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63° Congreso Internacional
de Ingeniería Naval
e Industria Marítima
Madrid, 24-26 abril, 2024

TRANSFORMANDO
LOS OCÉANOS:
INNOVACIÓN e ingeniería naval para
un mundo CONECTADO y SOSTENIBLE

Tdyn WindTunnel and E-SeaFEM:

Optimising and transforming the workflow of Design and Naval Architecture analysis in the context of the Digital Twin

ASOCIACIÓN DE INGENIEROS
NAVALES Y OCEÁNICOS DE ESPAÑA

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Dr. Joel Jurado
Daniel Sá

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Modelling the Future through Engineering

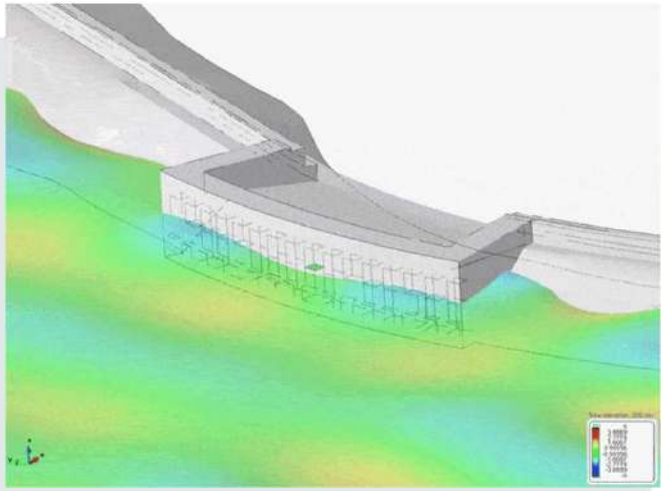
Consulting services Company:

- Engineering Design and Advanced technical consultancy services in **Naval Architecture**.
- Development and commercialization of software for numerical simulations: **Tdyn**.

✓ **20+** years bringing value to customers with **innovative solutions**.

✓ Capacity for **large scale projects** with international companies.

✓ Close collaboration with technological **research centers**.

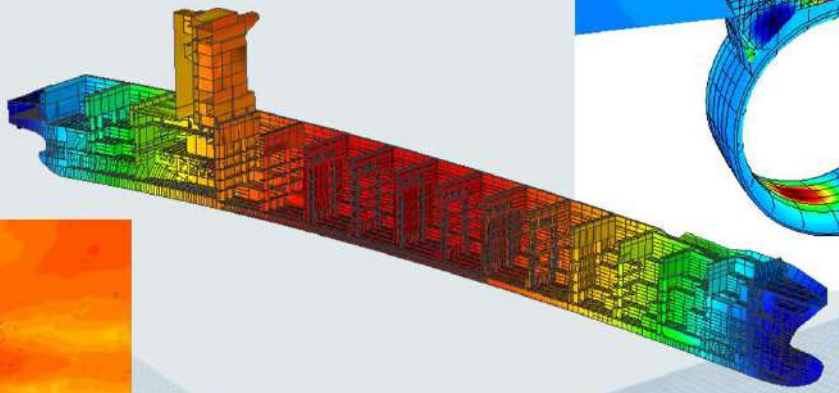


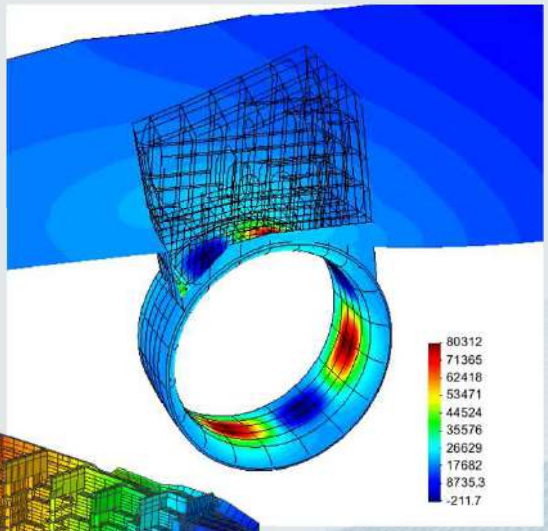
Wide range of services in **Naval Architecture and Marine Engineering** fields:

