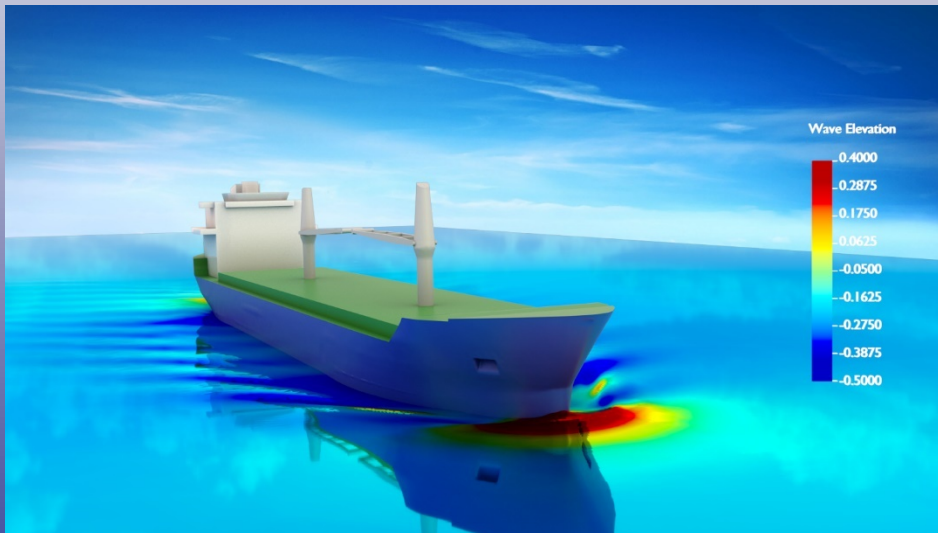


# NUMECA Solutions for the Marine Industry



Kevin VIDAL  
Marine Products &  
Applications group  
NUMECA International



A new wave in fluid dynamics



# NUMECA

## PORTFOLIO AND CUSTOMERS



A new wave in fluid dynamics

**FINE™/Design3D**  
Design Optimization Tool

**Portfolio**

**CFView™**  
Post-processing tool

**FINE™/Turbo**  
Turbo Machinery  
Structured Solver

**FINE™/Open**  
Multiphysics  
Unstructured  
Solver

**FINE™/Marine**  
Multi-phase Solver

**FINE™/FSI-OOFELIE**  
Fine Element Solver

**FINE™/Acoustic**  
Aero-Vibro-Acoustic Solver

**Hexpress™ &  
Hexpress™/Hybrid**  
Unstructured Grid  
Generator

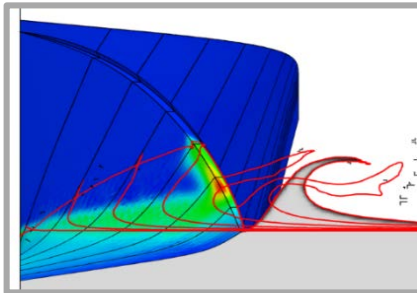
**IGG & Auogrid5™**  
Structured Grid Generator



