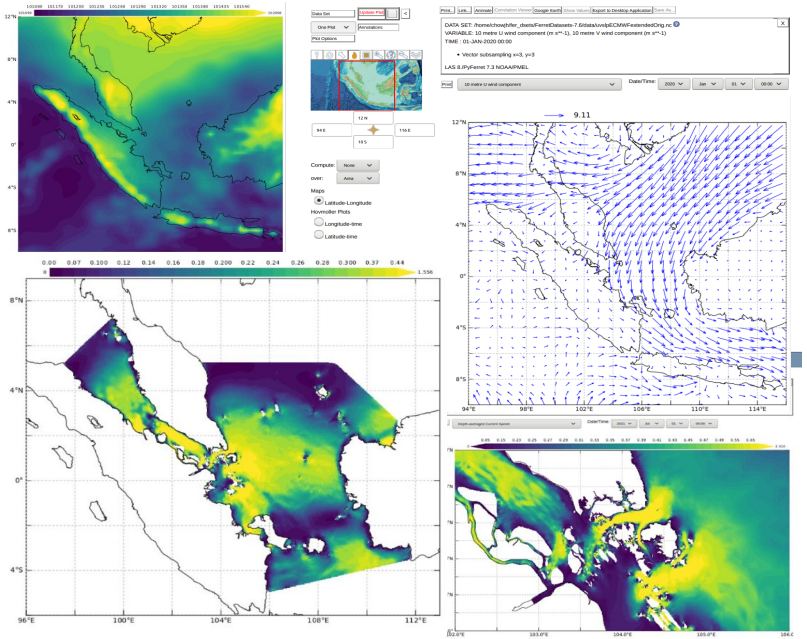
Digital Tools to Enhance Sustainable Performance of Vessels

Enabling Autonomous and Remotely Controlled Surface-Ship Operations

Digital Metocean

Digital Twinning of Operating Environment: accurate wind, wave, current and storm surge information to maritime stakeholders.

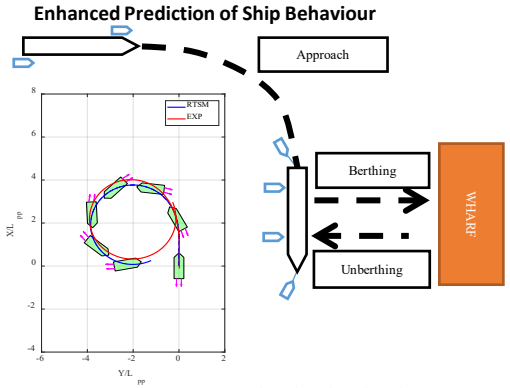
Wave Field Prediction through Advanced Sensing for optimal navigation in open seas.

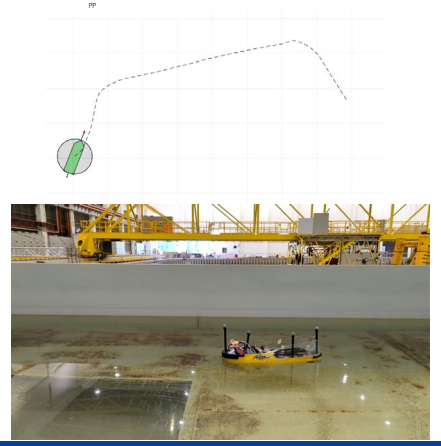


Ship Performance

Enhanced Prediction of Vessel Interactions:

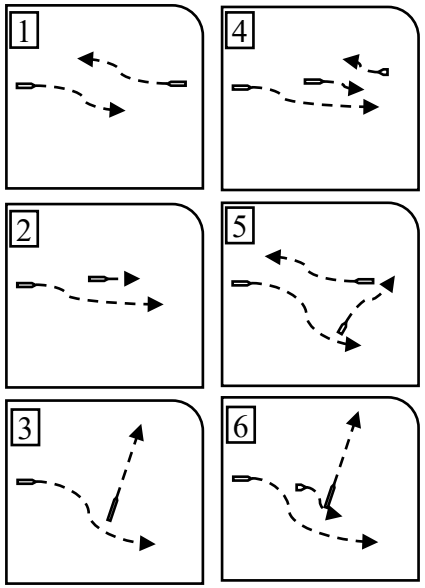
- Behavior & response of multiple vessels maneuvering in tight environments or critical scenarios.
- Cooperative or high-risk operations.





2-ship encounters:
1. Head on
2. Overtaking
3. Crossing

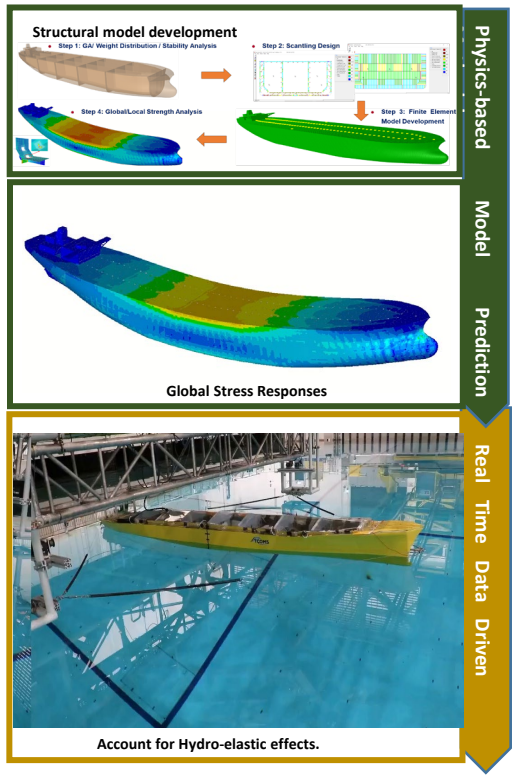
3-ship encounters:
4. Head on + overtaking
5. Head on + crossing
6. Overtaking + crossing



Structure Health Management

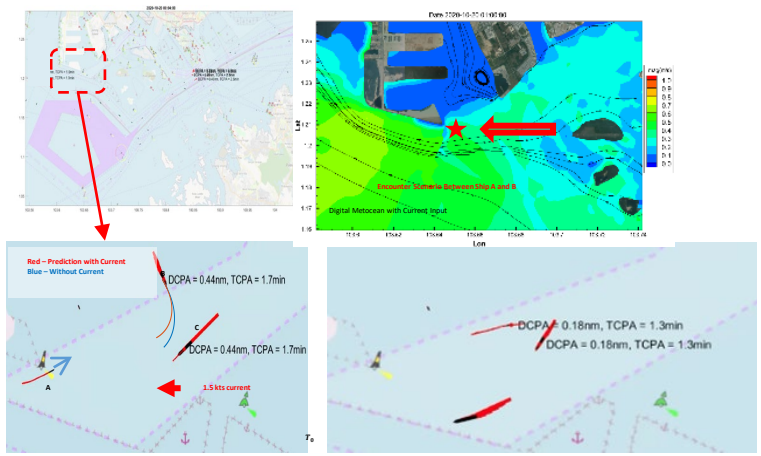
Digital Twinning of Ship Structure:

- Dynamic assessment of vessel's structural health.
- Smart management of inspection & maintenance cycles.

