

WSOS 2024 Düsseldorf (31 May-1 June)

Youngrong Kim, Postdoc

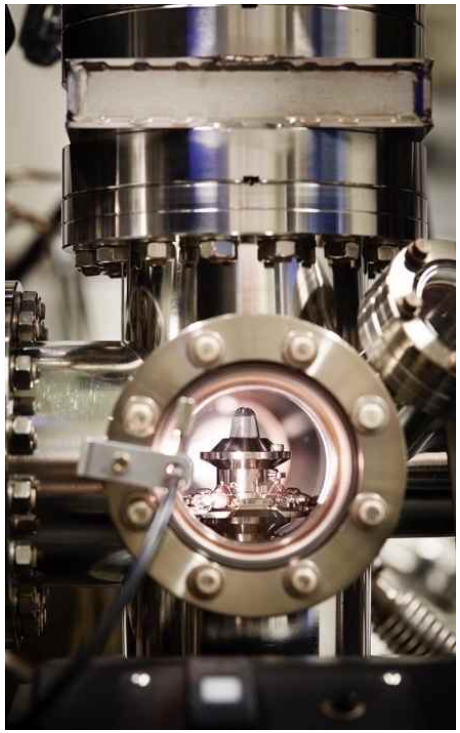
Jaseung Lee, Ph.D. student

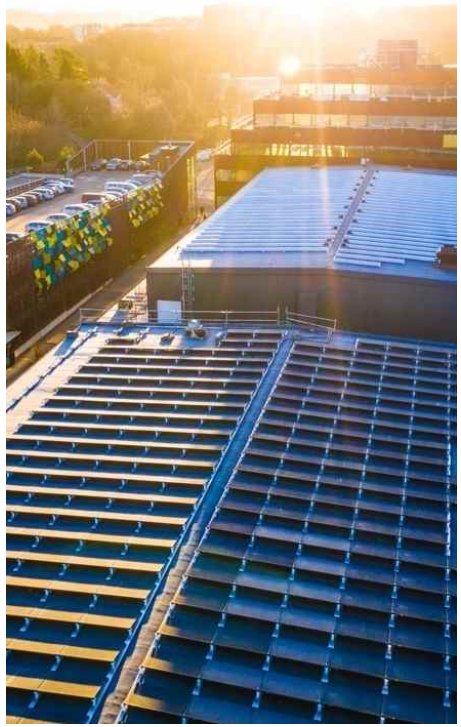
Department of Mechanics and Maritime Sciences

Introduction about Chalmers & M2 Department

2024-06-06









Chalmers University of Technology

- Based in Gothenburg, Sweden's west coast
- Conducts research and education in technology and natural science
- Offers education in engineering, natural sciences, shipping and architecture
- 10,000 students and 3,400 employees (1,025 Doctoral students)
- Founded in 1829