# Marine customers

Used by more than 200 users including biggest shipyards or best racing teams





# NUMECA SOLUTIONS NUMBERS AND APPLICATIONS

## FINE™/Marine in numbers



**2007**  
**Start**

**2018**  
**> 170 Users**

*10+ years of market experience*

*World-wide community of users*

*20 years of solver development*

## Main marine applications



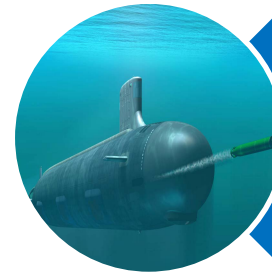
Cargo vessels  
& cruise  
ships



High speed  
motor  
boats



Sailing  
yachts



Military  
vehicles

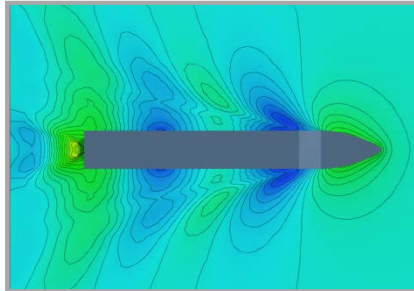


Off-shore  
vessels and  
platforms

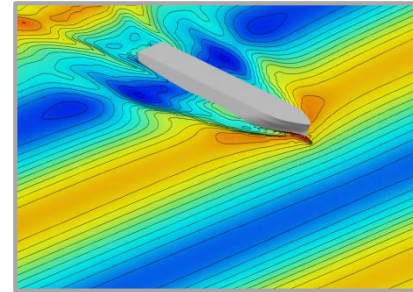


Others

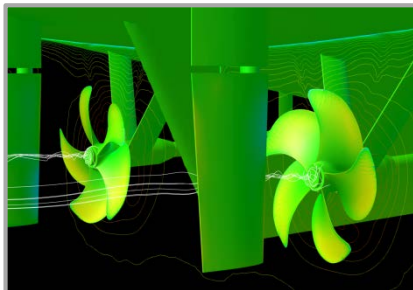
## Main CFD applications



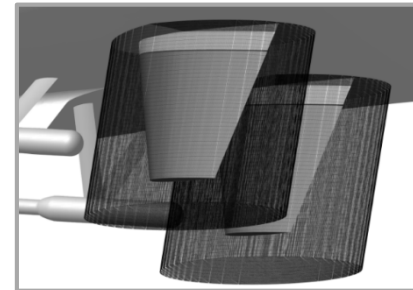
Resistance



Sea Keeping



Propulsion



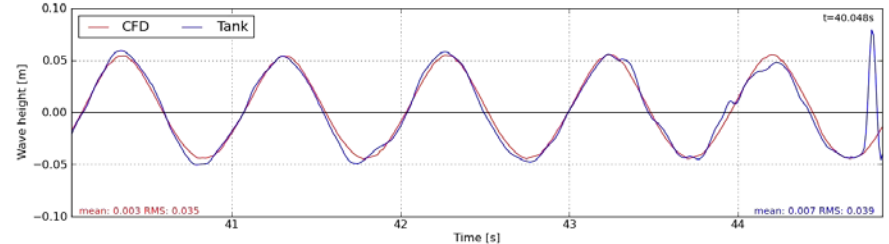
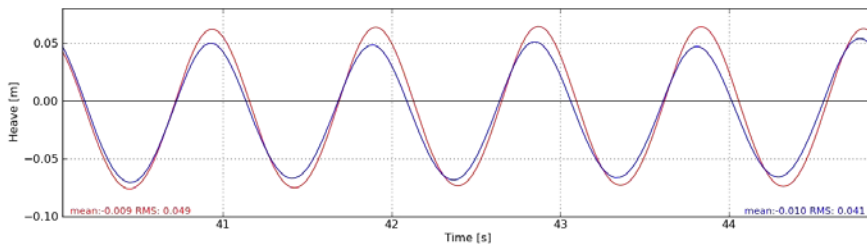
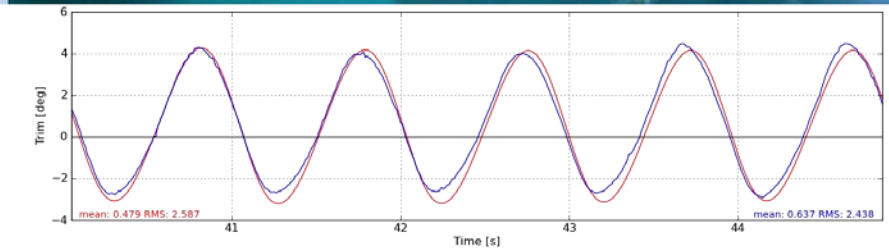
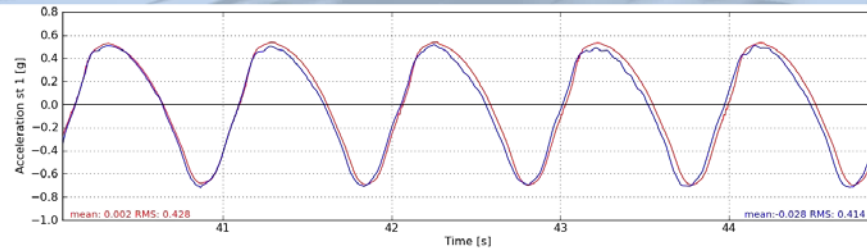
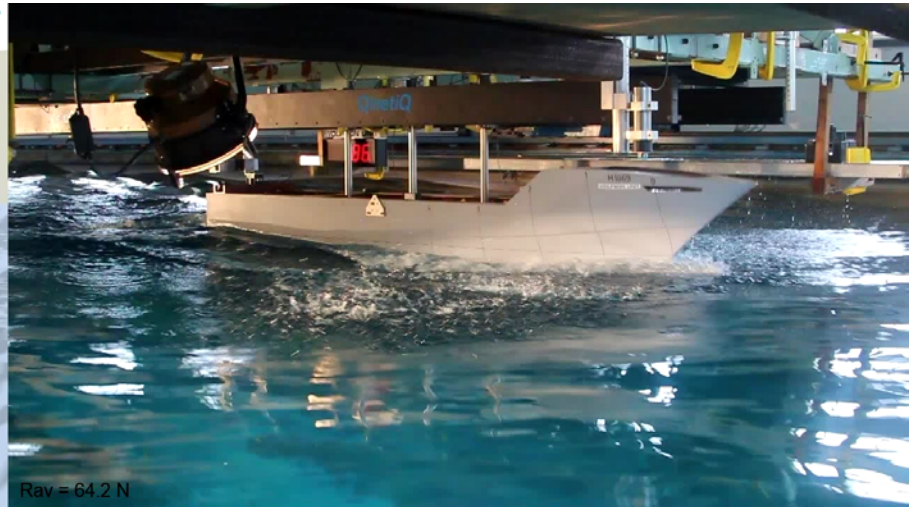
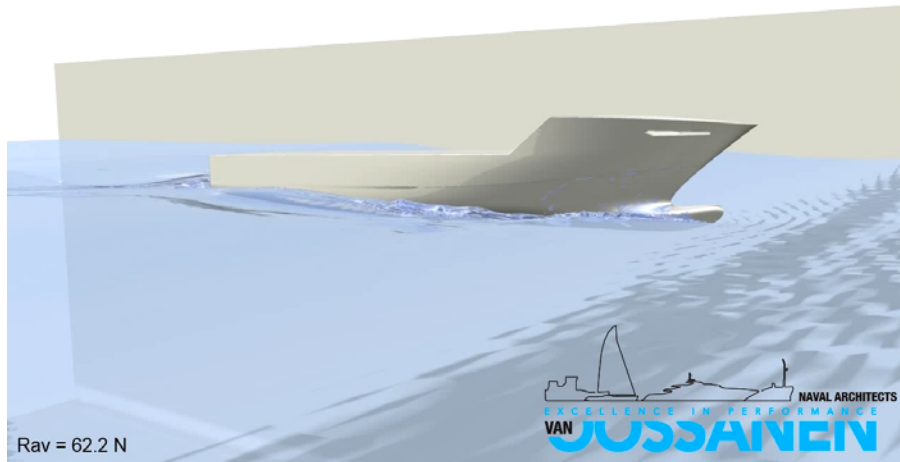
Maneuvering