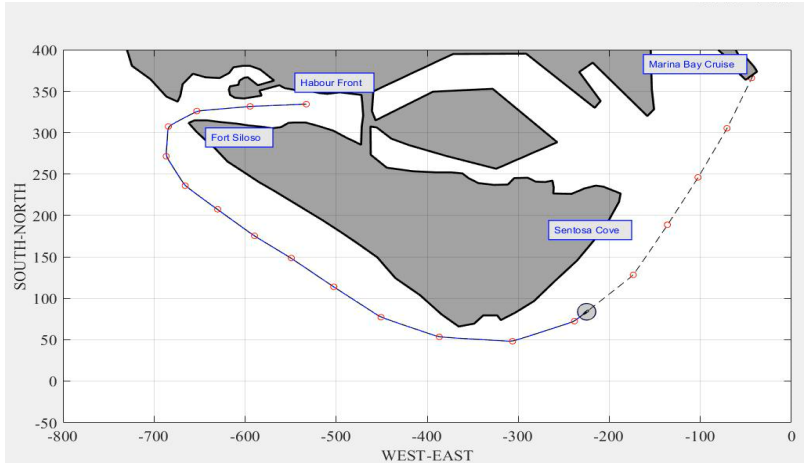


Smart Industry Applications

Smart Port Operations

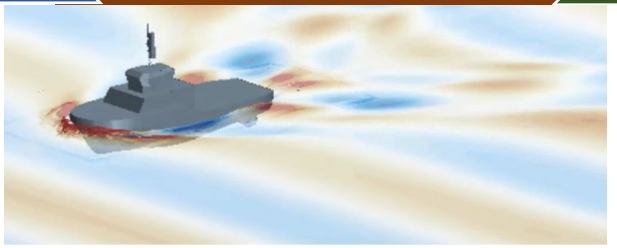


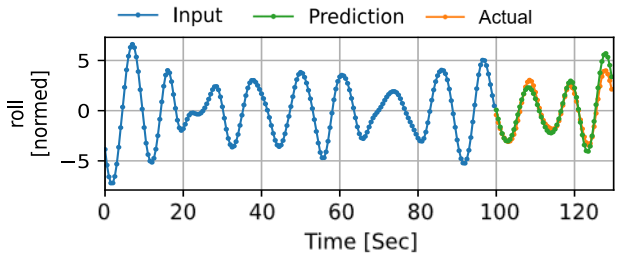
Safety of Navigation



Autonomous and Remote Operations

CEAOPS Capabilities

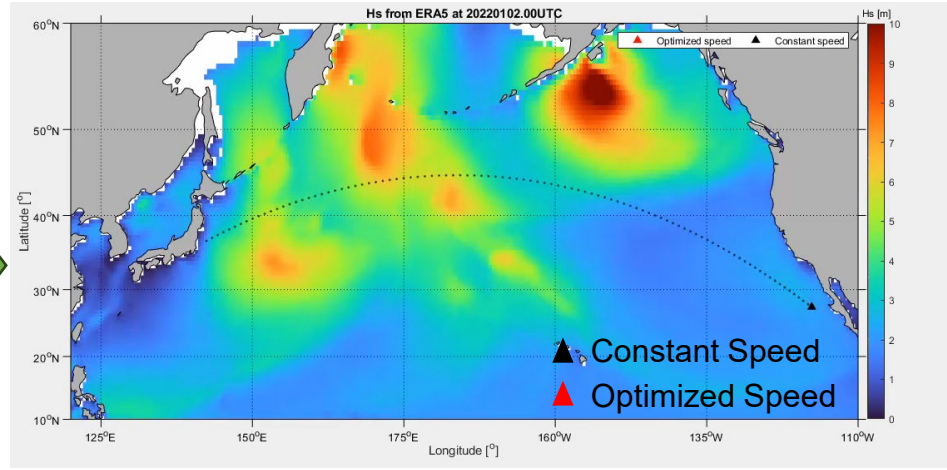




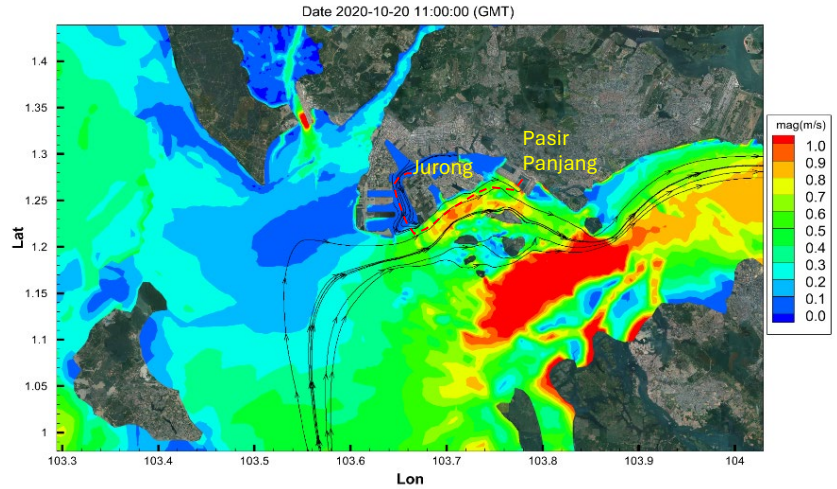
Vessel Response in Waves and Currents

Stress-Testing Smart Solutions

Green Shipping

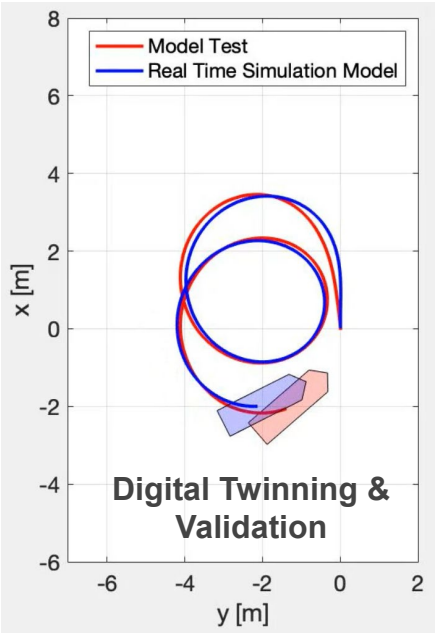


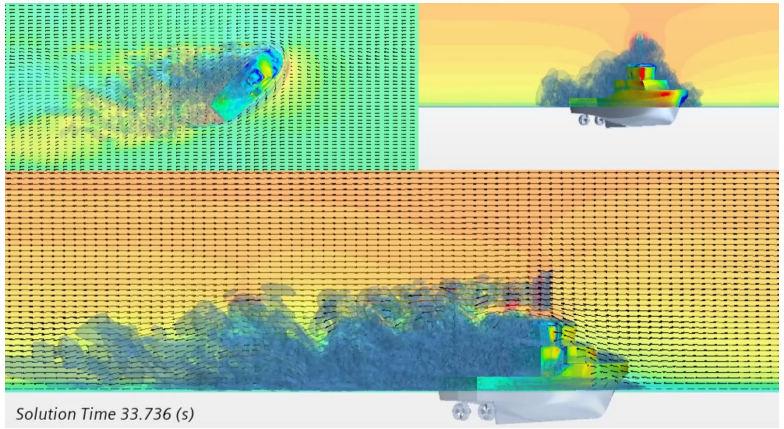
Voyage Optimization: Optimized Speed Profile to Avoid Harsh Weather Conditions



Transformation of Harbourcraft: Leveraging Tidal Currents for energy efficient eHC

