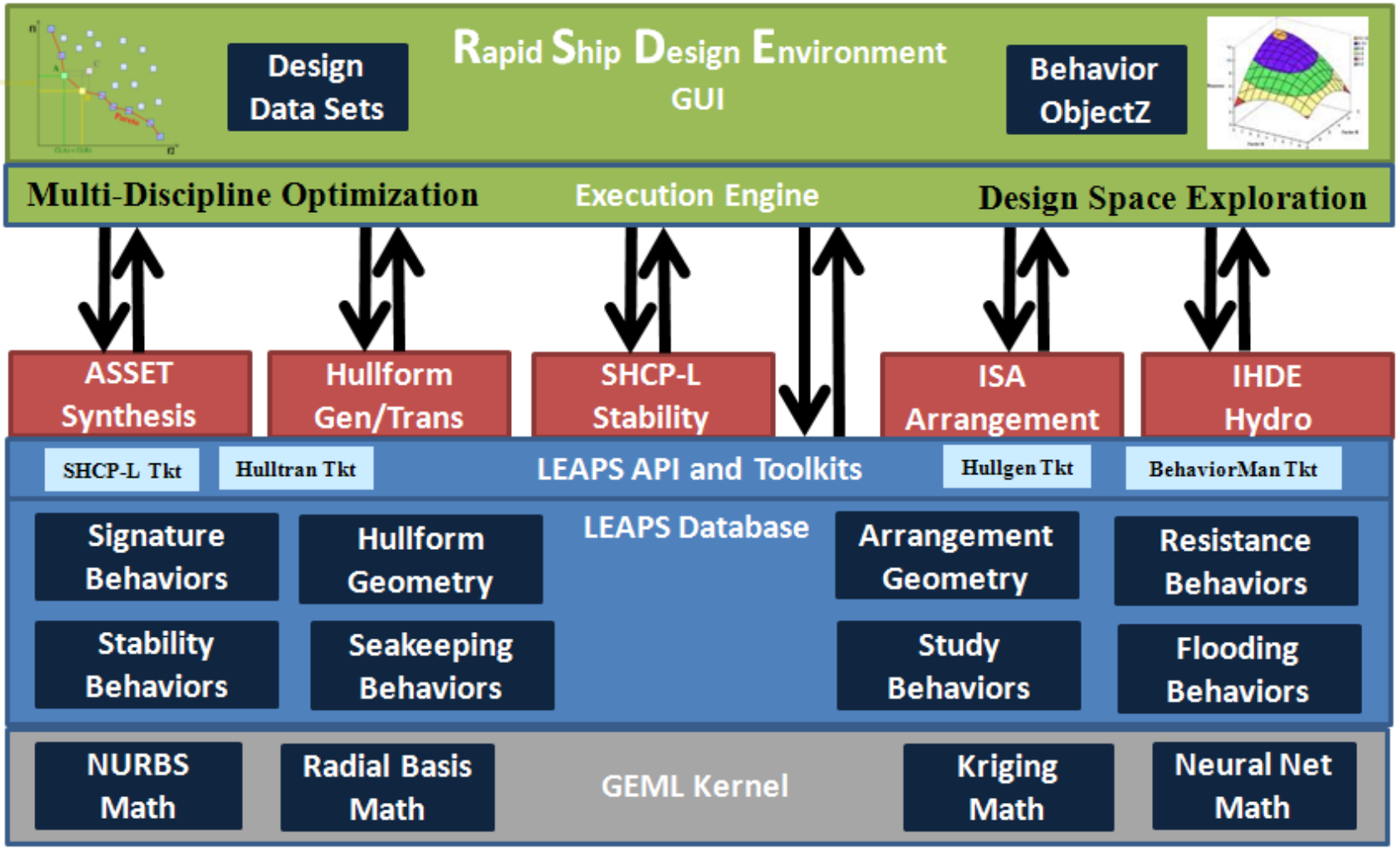
- The CREATE-Ships RDI effort produces 1 Product:
  - Rapid Ship Design Environment (RSDE)
    - New Design Space Exploration capability
    - New Multi-Disciplinary Synthesis capability

  - The use cases envisioned for RSDE require development of new capabilities in the existing tools:
    - Advanced Ship and Submarine Evaluation Tool (ASSET)
      - New Hull Transformation and Generation capability
      - New Structural Design Definition capability
    - Leading Edge Architecture for Prototyping Systems (LEAPS)
      - New Parallel Queries capability
  - The use cases envisioned for RSDE require development of a new tool:
    - Intelligent Ship Arrangements (ISA)
      - New Ship Arrangement capability

RSDE - Product Architecture



RSDE - Product Architecture



Description of the Rapid Ship Design Environment

1. RSDE will generate and interrogate design space data through….
   1.1 Generation of design space data through remote execution of tools.
   1.2 Aggregation of trade space data into larger sets.
   1.3 Evaluation and data extraction for downstream design and/or analysis tools.

2. RSDE will serve as a decision aid through visualization of trade space.

3. RSDE will be used by a naval architect needing higher fidelity design definition and physics based analysis during early stage design.

4. The output of this process will be a trade space. This trade space will be composed of discrete sets of design data and/or design data represented as interpolated behavior models.