# Example: seakeeping in heading waves

Vs=16kn Wave height=1.58m Wave period=1.72 s

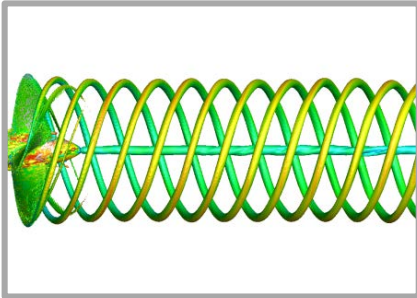
55m MOTOR YACHT



## Example: Life boat drop

NUMECA



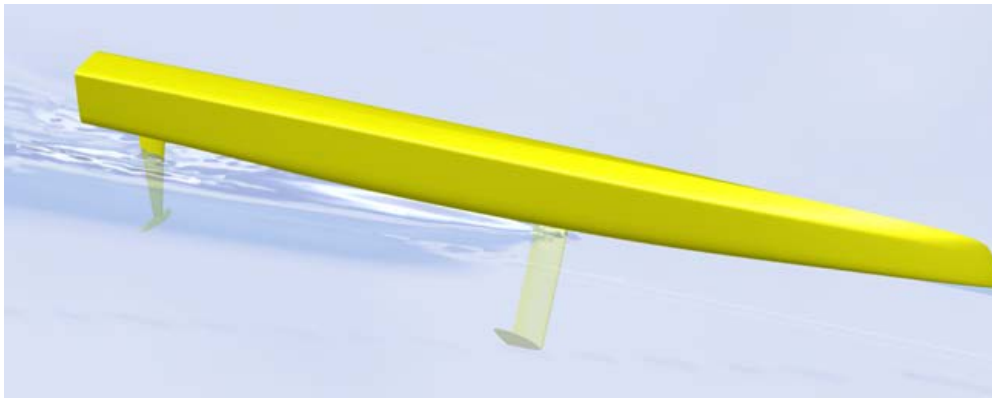


## **NUMECA SOLUTIONS**

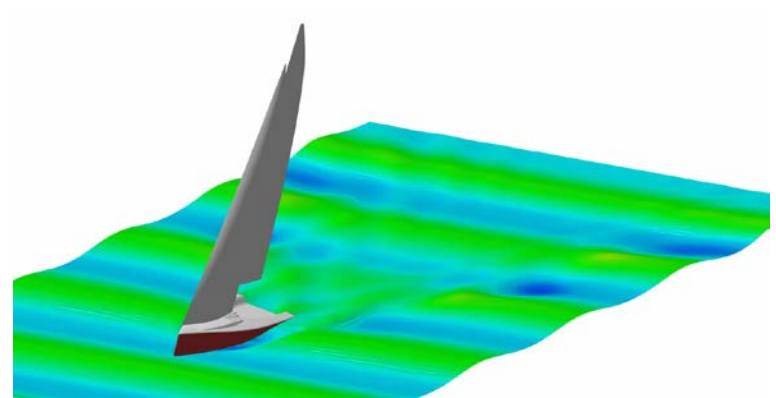
### MODELING THE PHYSICS

## Multi-phase Flows

Free-surface (FS) , ventilation and cavitation can be captured.



*Courtesy of Emirates Team New Zealand*



*Courtesy of Ker Yacht Design & Engineering*

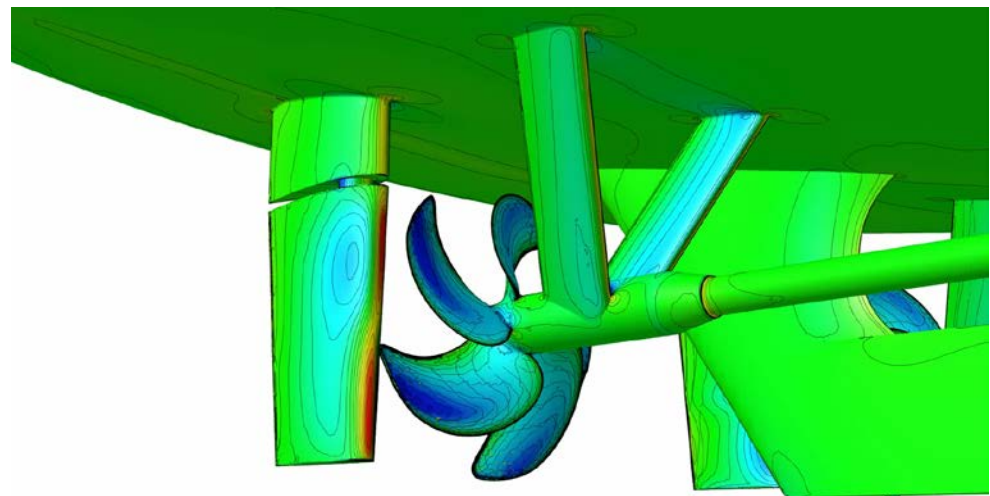
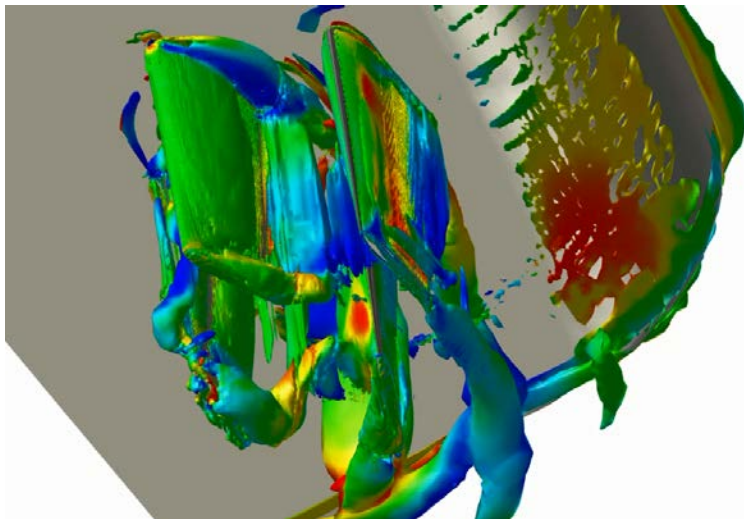
# Modeling the Physics

## Multi-phase Flows

## Body Motions

### 6 D.O.F. flow solver

A different motion law (fixed / imposed / solved / user defined) per D.O.F.