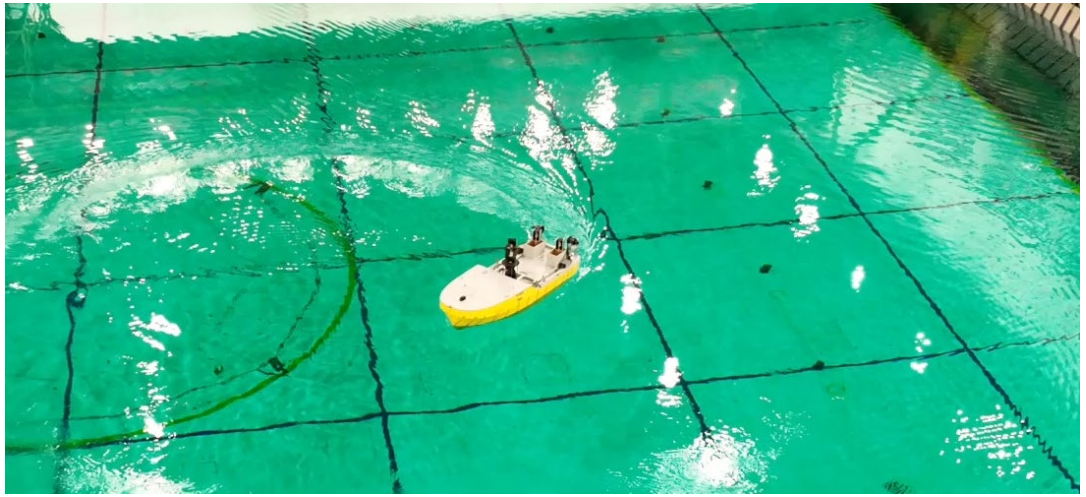
Stress-testing the Innovative Concepts





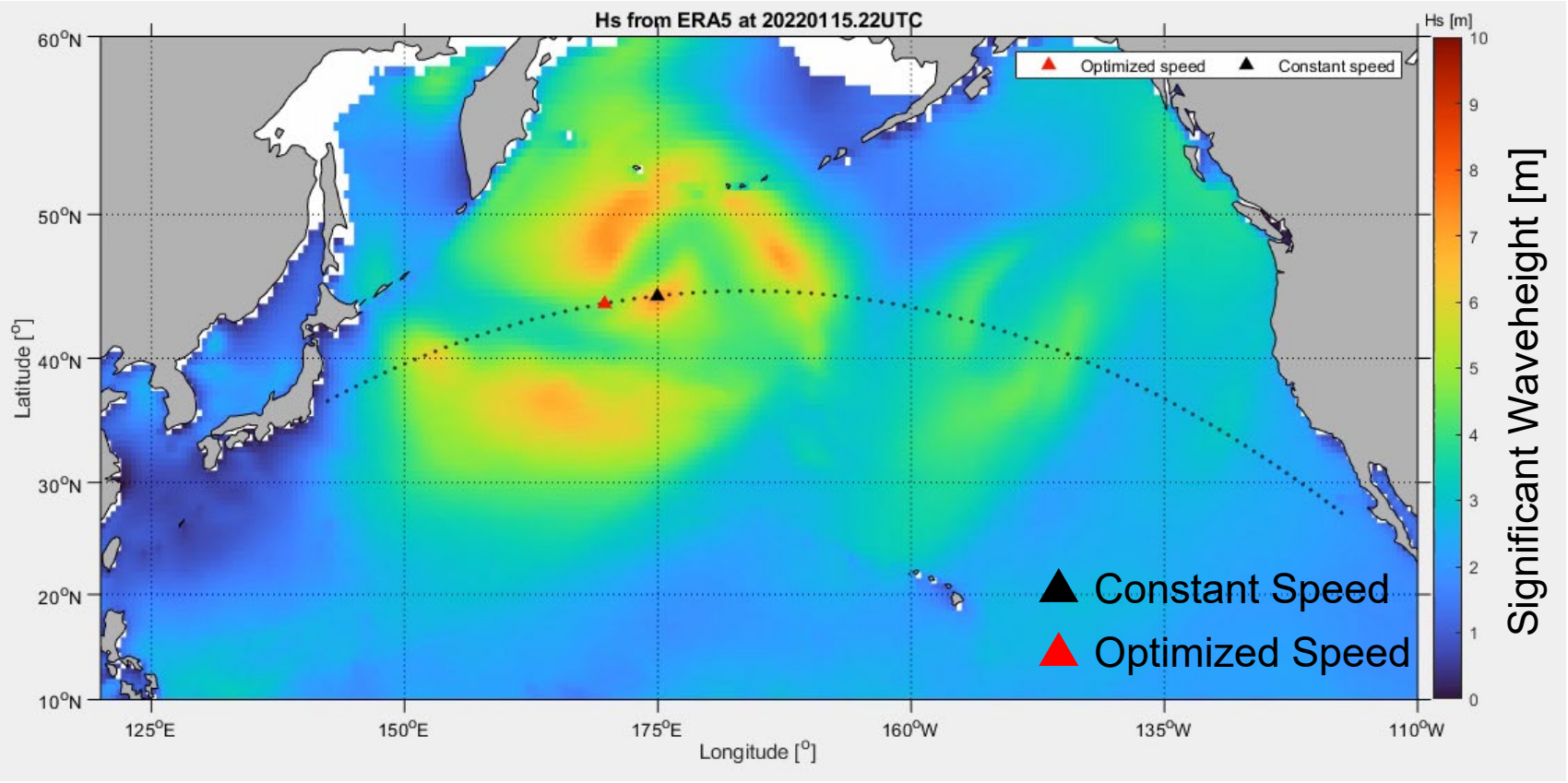
Wind Load Modelling

Apply Calculated Wind Loads to the Model



Cyber-Physical Modelling of Wind Loads