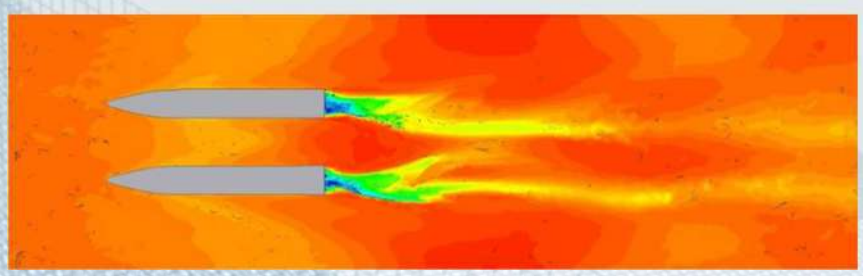
✓ Feasibility studies

✓ Global design

✓ Building management







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Tdyn:
The ultimate simulation technology

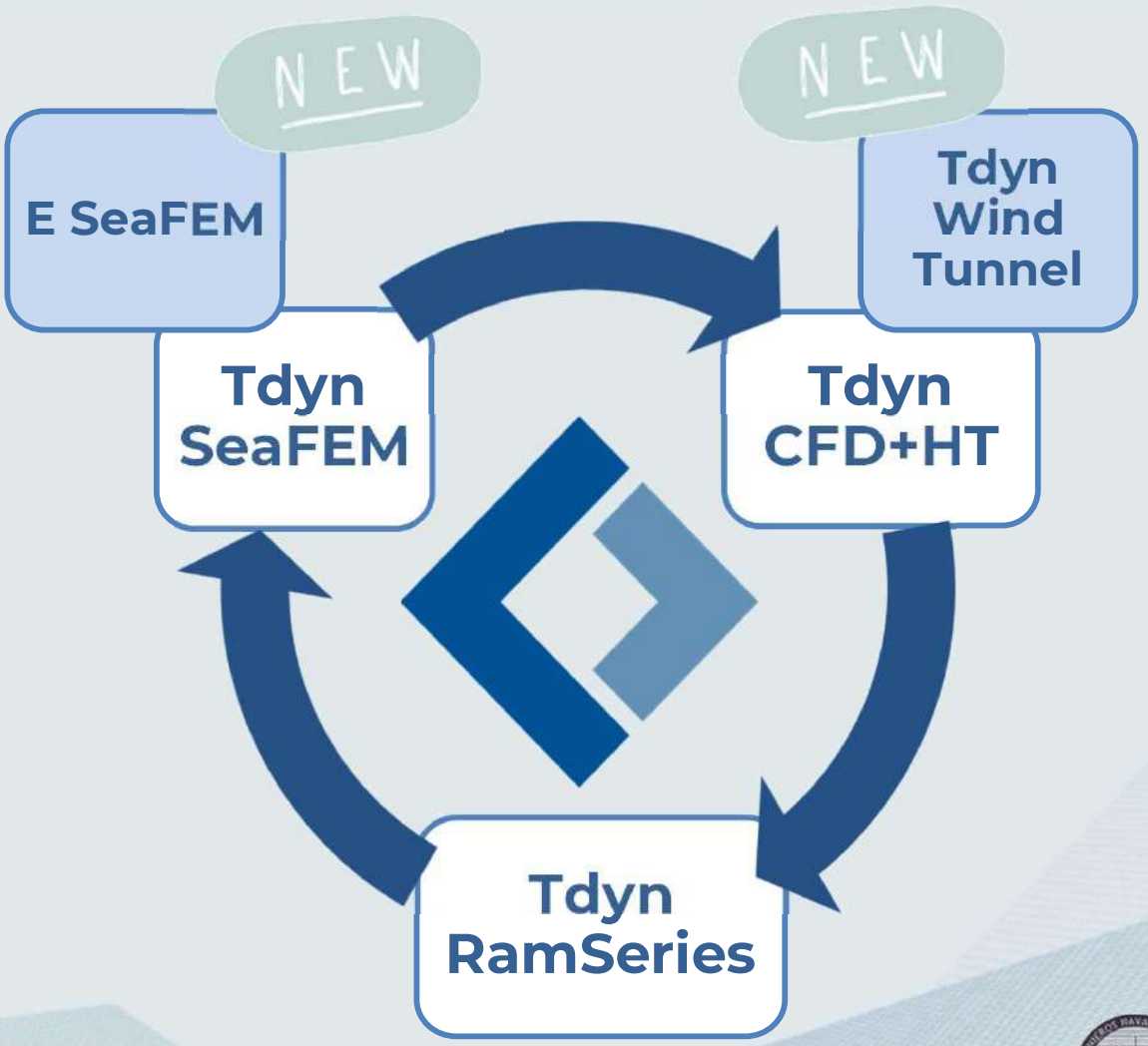
Unique integrated package solution for **structural, flow, heat transfer, coupled fluid-structure, multi-physics and seakeeping problems**.