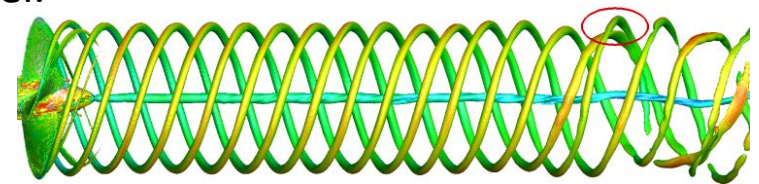
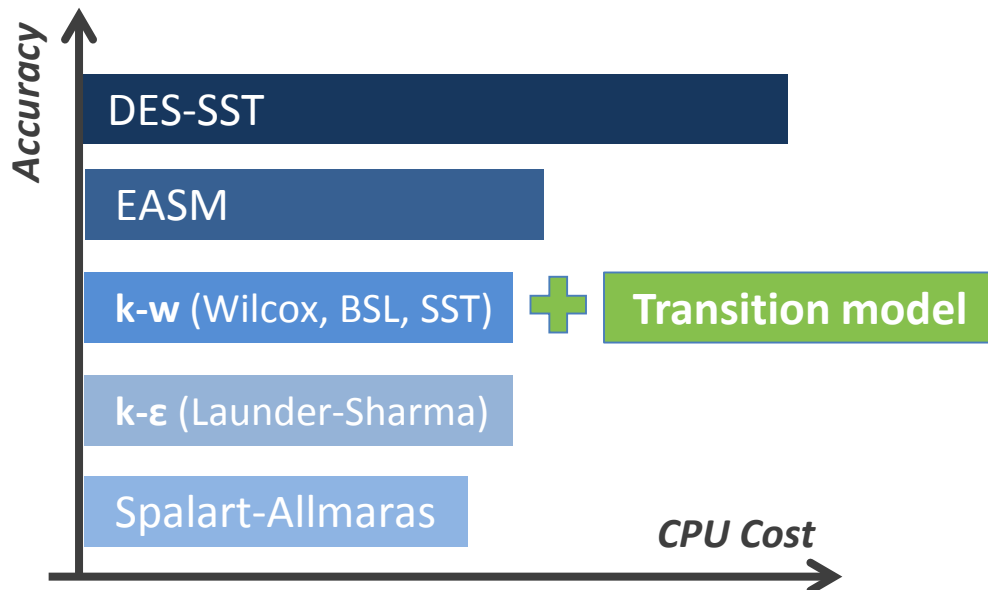
# Modeling the Physics

Multi-phase Flows

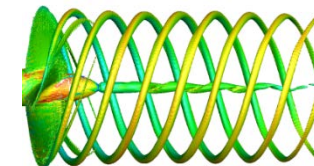
Body Motions

Turbulence

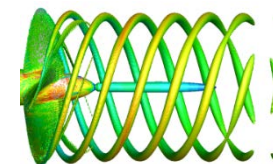
The solver includes state of the art turbulence model.