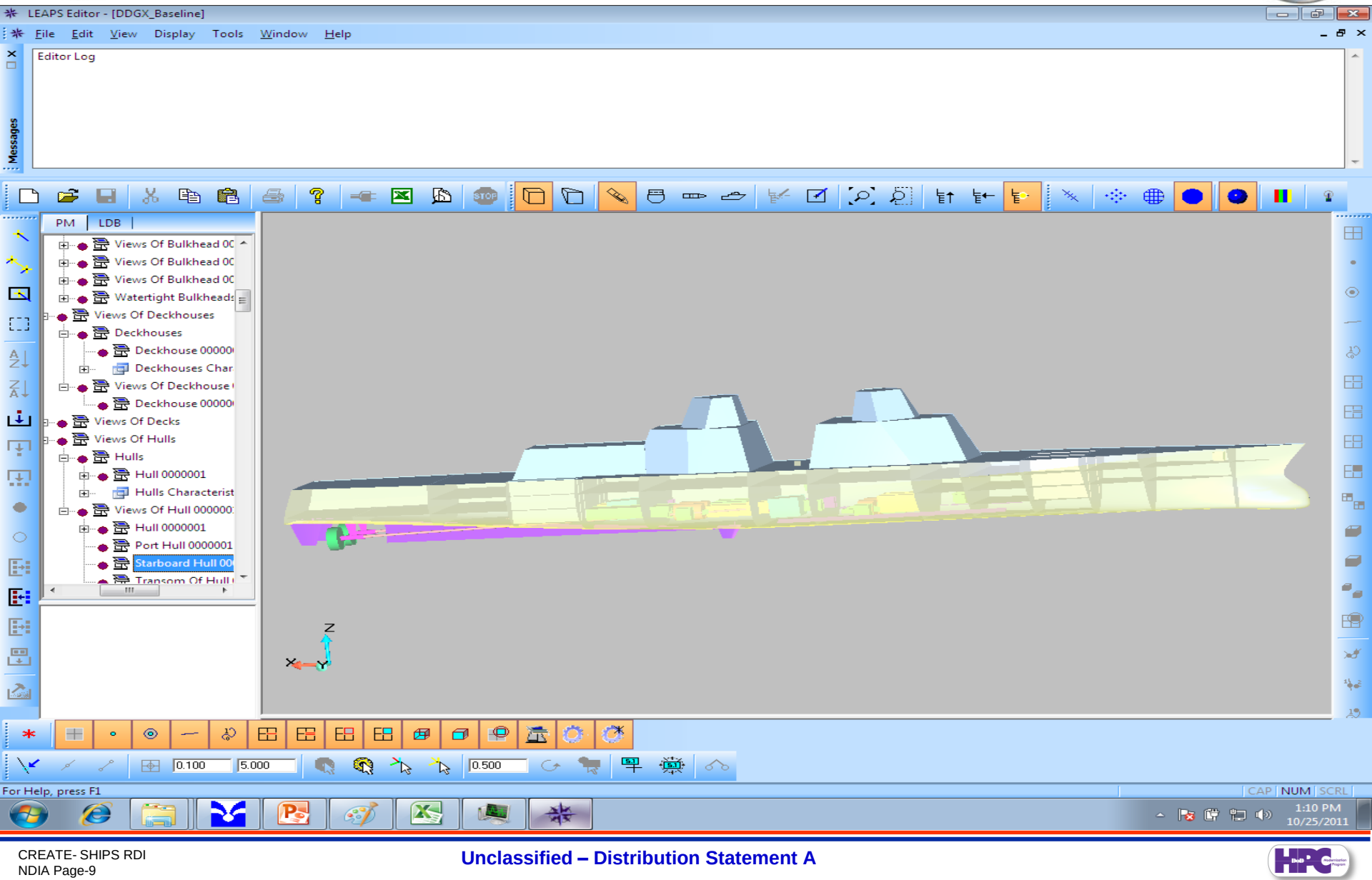
Users

- Rapid Ship Design Environment- planned 1st release date: Early CY 2012.
- ASSET
  - Has been used in the early stages of design by most major ship acquisition programs in recent history: DDG-1000, LCS, CVN-78, LPD-17, CG(X), DDG-51 flight upgrade.
  - Currently has 86 org/users on distribution.
  - Currently there are an estimated 40 heavy users.
- LEAPS
  - Has been used by the following ship acquisition programs: DDG-1000, SSC (Ship to Shore Connector – LCAC replacement)
  - Used by all ASSET users as the database for ASSET models
  - *Has promise, but is currently underutilized – most users are computer programmers developing applications.*
  - Currently has 129 org/users on distribution.
  - Currently there are an estimated 30 heavy users.