User-friendly, fully integrated Graphic User Interface (GUI): GiD + CustomLib

- ✓ Geometry (CAD) and data definition
- ✓ Mesh generation
- ✓ Post-processing

Tdyn integrates 3 analysis packages, offering **12 simulation modules** altogether, plus **NEW enhanced automatic GUI for model generation**:

- **E-SeaFEM**
- **Tdyn Wind Tunnel**



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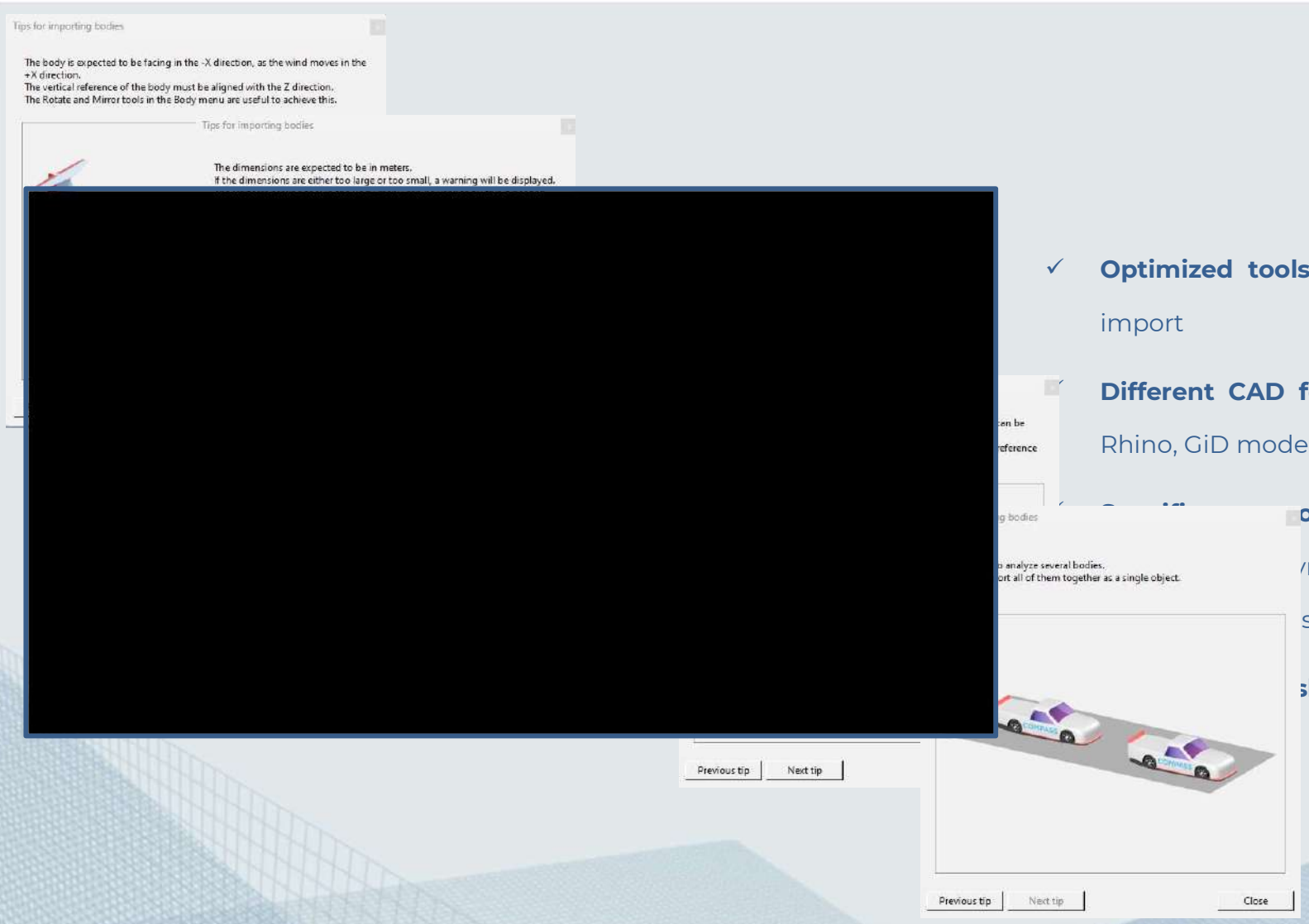
Tdyn CFD+HT to Tdyn Wind Tunnel: Processes automation & optimization