DES SST



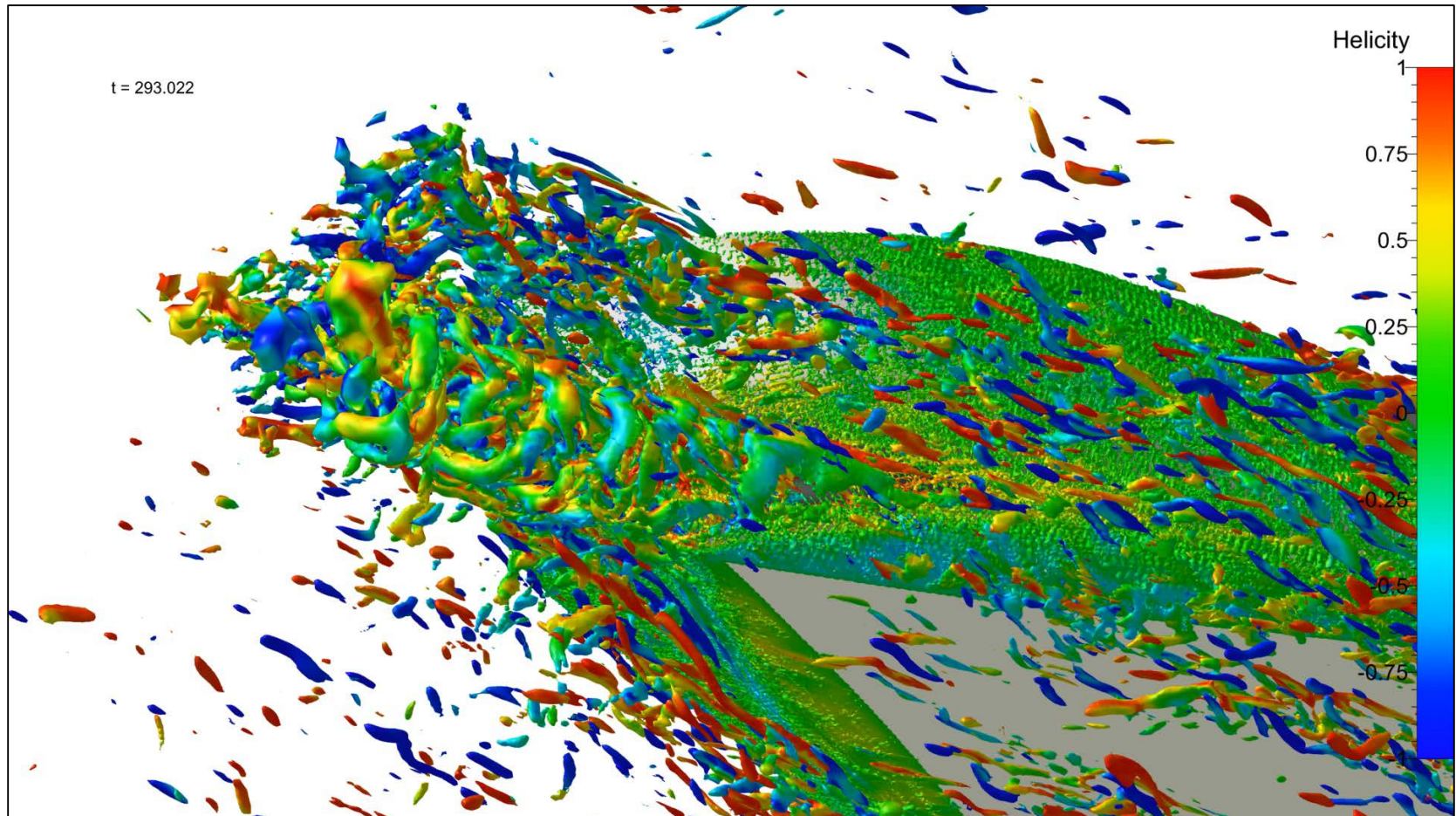
EASM

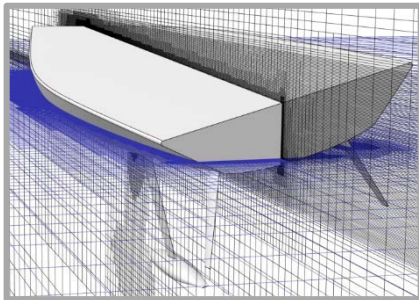


k-w SST

# DES simulation on the JBC (transom)

## Turbulence



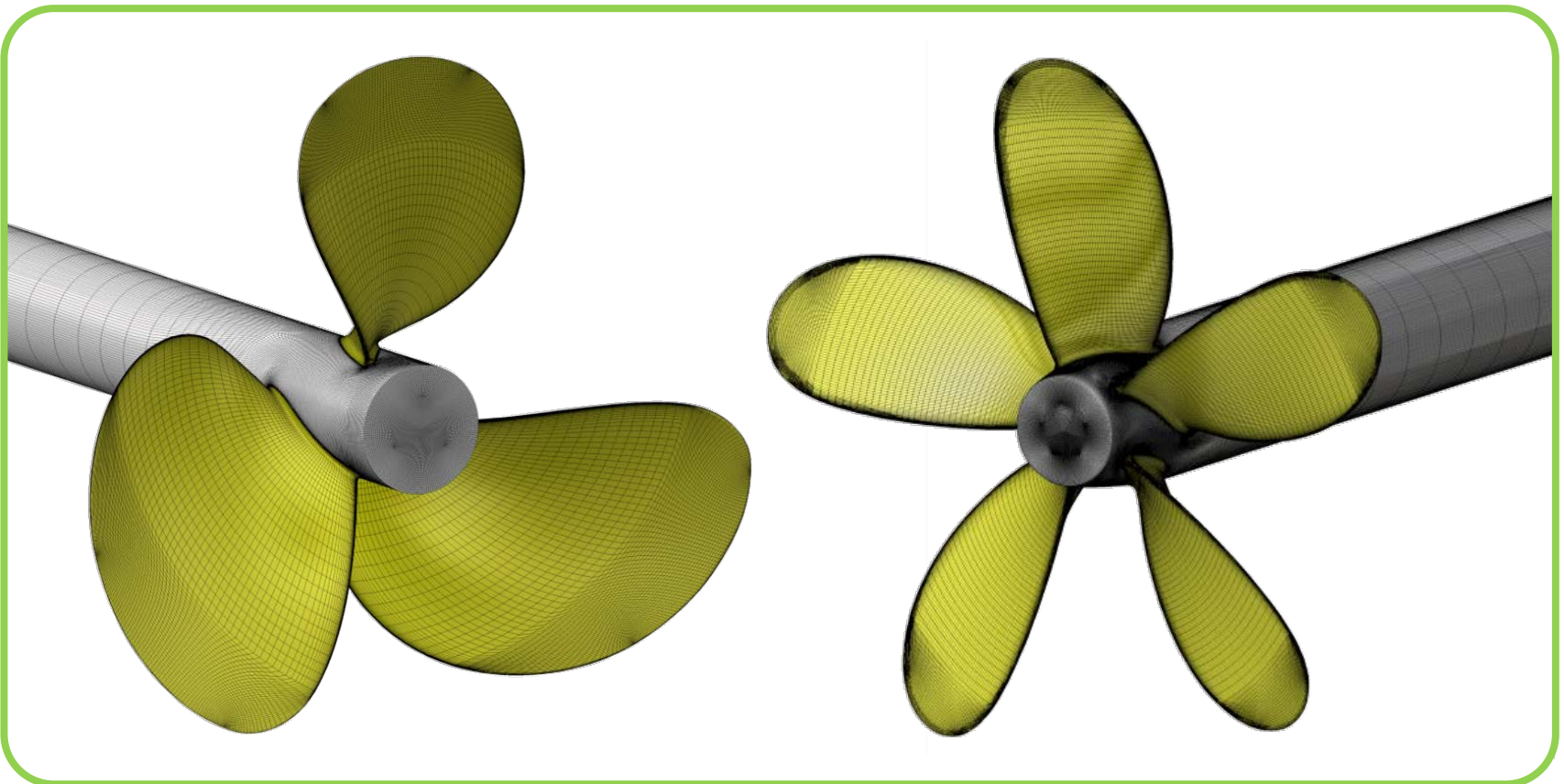


## NUMECA SOLUTIONS MESH MANAGEMENT



## Mesh Types and NUMECA Tools

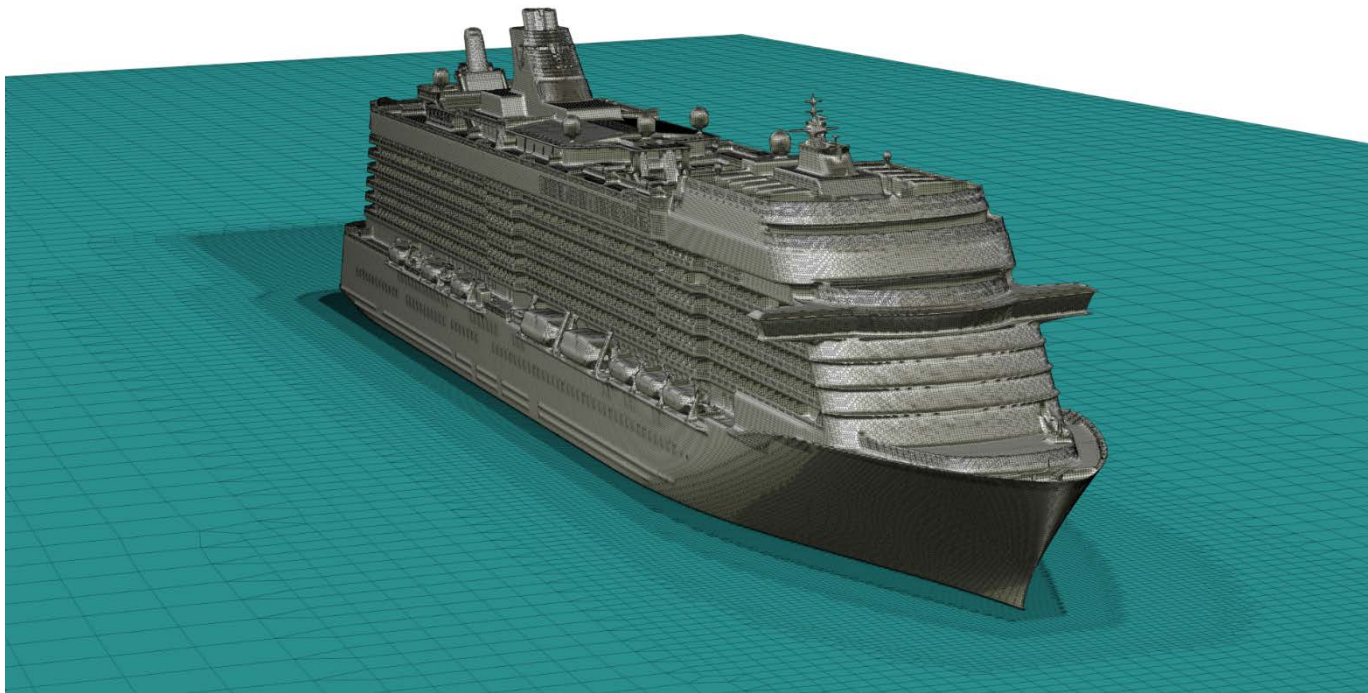
### Automatic Structured grid generator

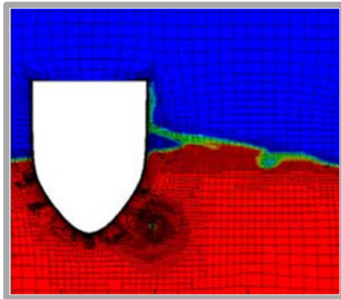


## Mesh Types and NUMECA Tools

### Unstructured grid generator for complex geometry

NUMECA