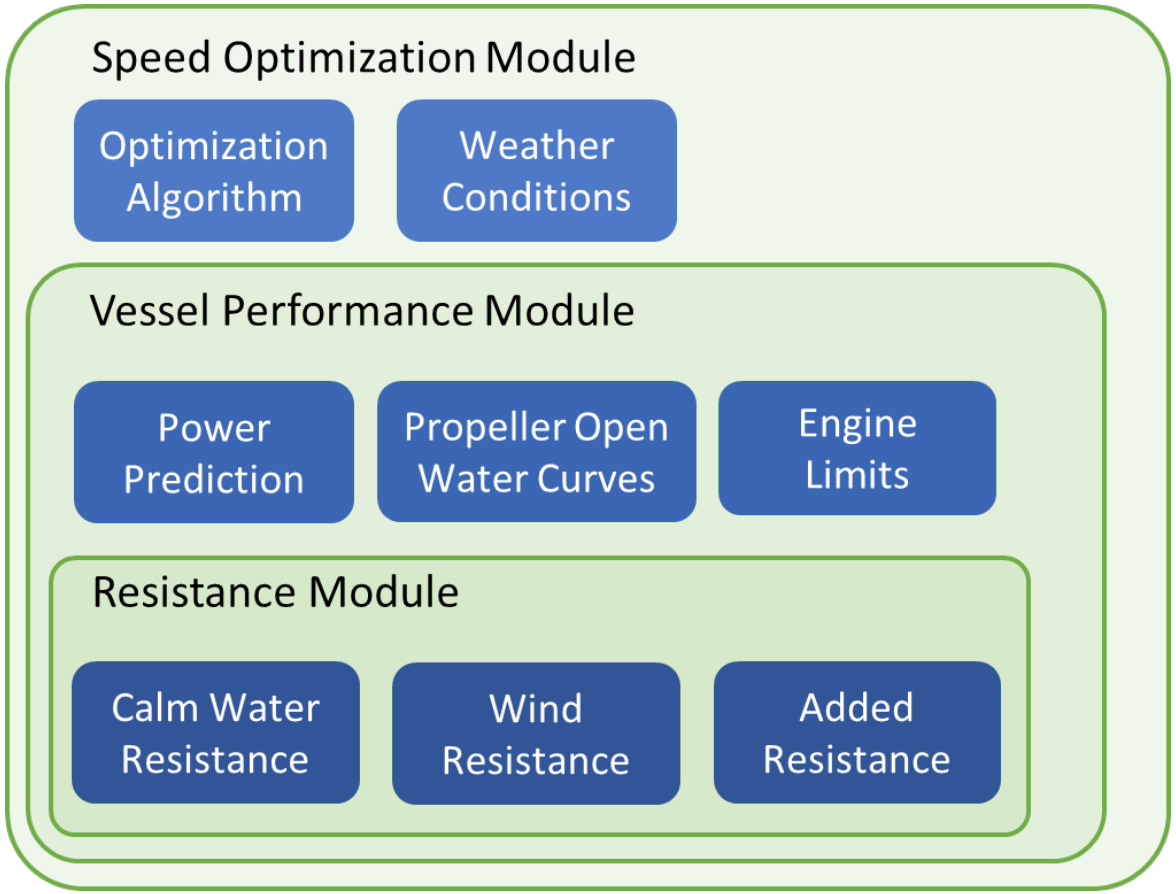
Fuel Savings through Speed Optimization to Avoid Rough Weather



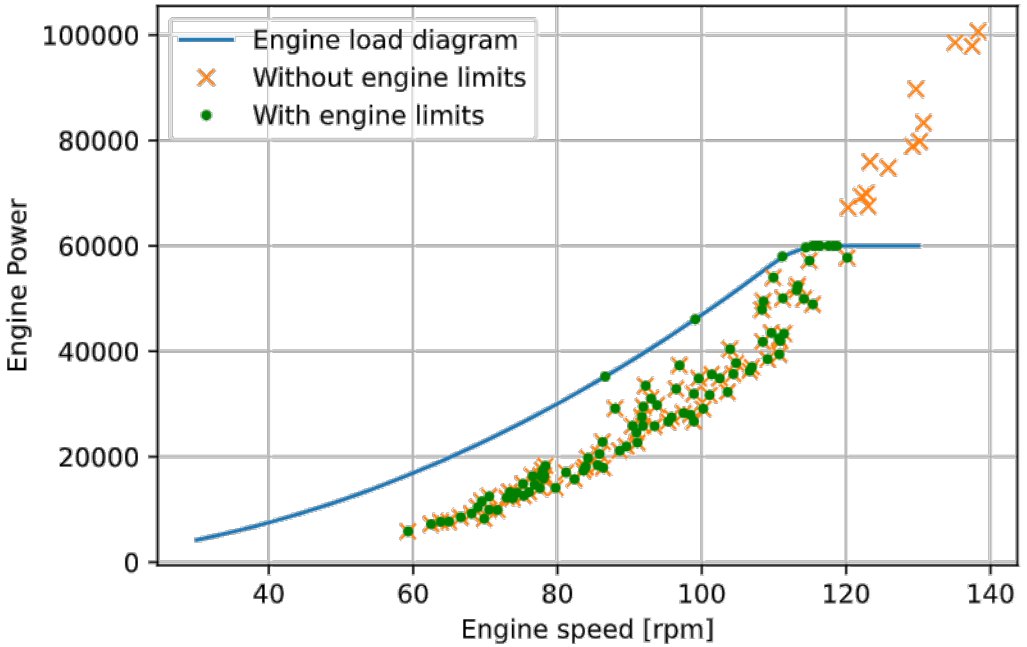
Optimized speed profile is able to avoid harsh weather conditions by speeding up and slowing down the ship along the way