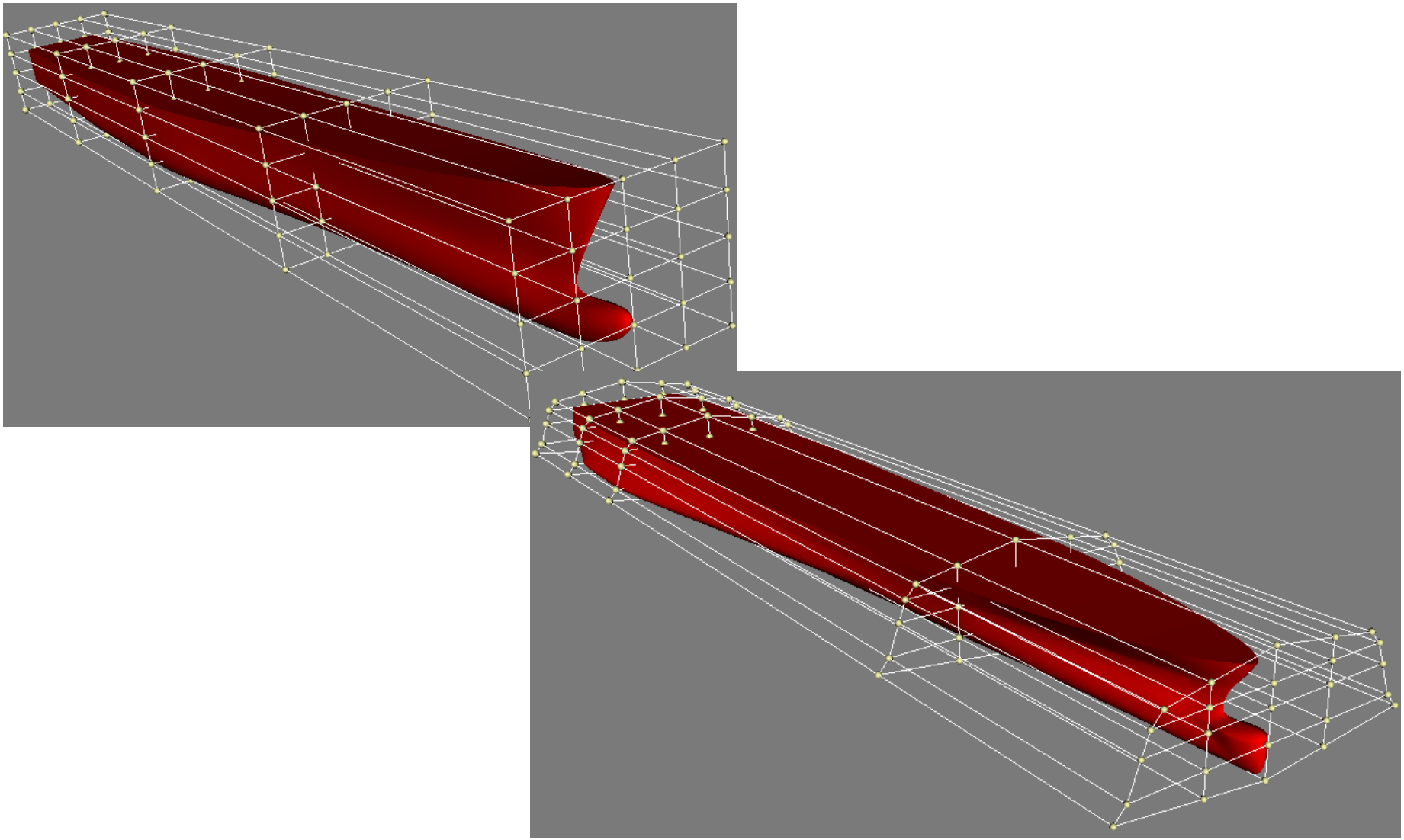
Potential Ship Programs

- DDG-51 Flight III Destroyer (FY 16 award)
  - currently using ASSET/LEAPS toolset
- LHA-8 Amphibious ship (FY 16 award)
- T-AO(X) Tanker (FY 17 award)
  - currently using ASSET/LEAPS toolset
- LSD(X) Amphibious ship (FY 17 award)
  - currently using ASSET/LEAPS toolset
- Ohio Replacement (FY 19 award)
- Sub Tender replacement (FY 23 timeframe)
  - Good option for RSDE use
- DDG(X) Future Surface Combatant (FY 25 timeframe)
  - Good option for RSDE use
- LCS(X) replacement (FY 25 timeframe)
  - Good option for RSDE use
- Virginia class submarine replacement (???)