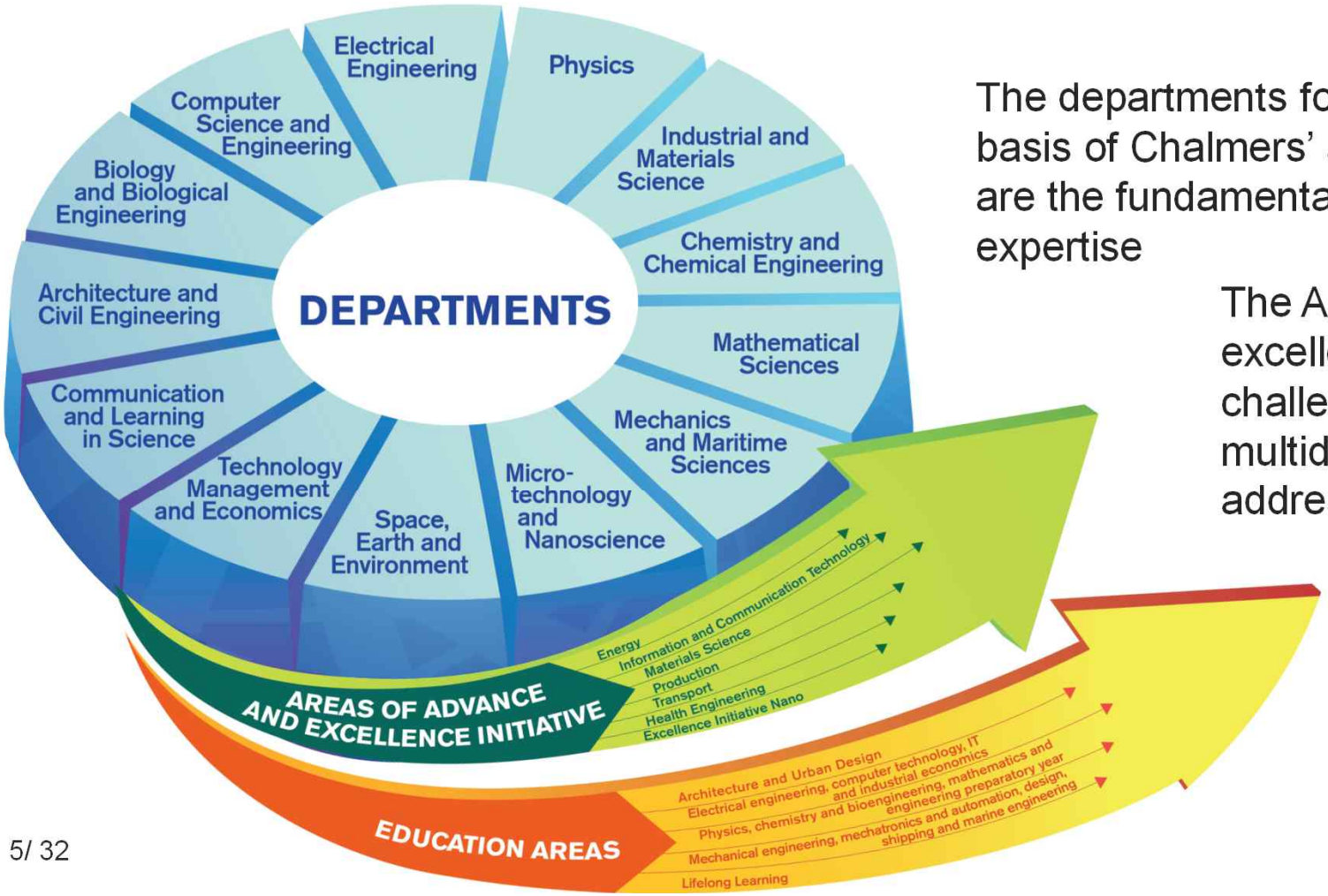
Campus areas

- Campus Johanneberg
- Campus Lindholmen
- Onsala Space Observatory

Chalmers' campuses aim to be inspiring creative environments that encourage people to thrive here.

In addition to research, study and office facilities, our campuses include some 80 startups and companies.

Chalmers' matrix organisation

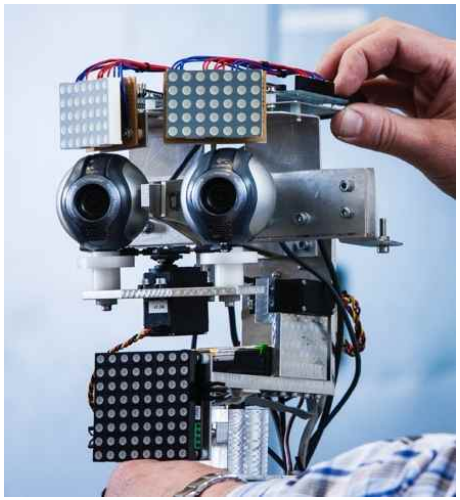


The departments form the organisational basis of Chalmers' academic operations and are the fundamental source for our scientific expertise

The Areas of Advance and excellence initiative deliver challenge-driven and multidisciplinary perspectives to address complex global issues

The Education Areas lead and develop Chalmers' educational programmes







Department of

Mechanics and Maritime Sciences

conducts fundamental and applied research in all modes of transport to achieve sustainable technology solutions.

Divisions:

Dynamics
Vehicle Safety
Combustion and Propulsion Systems
Maritime Studies
Marine Technology
Fluid Dynamics
Vehicle Engineering and Autonomous Systems (VEAS)

Introduction about Division of Maritime Studies

2024-06-06

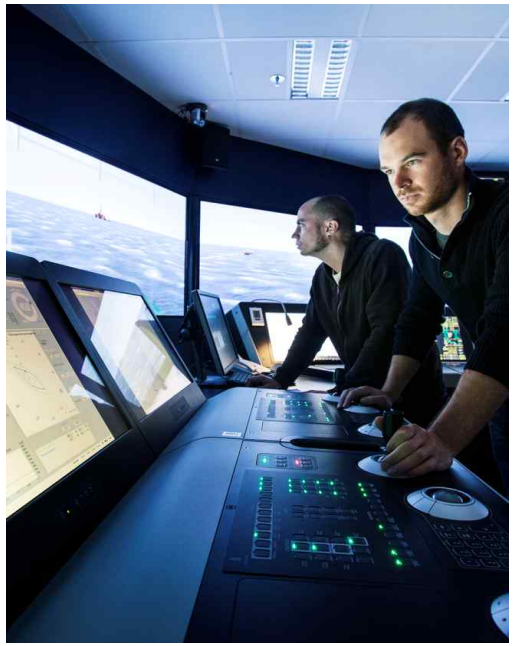
Division of Maritime Studies

One of Sweden's most extensive simulator center for navigation

- Full Mission Bridge Simulator
- Cargo Operations Studio
- Nautical operations studio
- GMDSS Simulator
- Engine Operations Simulator
- Bridge Operations Simulator
- Dynamic Positioning
- Seaman Online
- Driving simulator