Speed optimization leads to 11% lower fuel consumption compared to constant speed profile

Digital Twinning of Ships: A Requirement for Optimization

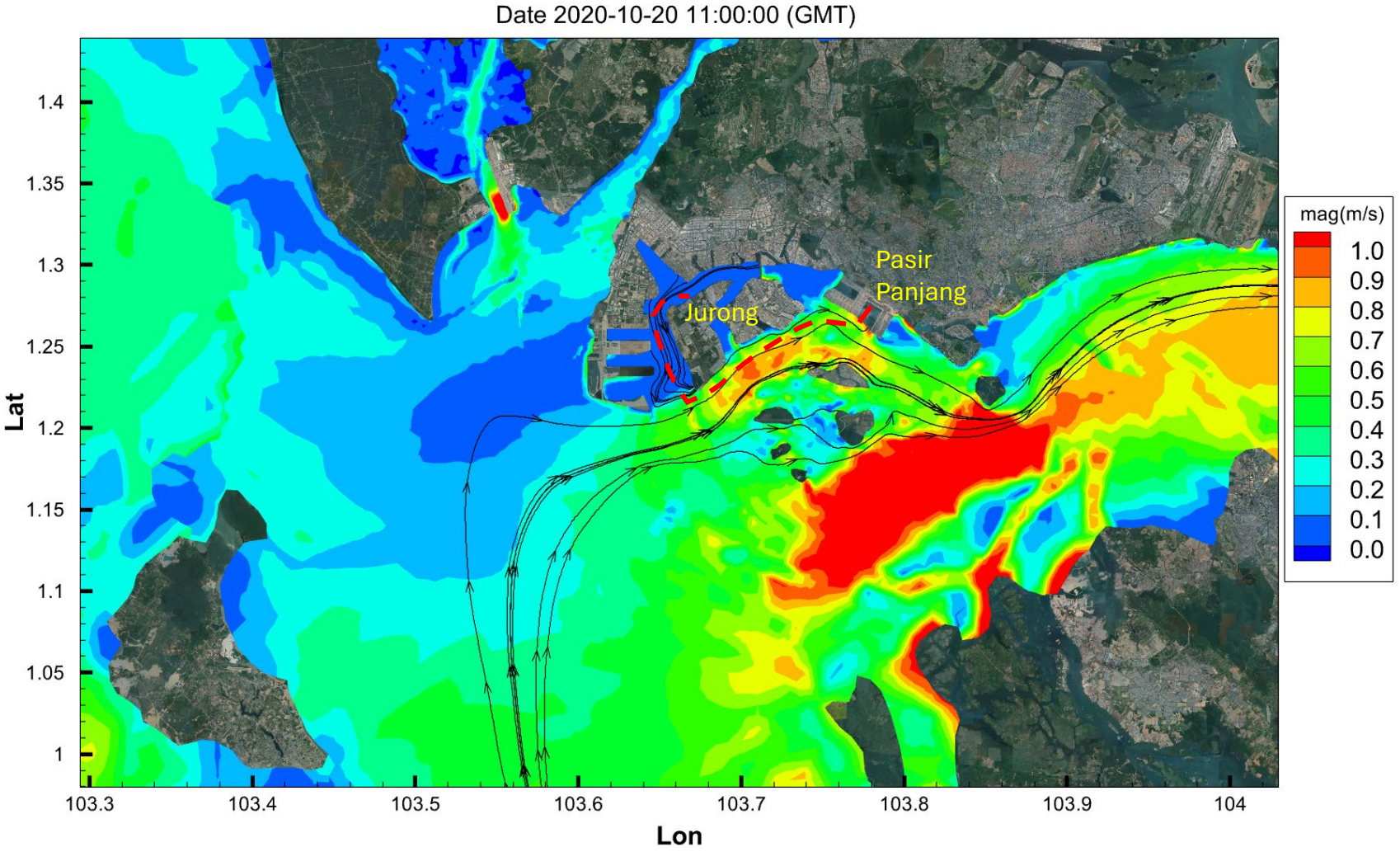


Engine power curve of a generic engine



Engine model for realistic speed prediction in different weather conditions

Fuel Savings by Leveraging Tidal Currents

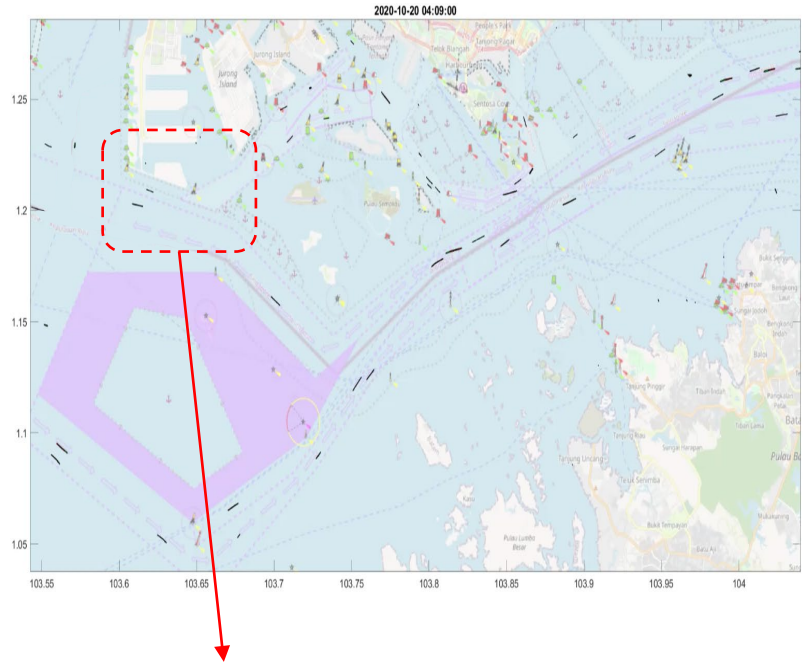


Pasir Panjang to Jurong	Jurong to Pasir Panjang
56.9% extra fuel required to go against the currents	34.9% fuel savings by sailing along the currents