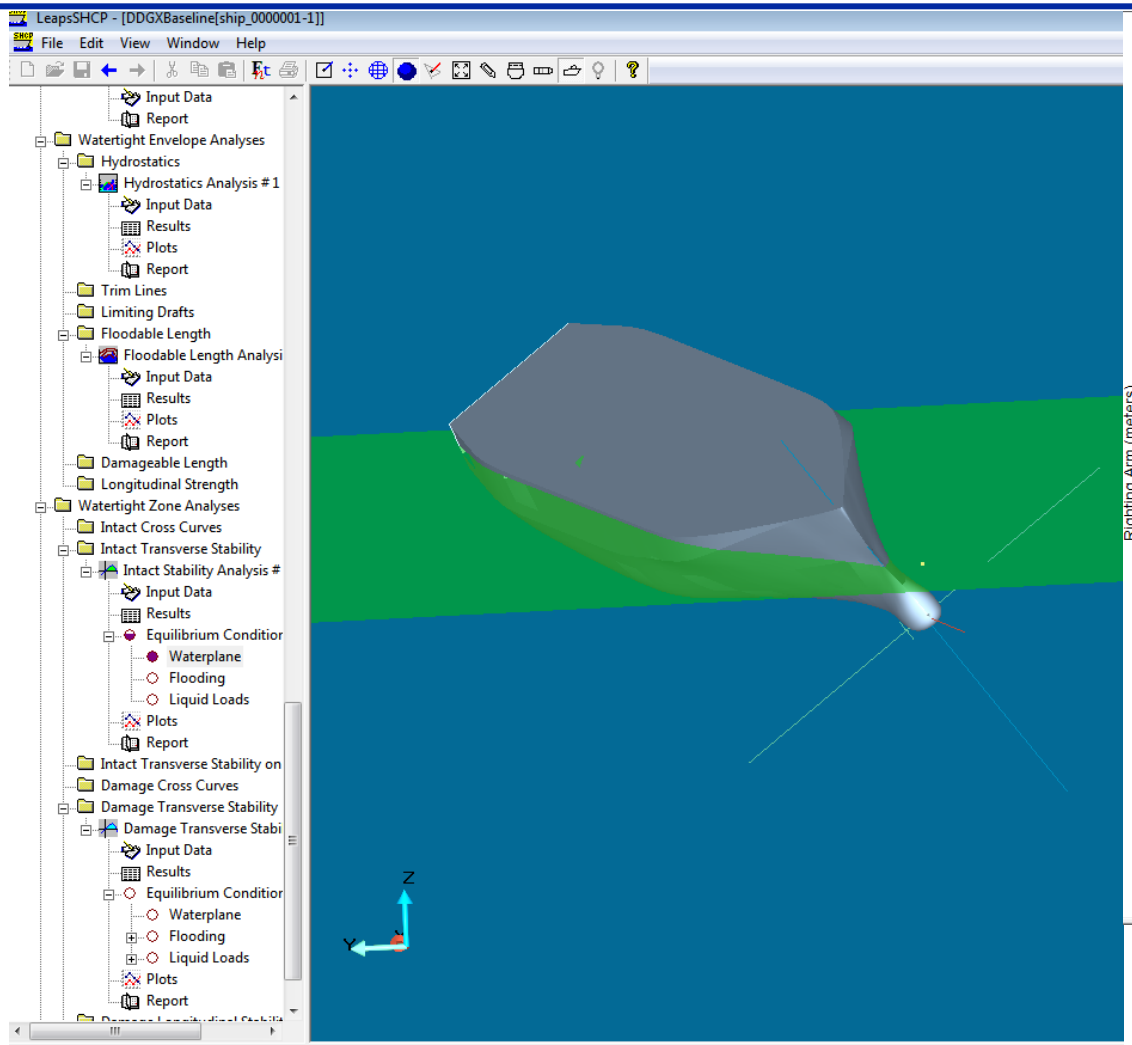
Ship Synthesis (using ASSET)