- ✓ **RANSOL** Fluid Dynamics solver
- ✓ **HEATRANS** Heat transfer analysis
- ✓ **ADVECT** Transport of mass/species
- ✓ **URSOLVER** User-defined PDE solver
- ✓ **ALEMESH** Mesh updating tools
- ✓ **FSURF** Free surface solvers

- ✓ **Tdyn Wind Tunnel GUI:** Advanced interface for automatic wind tunnel CFD models generation

Tdyn CFD+HT

Tdyn wind Tunnel: Importing geometry



- ✓ **Optimized tools** for CAD geometry import
- **Different CAD formats**: IGES, STEP, Rhino, GiD models
- **ocess tools:** plane ymmetries, uniform s
- **shoothing**

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Tdyn wind Tunnel: Problem setup

- ✓ **Reduced input data:** Minimum user requirement for interaction.
- ✓ **Automatic creation of fluid domain**: Applying CFD common practice and internal know-how
- ✓ **Automatic assignment of boundary conditions:** walls, bodies, inlet and outlet, together with turbulence model selection and its initialization.
- ✓ **Automatic mesh size assignment**
- ✓ **Automatic time step and total duration definition**

Tdyn wind Tunnel: Mesh generation

- ✓ **Unstructured mesh (tetrahedra)**
- ✓ **Automatic meshing preferences:** Mesh transition, mesher, max generic mesh size, … (based on the precision parameter selected by the user)

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Tdyn wind Tunnel: Calculation and post-processing

- ✓ **Complete post-processing options:** turbulence, pressure and velocity contour fills maps and time evolution maps.
- ✓ **Specific improved tools:** Automatic generation of cut planes and stream lines.