- Connected to EMSN

(European Maritime Simulator Network)



Technical Operations and Management & Nautical Studies

Education groups

- Mechanical engineering
- Cargo operations and ship stability
- Logistics, economy and chartering
- Navigation
- Safety
- Leadership

Maritime Environmental Sciences

Research groups

- Environmental impacts from shipping
- Emissions to air and water
- Future marine fuels
- Ship antifouling
- Waste emissions
- Maritime Human Factors (Nautical Studies)

People in Maritime Environmental Sciences Unit



Kent Salo,
Senior Lecturer
and head of Unit



Ida-Maja Hassellöv
Professor



Maria Grahn,
Associate
professor



Lena Granhag
Assoc Professor



Erik Ytreberg
Senior Researcher



Selma Brynolf,
Researcher



Maria Lagerström
Researcher



Julia Hansson,
Researcher,
Chalmers & IVL

Maritime Environmental Sciences
: Different aspects of environmental impact from shipping

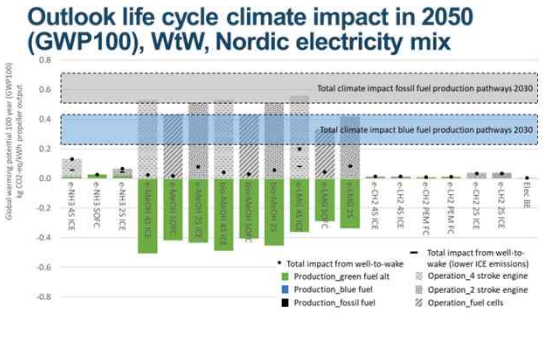
Research field

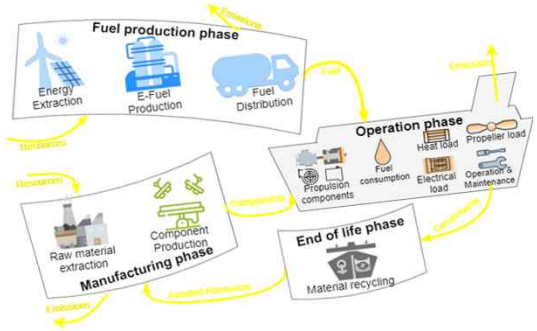
- Future Fuels and Propulsion Technologies
- Sustainable Antifouling Strategies
- Holistic Assessment of Shipping

+ 6 postdocs, 8 Ph.D. students

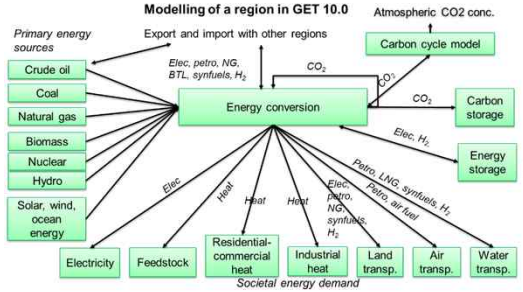
Future Fuels and Propulsion Technologies