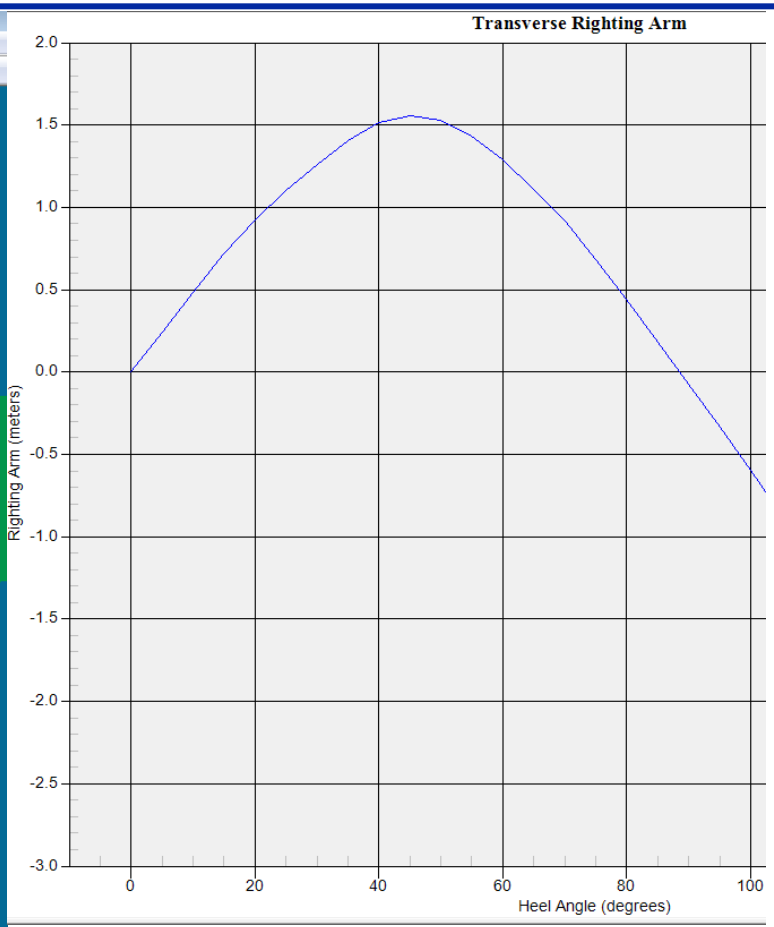


Hull Transformation Approach

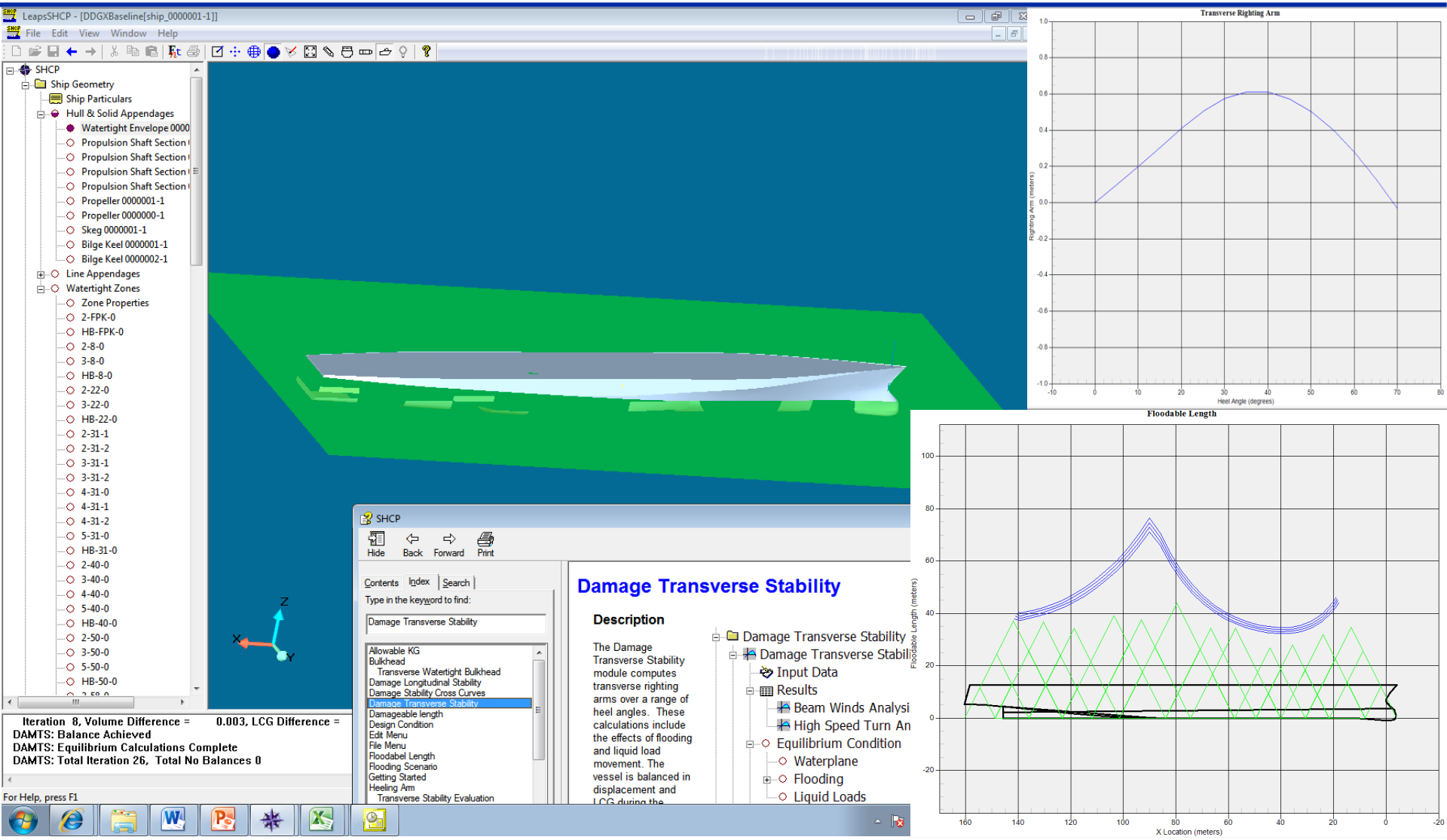


Intact Stability using SHCP-L

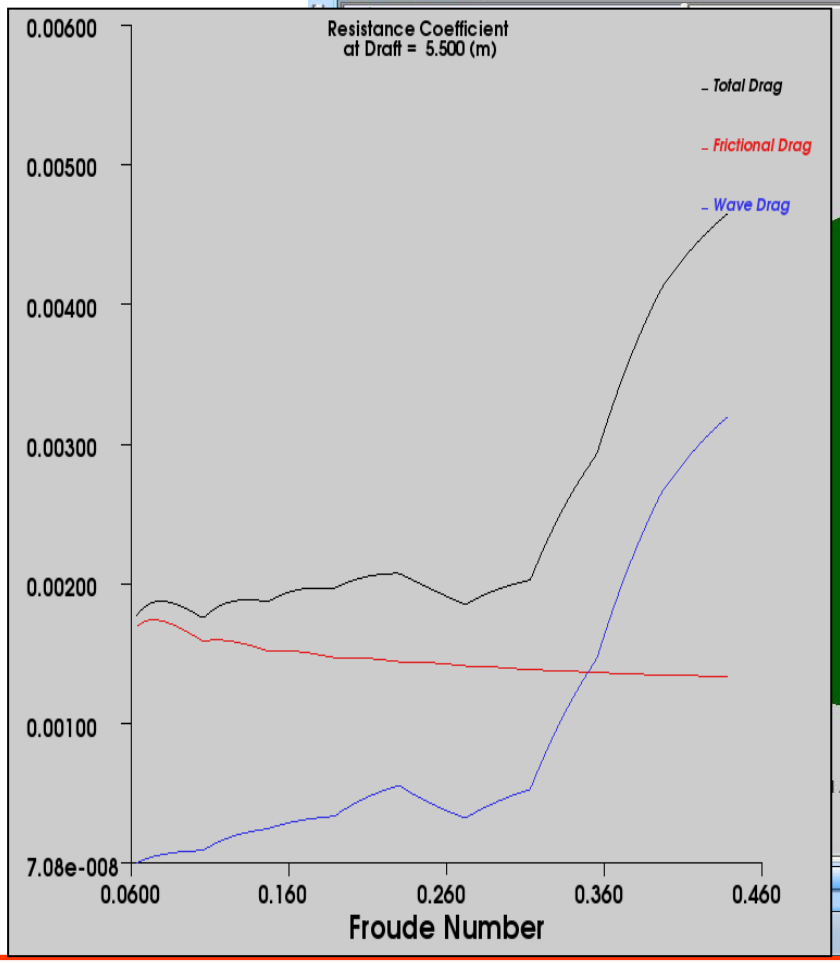




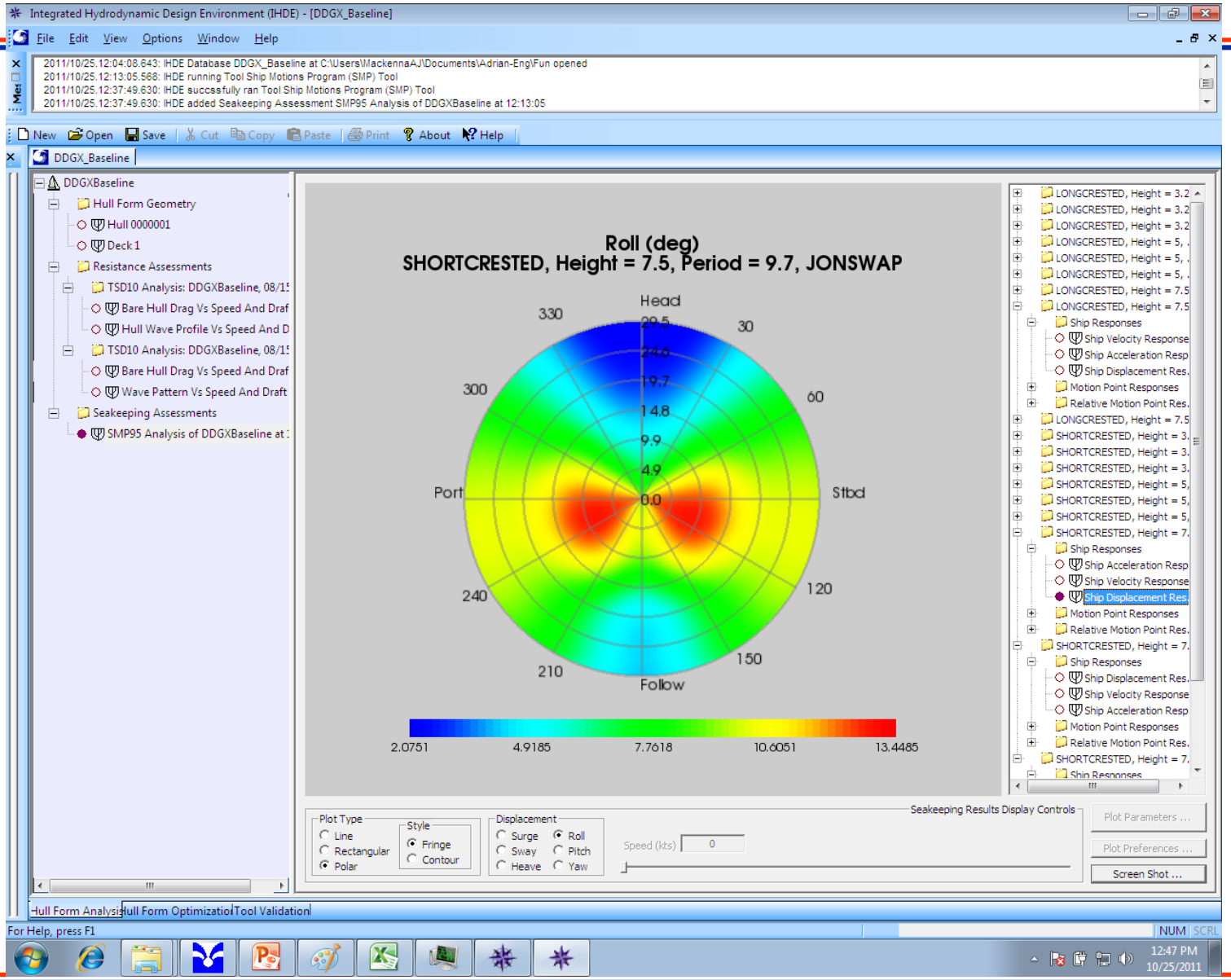
Damage Stability using SHCP-L



Resistance Analysis using IHDE