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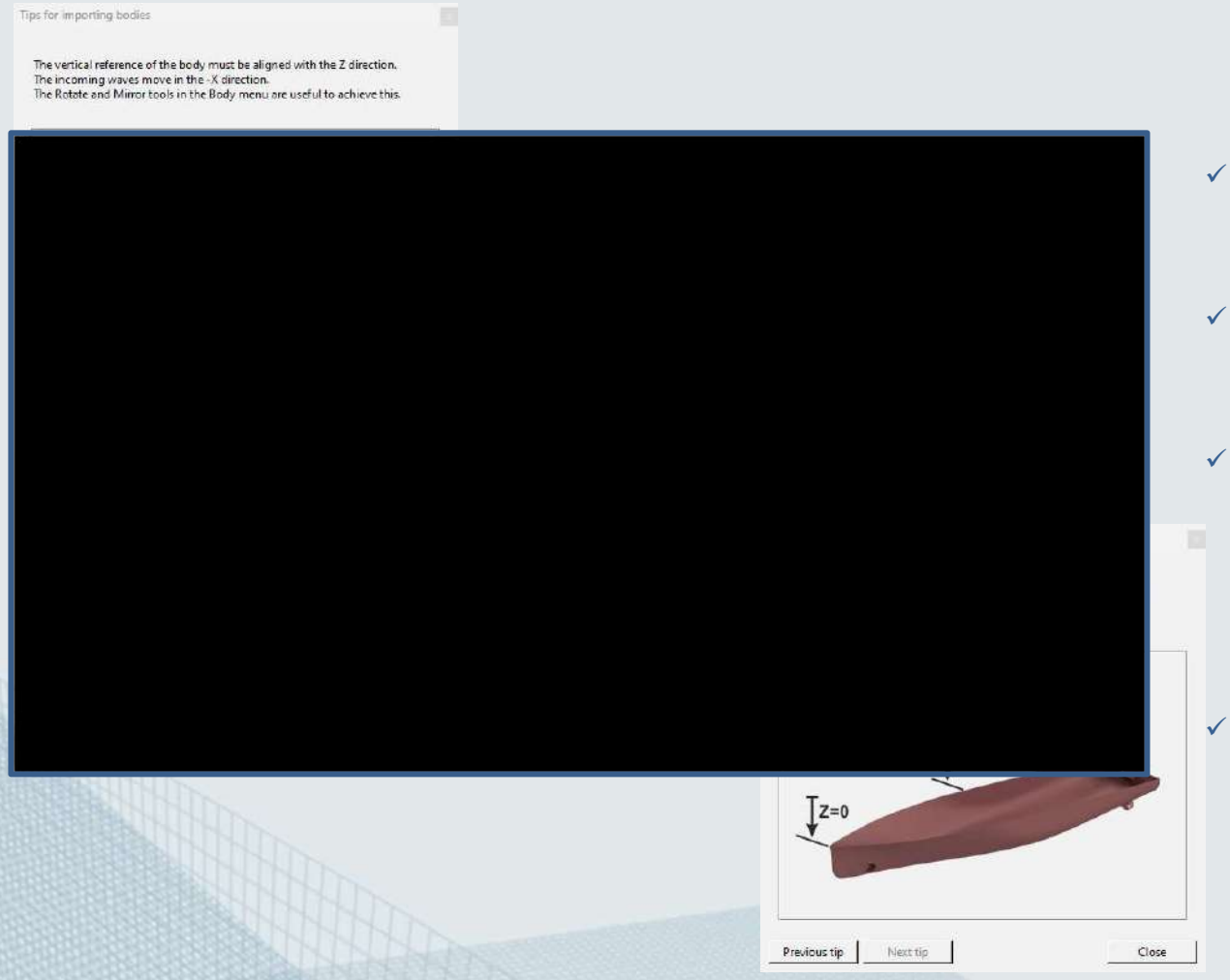
Tdyn SeaFEM to E-SeaFEM: Processes automation & optimization

- ✓ **BASIC**: FEM multi-body diffraction-radiation potential solver in the time domain, including connections, mooring, and slender elements
- ✓ **ADVANCED:** 2nd order effects and advanced analysis tools (dynamic cables, non-linear hydrostatics)

- ✓ **E-SeaFEM GUI:** Advanced interface for automatic seakeeping models generation

E-SeaFEM: Importing geometry



- ✓ **Optimized tools** for CAD geometry import
- ✓ **Different CAD formats**: IGES, STEP, Rhino, GiD models
- ✓ **Specific preprocess tools:** free surface plane adjustment to problem requirements , symmetries, uniform scaling, rotations .
- ✓ **Tips for troubleshoothing**

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E-SeaFEM: Problem setup

- ✓ **Minimized input data:** Reduced to ship naval architecture data, sea conditions and environment.
- ✓ **Automatic creation of analysis domain**: Specific analysis domain is automatically dimensioned and generated, based on internal algorithms.
- ✓ **Automatic assignment of boundary conditions:** Free surface, body, outlet, bottom, together with specific problem data.
- ✓ **Automatic mesh size assignment**
- ✓ **Automatic time step, total duration and numerical data definition**

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E-SeaFEM: Mesh generation

- ✓ **Unstructured mesh (tetrahedra)**
- ✓ **Automatic meshing preferences:** Mesh transition, mesher, max generic mesh size, … (based on the specific problem requirements)