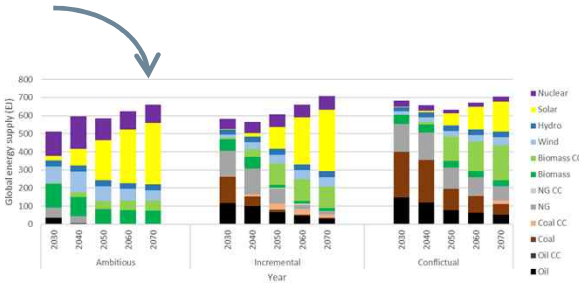
LIFE CYCLE ASSESSMENT AND MULTI-CRITERIA ASSESSMENT



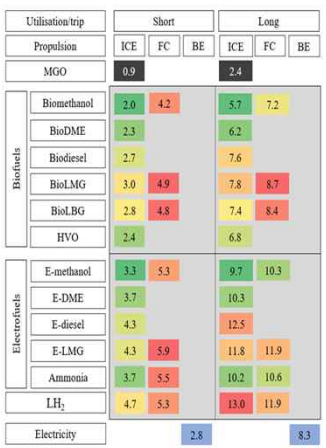


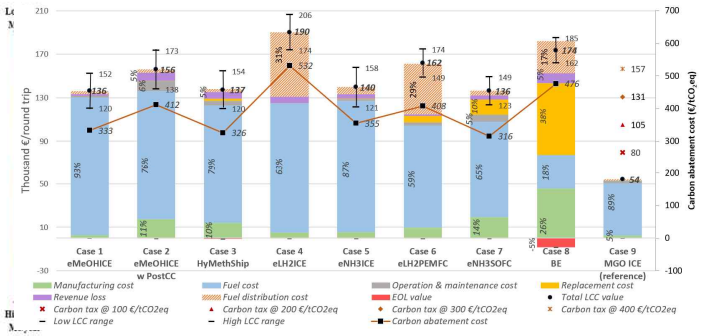
GLOBAL ENERGY SYSTEM MODELLING AND SCENARIOS