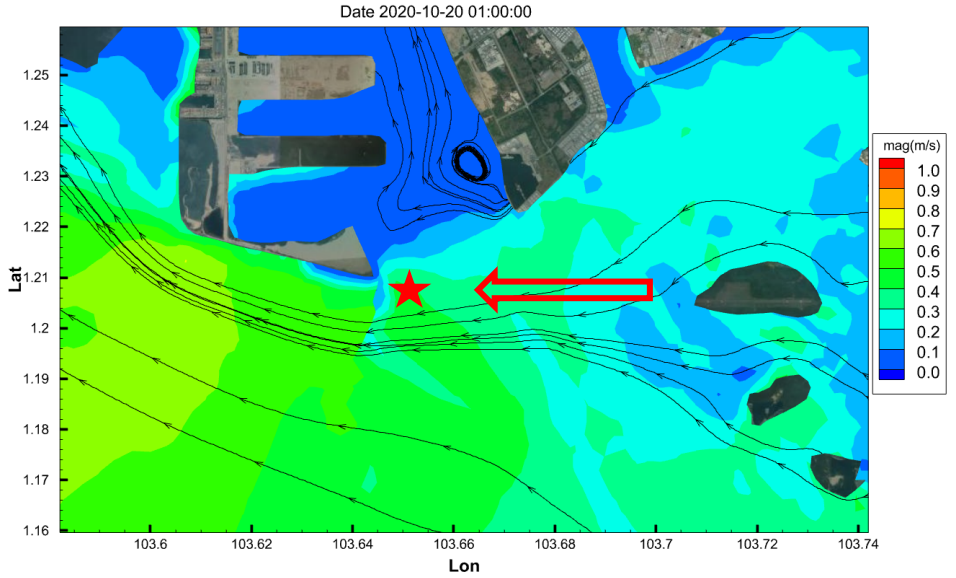
Currents are **strong** and **predictable** in Singapore port waters

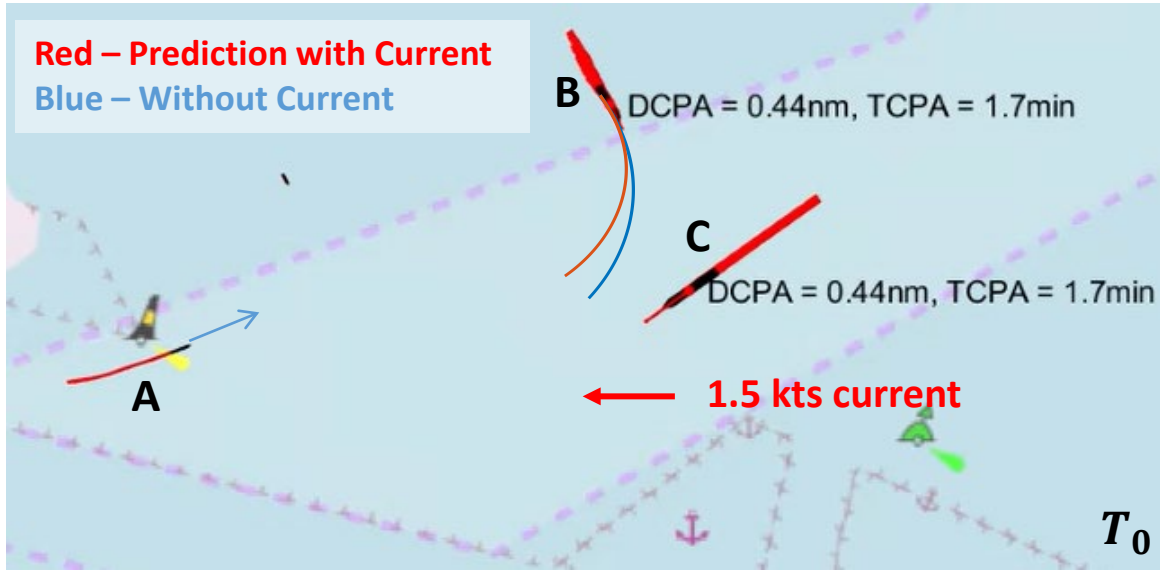
For Decarbonization and Efficient Operations of Harbourcrafts