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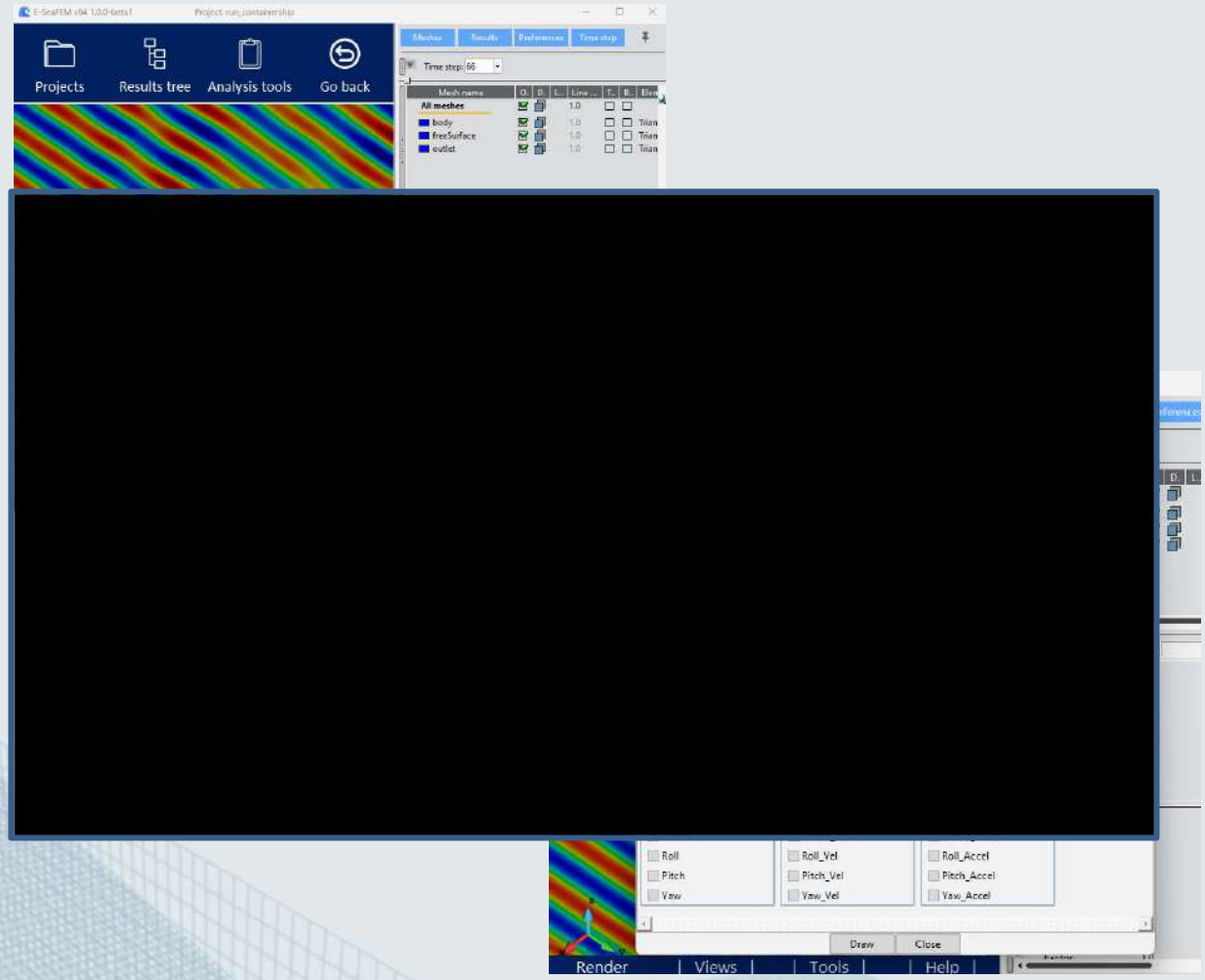
E-SeaFEM: Calculation and post-processing



- ✓ **Complete seakeeping post-processing options:** free surface elevation, total pressure on the hull, dynamic response graphs.