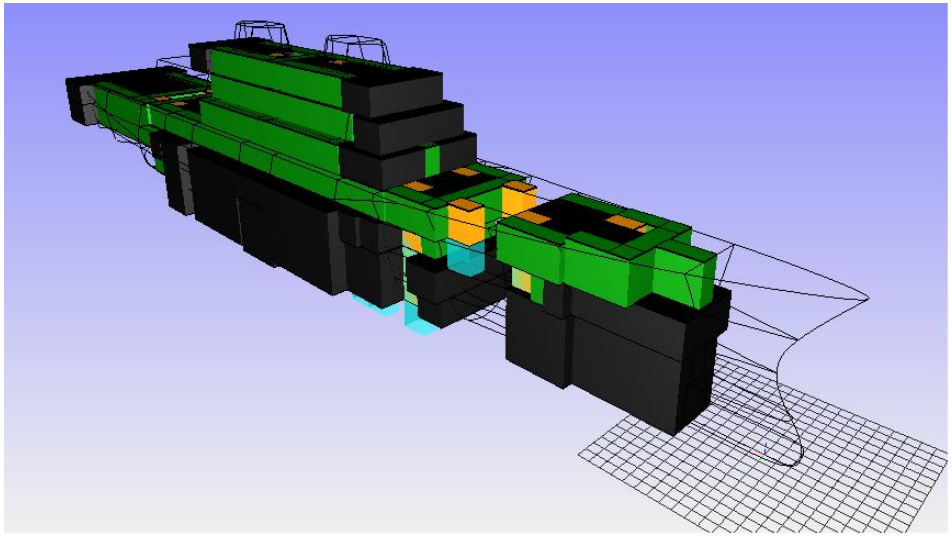


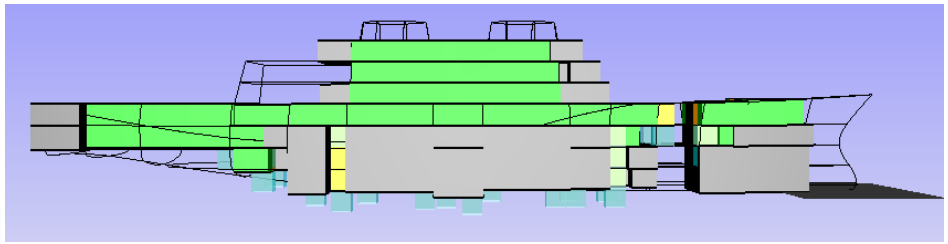
Seakeeping Analysis using IHDE

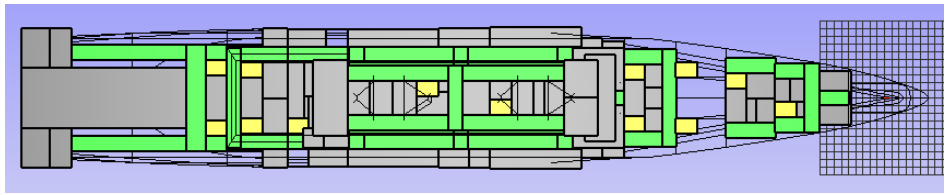


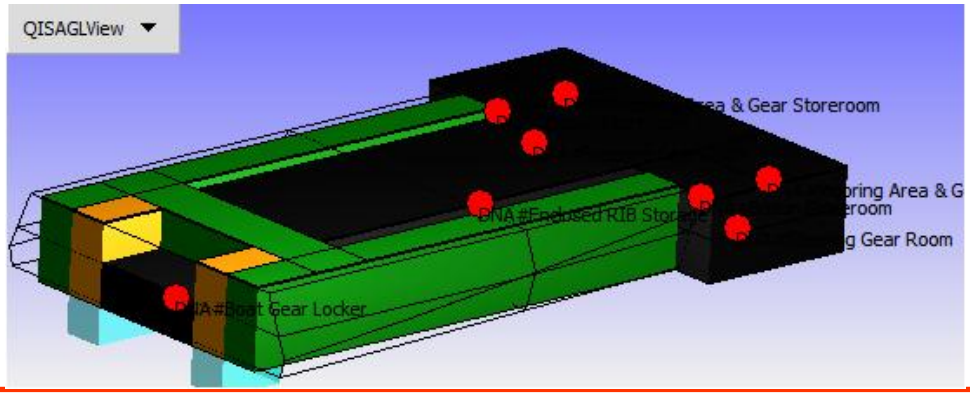
Intelligent Ship Arrangements (ISA)

- **Capabilities of ISA:**
  - LEAPS database as input for ship geometry and requirements
  - Arrangement requirements are input as a constraints database
  - Passageways are laid out using an initial lattice network
  - ISA performs allocation and arrangement of ship compartments
  - Fuzzy logic is used to lay out and optimize arrangement
  - 3D arrangements model is populated back to LEAPS