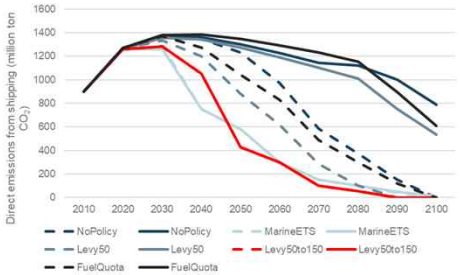


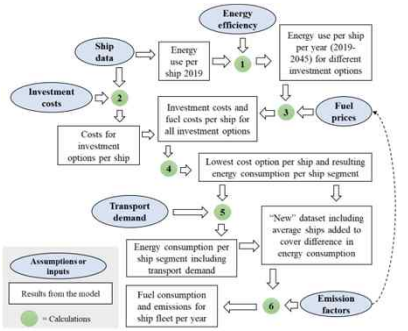
TECHNO-ECONOMIC ASSESSMENTS





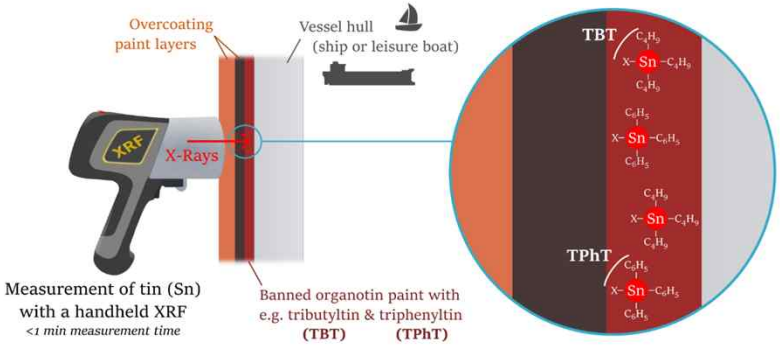
ASSESSMENT OF POLICES AND MEASURES FOR REDUCING CLIMATE IMPACT OF TRANSPORT



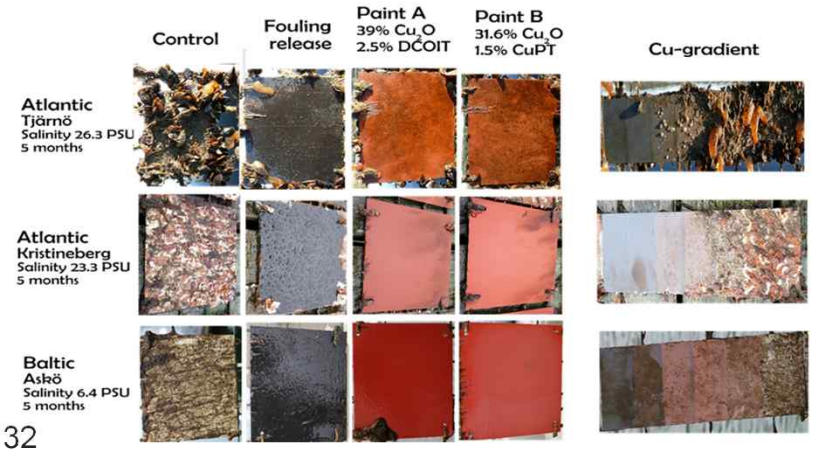


Sustainable Antifouling Strategies

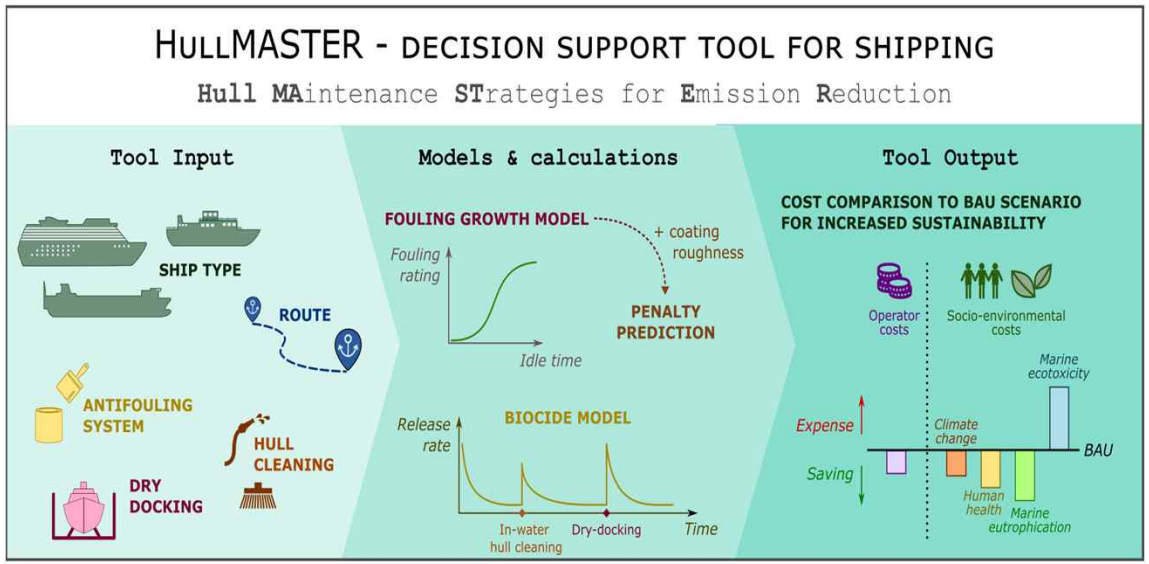
ANALYSING BANNED ORGANOTIN COATINGS & BIOCIDES RELEASE



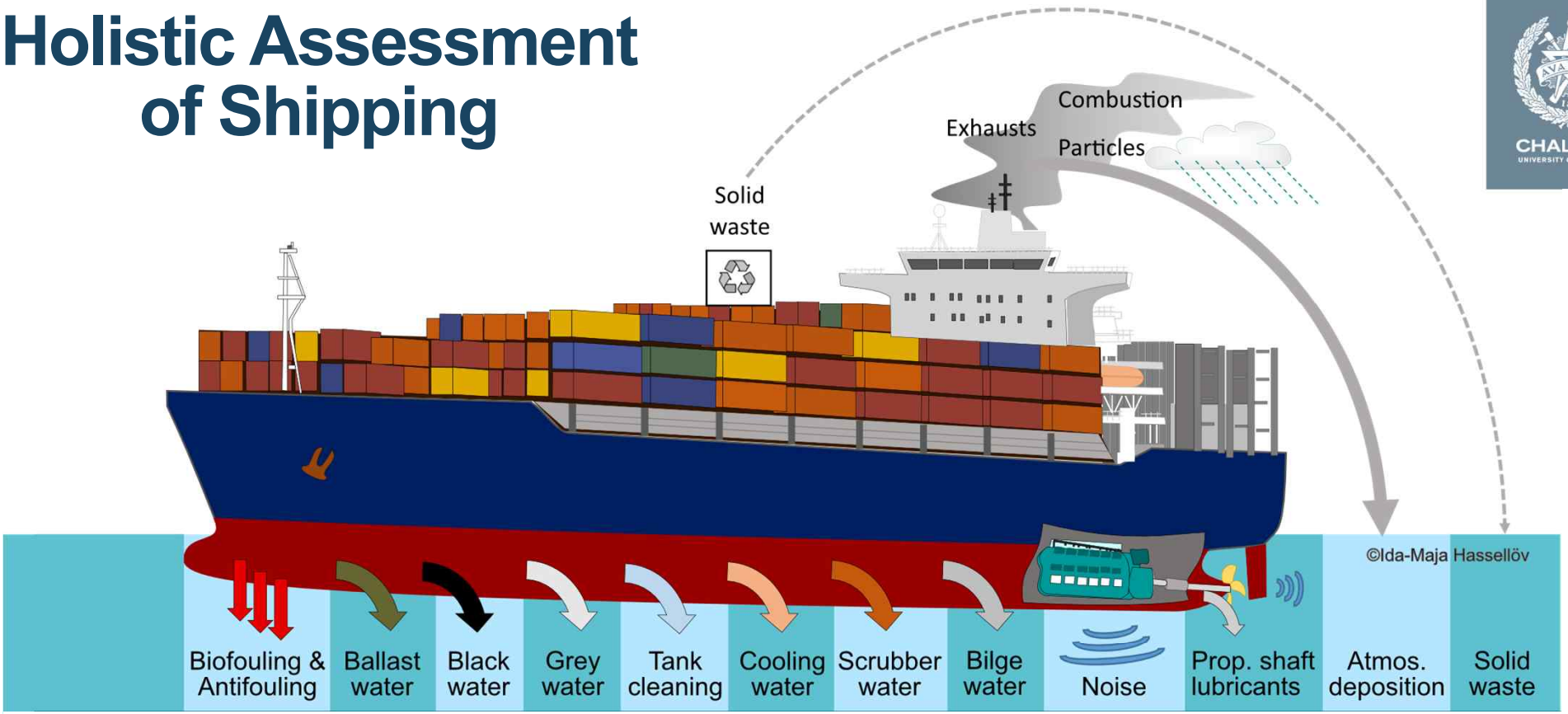
ANTIFOULING COATINGS EFFICACY (INC, MONITORING INVASIVE SPECIES)