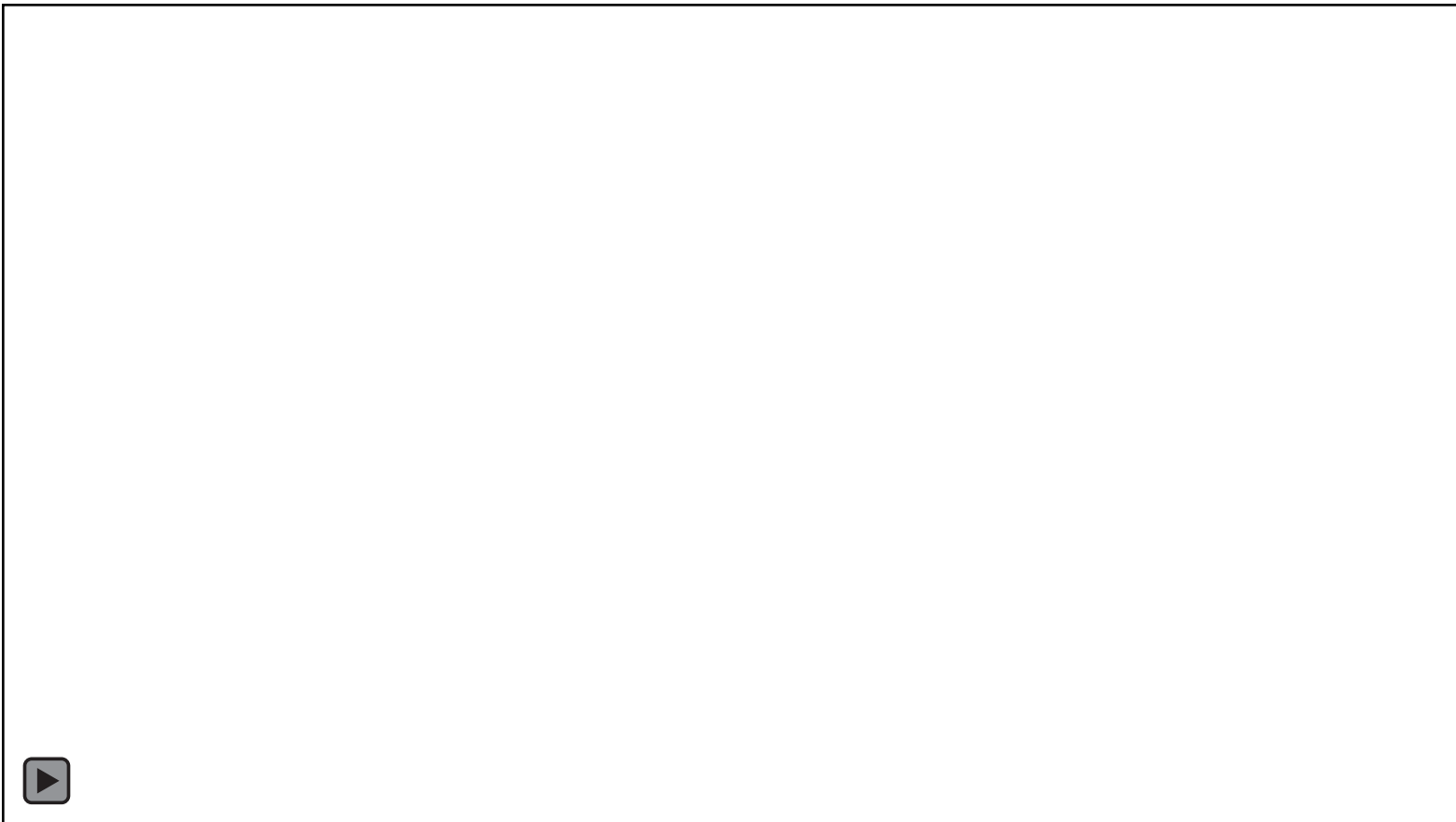


## NUMECA SOLUTIONS

### UNIQUE FEATURES

# Dynamic mesh refinement

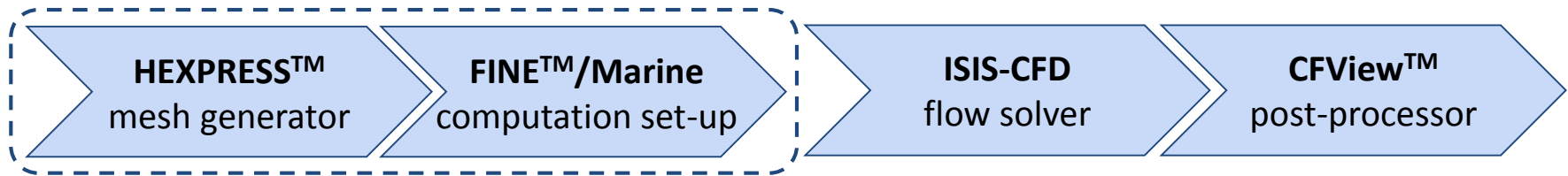
## Adaptive Grid Refinement



# Workflow Automation

## NUMECA Integrated Software Environment for Marine Applications

### C-Wizard



**Complete CFD Tool Chain**



User interaction  
Potential errors

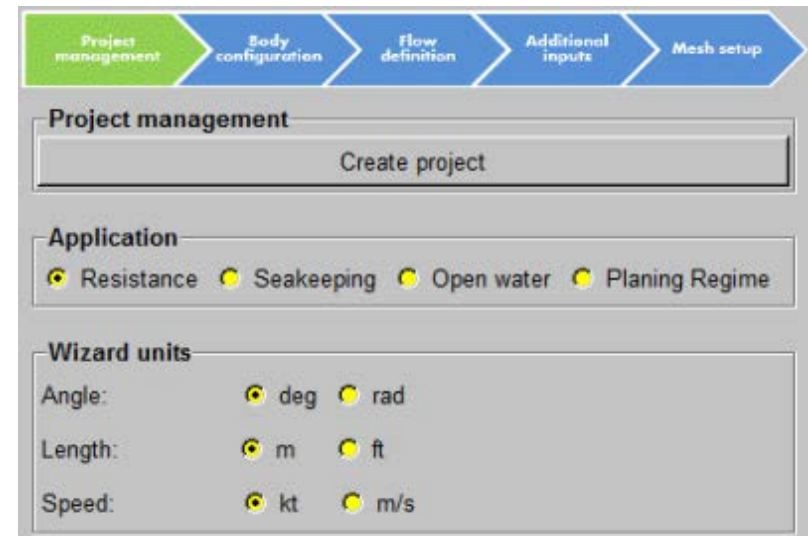


Productivity

# Workflow Automation

## NUMECA Integrated Software Environment for Marine Applications

-  Resistance
-  Seakeeping
-  Open-water
-  Planing regime
-  Sailing yacht VPP
-  Hydrofoil VPP

The Wizard interface shows a workflow process with five steps: Project management, Body configuration, Flow definition, Additional inputs, and Mesh setup. The 'Project management' section includes a 'Create project' button. The 'Application' section has radio buttons for Resistance, Seakeeping, Open water, and Planing Regime. The 'Wizard units' section has radio buttons for Angle (deg, rad), Length (m, ft), and Speed (kt, m/s).