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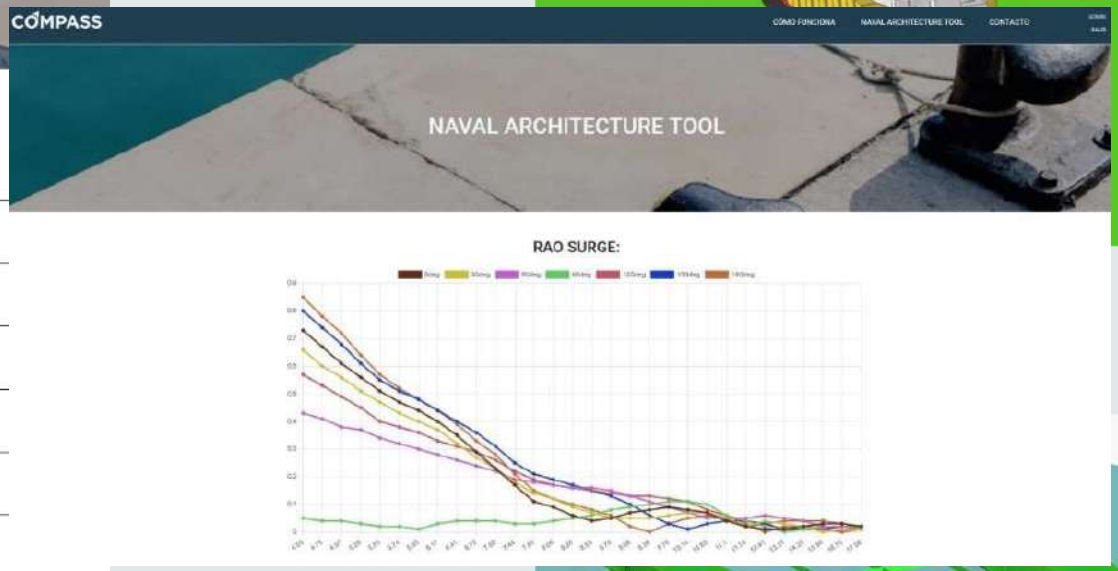
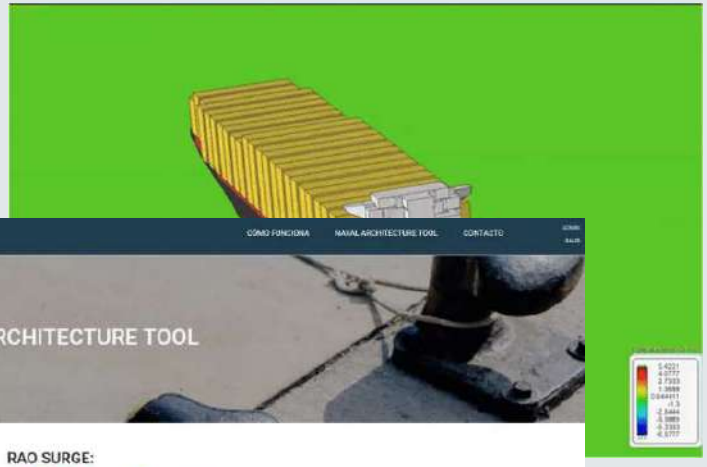
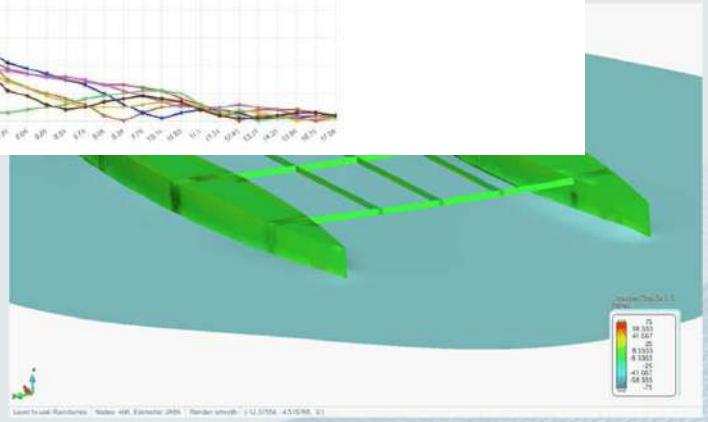
Tdyn wind Tunnel & E-SeaFEM: Embracing the Digital Twin

E-SeaFEM and **Tdyn Wind Tunnel** can be easily embedded in the **Digital Twin and Shipyard 4.0 workflows**, with countless advantages:

- ✓ **Automation:** Significant reduction of time and bottlenecks regarding ana… …esh generation, bou…
- ✓ **Sim…** Extr… diffe…
- ✓ **Effi…** arch…
- ✓ **Pre…** Dec…
- ✓ **Eas…** CFD…
- ✓ **Inn…** solu…
- ✓ **Integration:** With other design software, and analysis tools, sharing feedback and results, enabling a unified true digital twin workflow.







- ✓ **Extension to machine learning and AI**: Easy use of tools allows to train neural network and create new specific tools.

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Shaping Tomorrow with Advanced Simulation Engineering

Thank You!

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