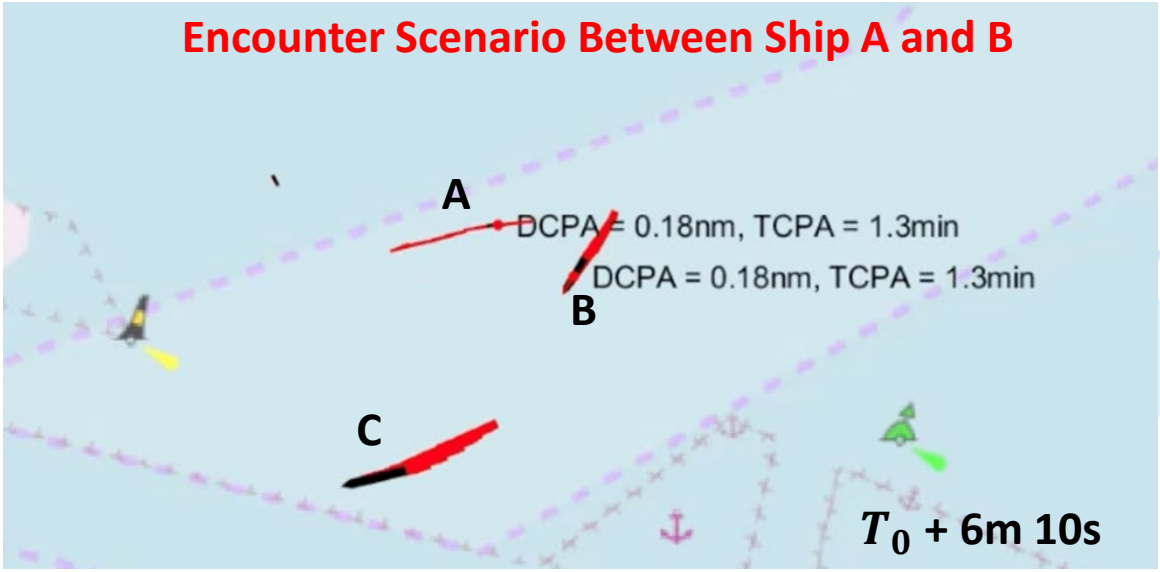
Vessel Traffic Control



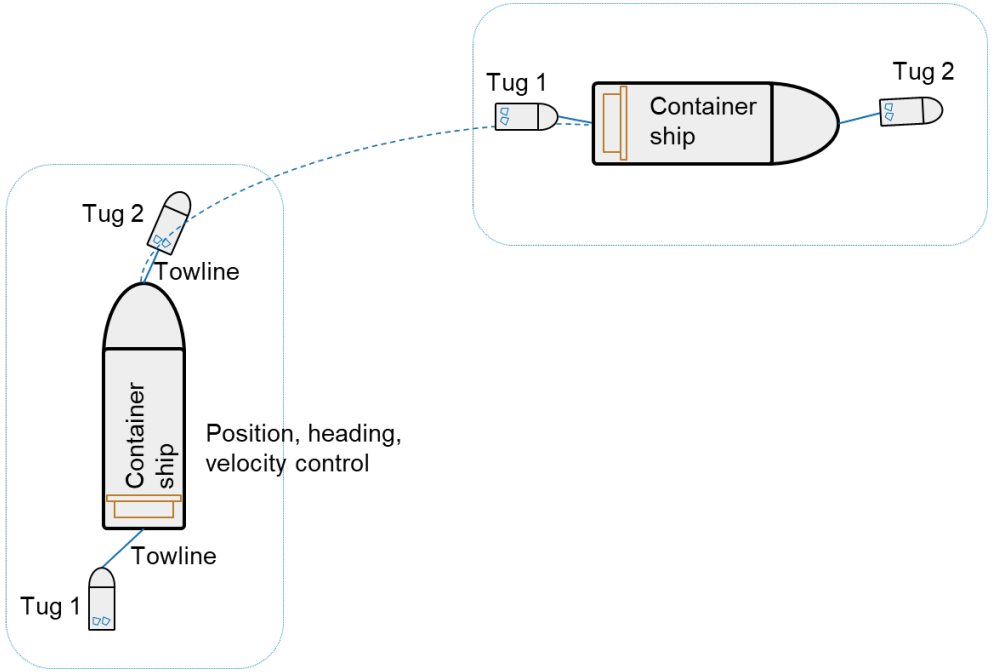
Digital Metocean with Current Input

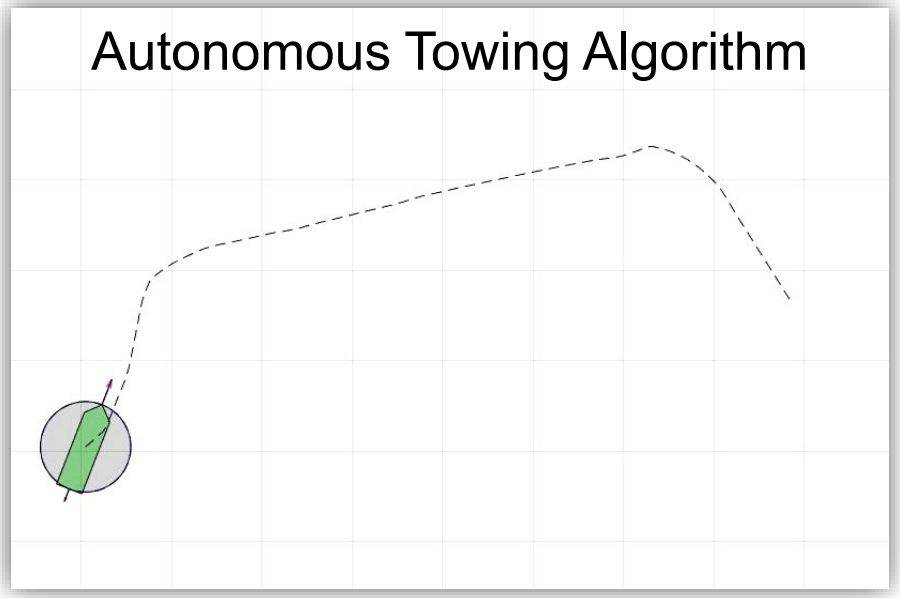


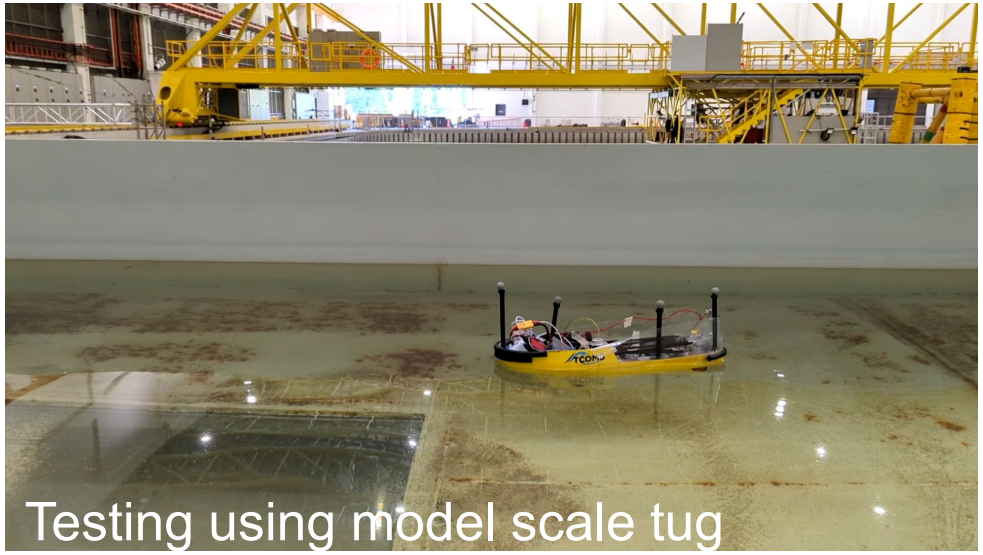




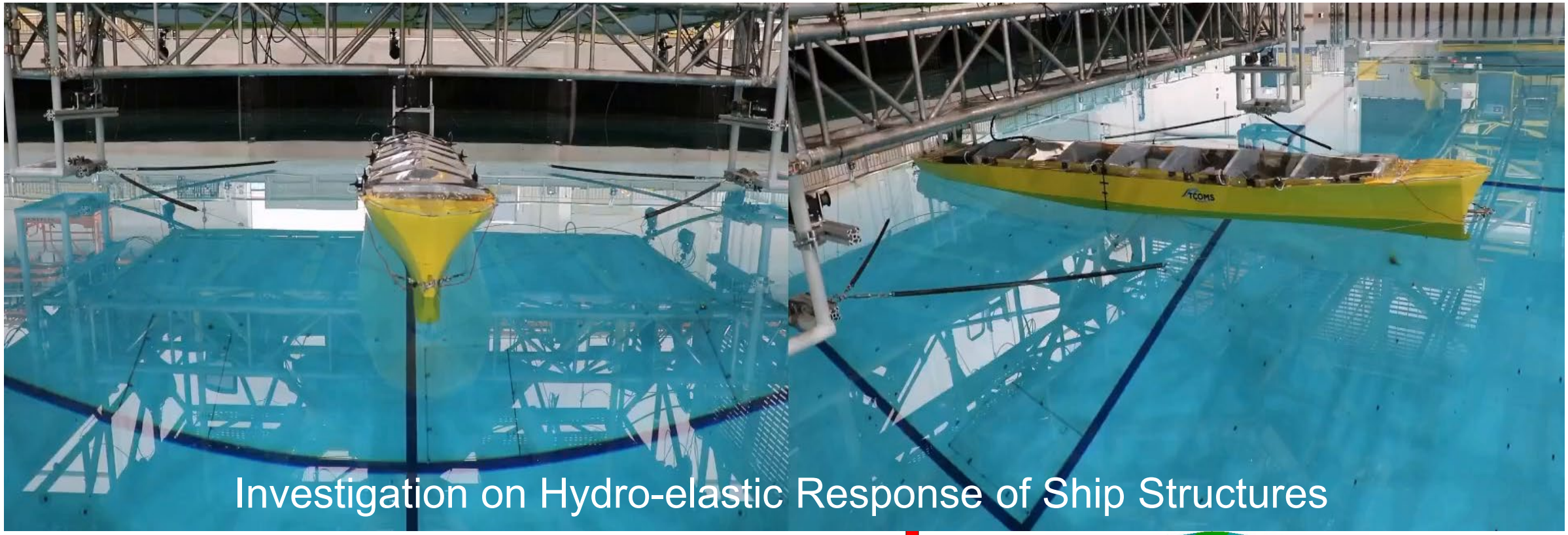
Autonomous Collaborative Tugging



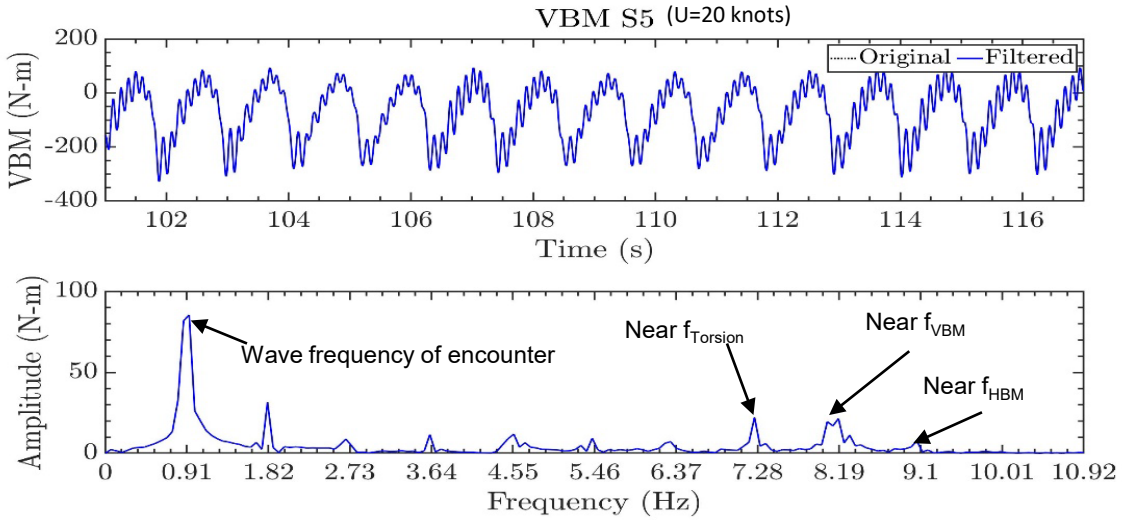