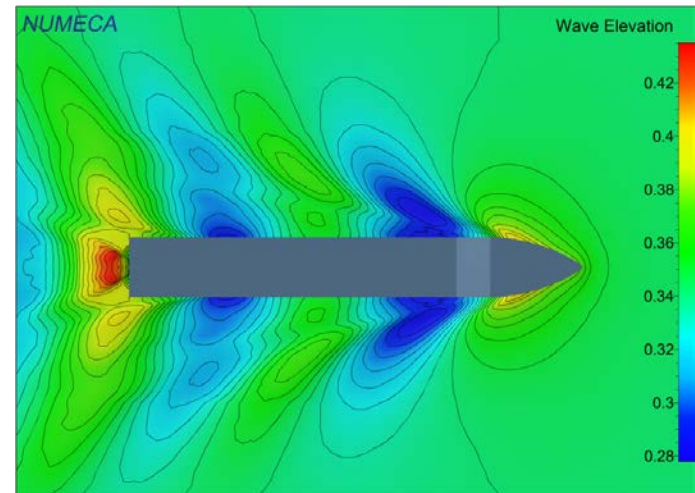
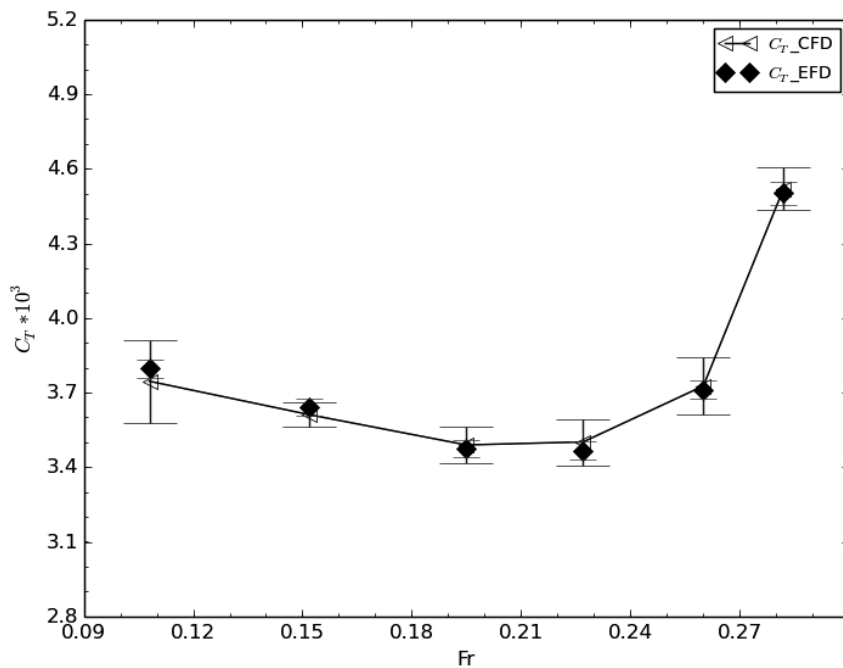


# NUMECA SOLUTIONS VALIDATIONS AND EXAMPLES

# Validation and examples

## Resistance: ship industry

KCS Tokyo Workshop 2015



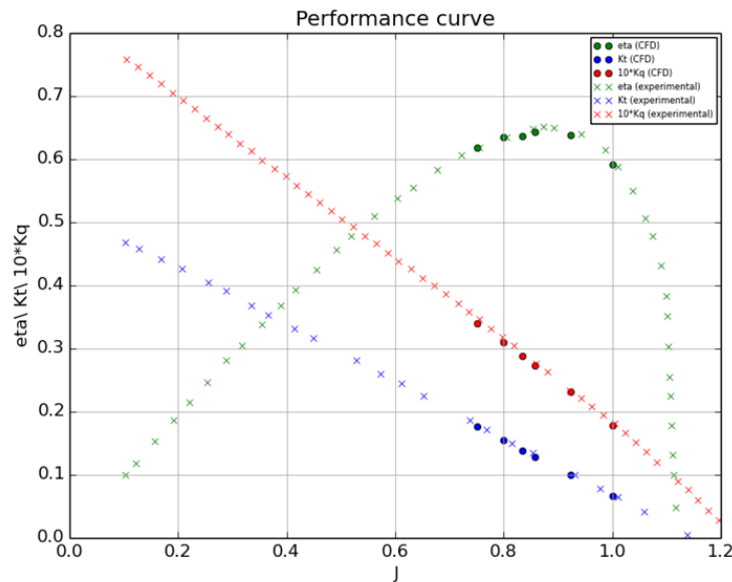
« FINE/Marine is the best CFD code to predict the wave pattern »



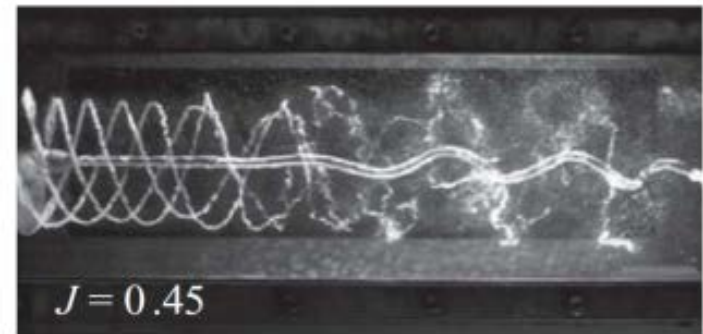
# Validation and examples

## Propellers

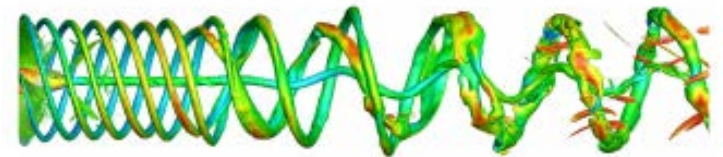
Comparison EFD Vs CFD: performance curve from DTMB 4419 propeller



Propeller simulation with DES model for wake destabilization capturing – OMAE 2015



(a) Experimental view (Fig. 8 in Felli et al. (2011))



**Thank you for your attention**  
**Questions?**