DECISION SUPPORT TOOL REGARDING SUSTAINABLE ANTIFOULING STRATEGIES



Holistic Assessment of Shipping



Nutrients	**Hazardous substances**	**Acidifying substances**	**Invasive species**	**Marine liter**	**Underwater noise**

Introduction about Youngrong's Research Topics

2024-06-06

Ph.D. research at NTNU – CLIMMS project (2020-2023)

Modeling Operational Performance for the Global Fleet & Application of an Energy Saving Measure

Industrial partners (**9 Shipping companies**)

HÖEGH AUTOLINERS · Solvang ASA · GRIEG STAR · Wilh. Wilhelmsen · KRISTIAN GERHARD JEBSEN SKIPSREDERI (PART OF THE KRISTIAN GERHARD JEBSEN GROUP) · Torvald Klaveness · ODFJELL

IHS Seaweb database

IHS Markit

ECMWF*

Norsatellite 1,2

Ship operation data (**15s~15m** interval)

Ship information (**76,937** ships)

Global Weather data

AIS data (**50,000** ships)

Base Station

Satellite gateway

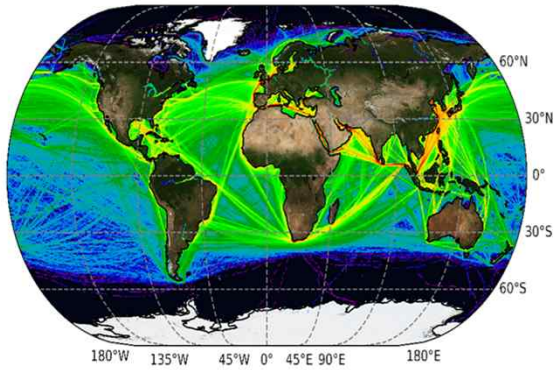
CLIMMS

NTNU center

MariTEAM model

Global emission platforms

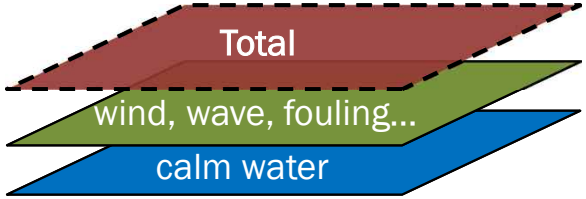
+ Greenshipping technologies



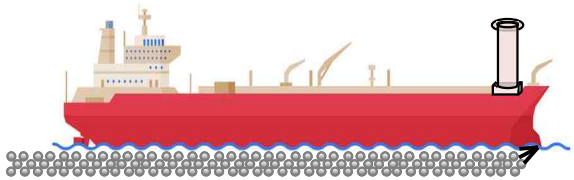
* European Centre for Medium-Range Weather Forecasts

Ph.D. research at NTNU – CLIMMS project (2020-2023)

Modeling Operational Performance for the Global Fleet & Application of an Energy Saving Measure