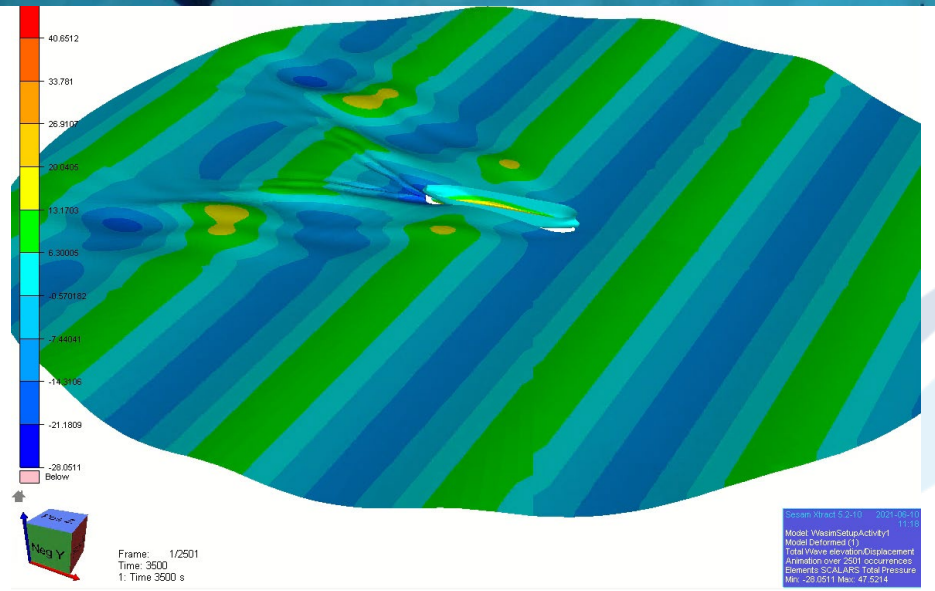

Testing using model scale tug

- Automated towing for improved port efficiency
- Reduced risks arising from human error
- Reduced manning onboard tugs



Investigation on Hydro-elastic Response of Ship Structures





Thank you

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