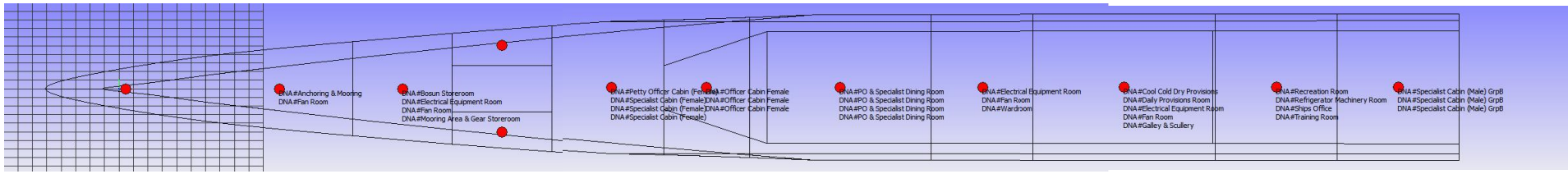




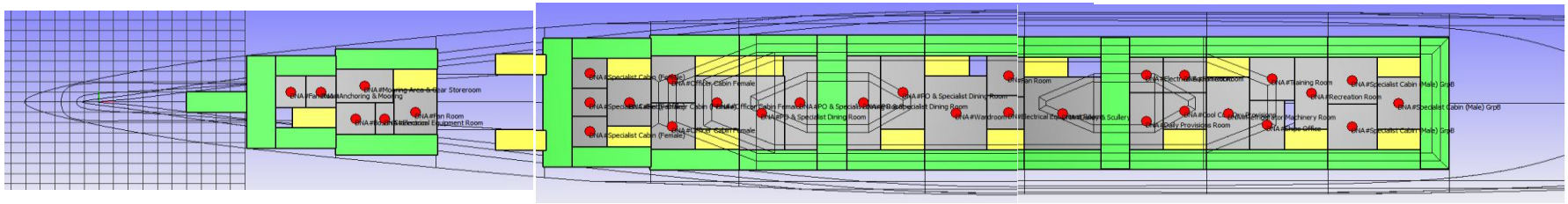


Intelligent Ship Arrangements (ISA)

Allocation Step



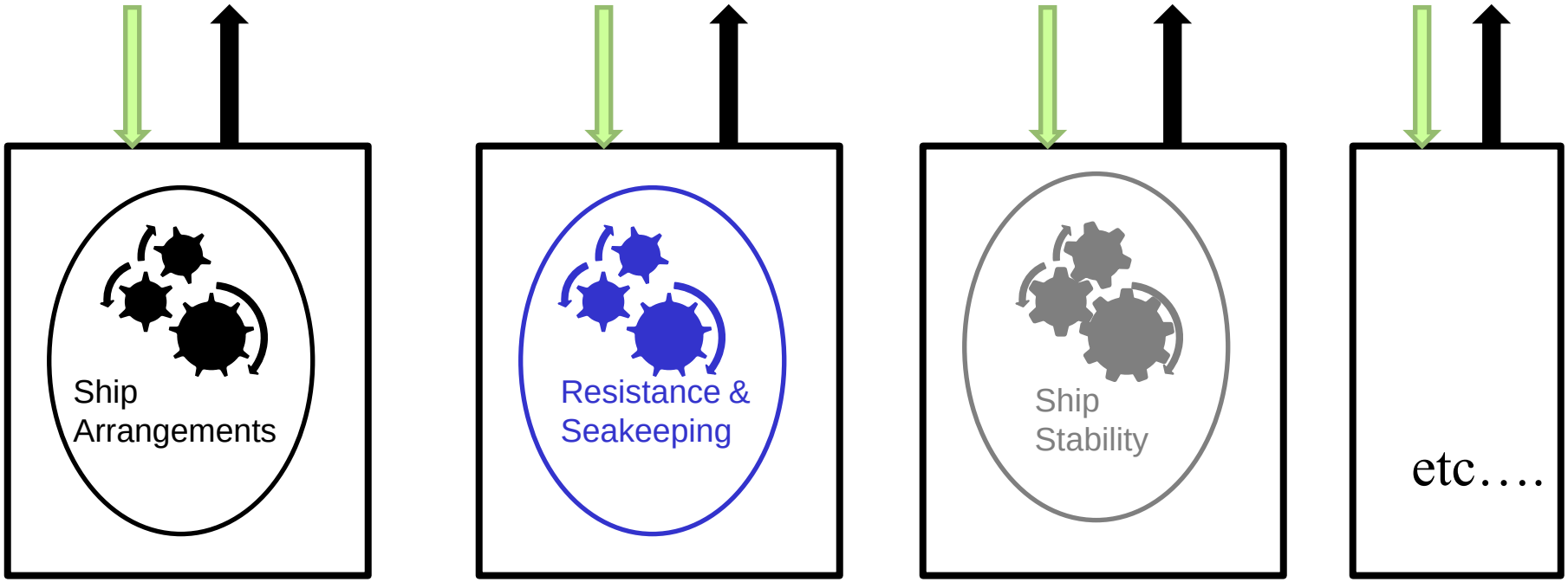
Arrangement Step



Multi-Disciplinary Synthesis

MDS (Multi-Discipline hierarchical Systems engineering)

Coordinate decision making process among *ship design generation tools and physics-based analysis tools*



Exchange of information and interaction among disciplines; effects of uncertainty; sharing of design variables; coordination of mutually competing objectives and constraints.

Multi-Disciplinary Synthesis