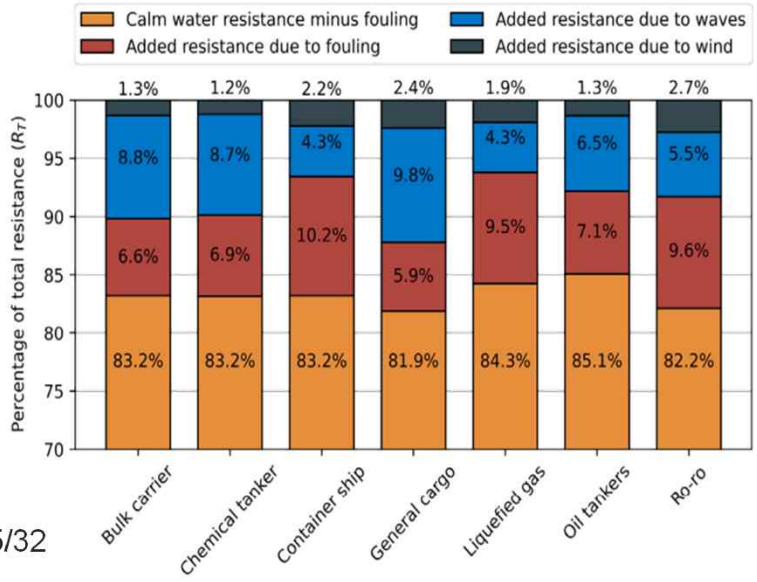


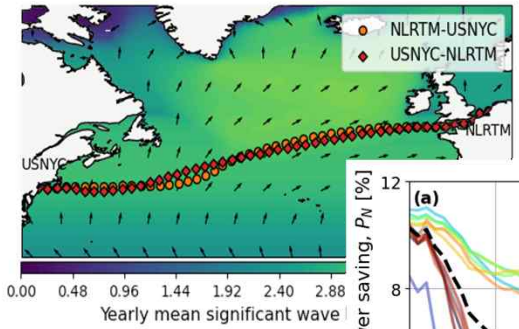
Fleet Resistance Estimation Model



Fleet Energy Saving Measure

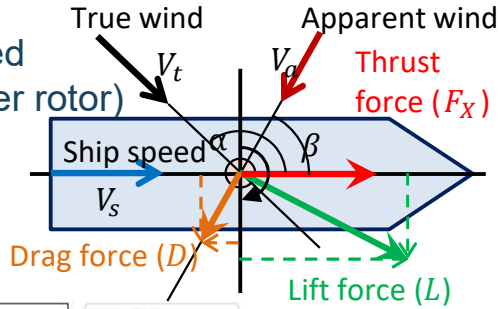
$$R_{Total} = R_{calm} + R_{wind} + R_{waves} + R_{fouling} + \ldots$$

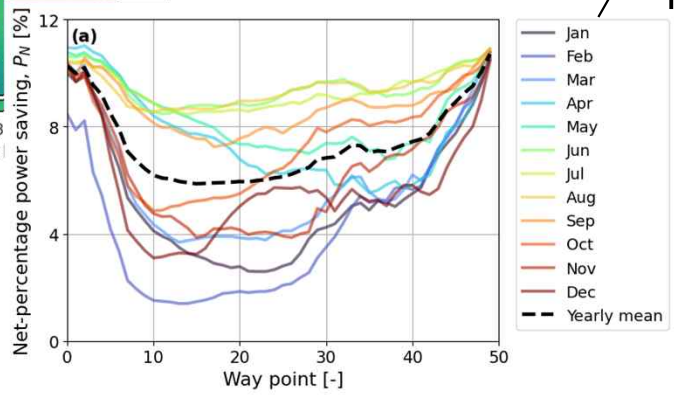




Air lubrication system

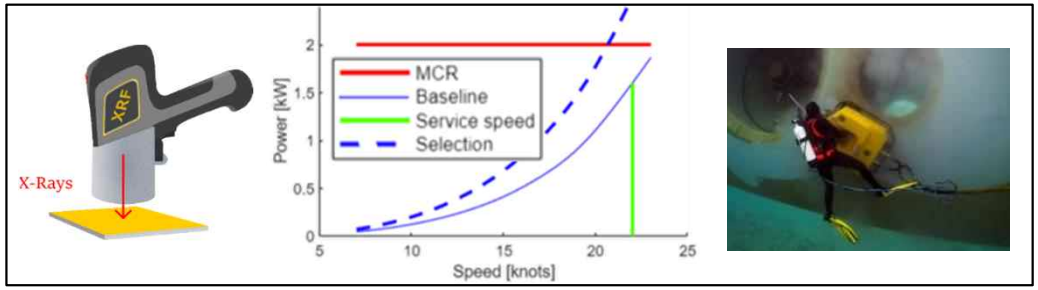
Wind assisted propulsion (Flettner rotor)





Postdoc research at Chalmers – HÅLL2 project (2023-present)

Sustainable hull maintenance strategies





Antifouling Efficacy Field test

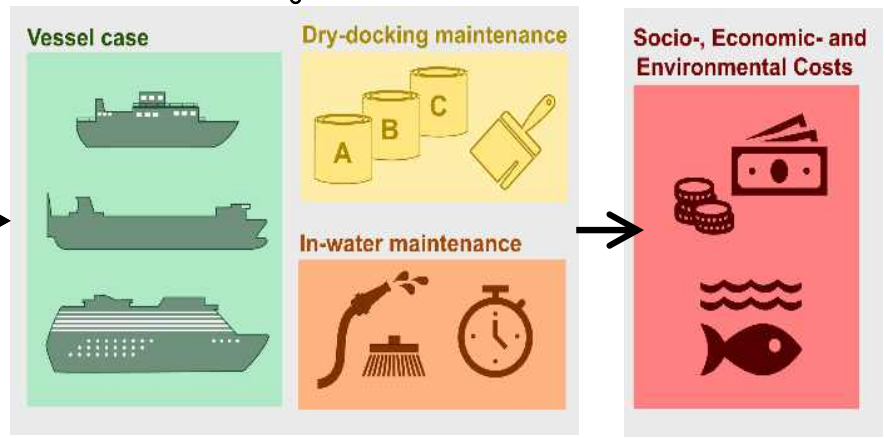


Ship information

Biocide release measurements

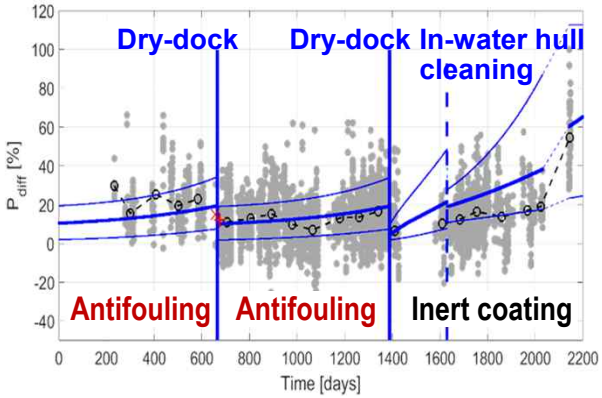
Ship performance estimation

Economic estimates from industry



Output:

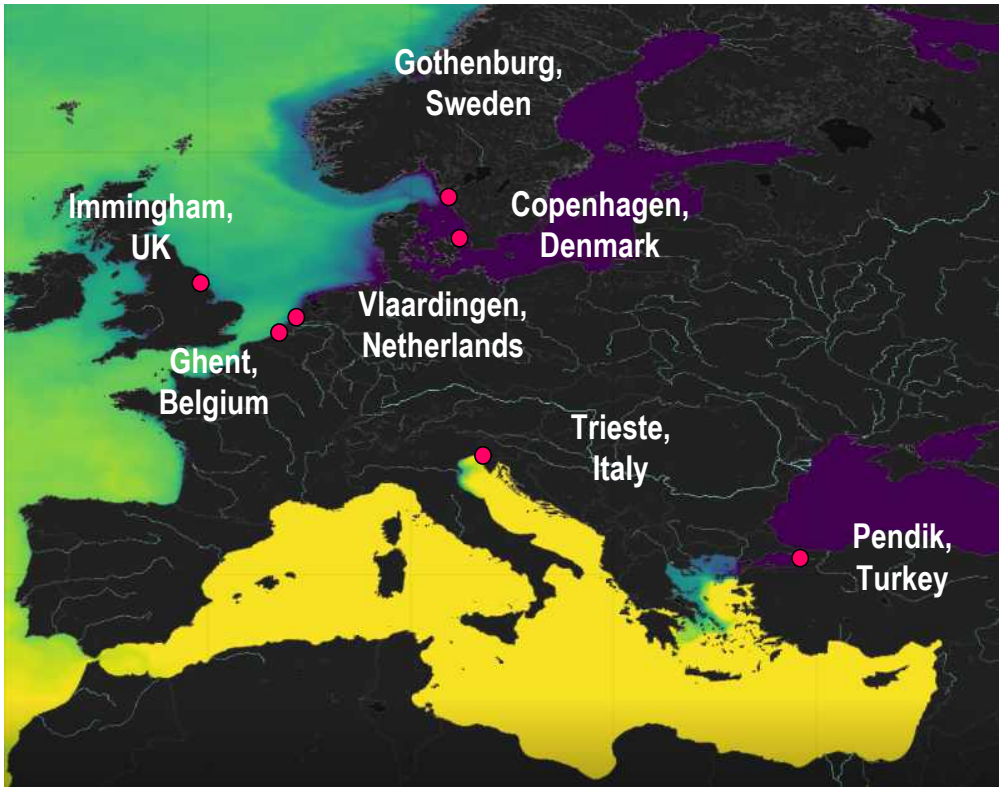
- *Socio-, Economic-, Environmental cost*
- *Optimized hull maintenance strategy*



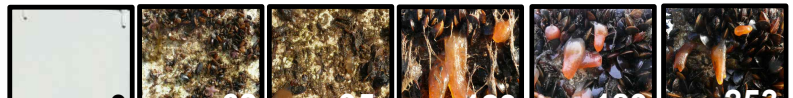
Hull Maintenance Decision Support Tool (HullMASTER)

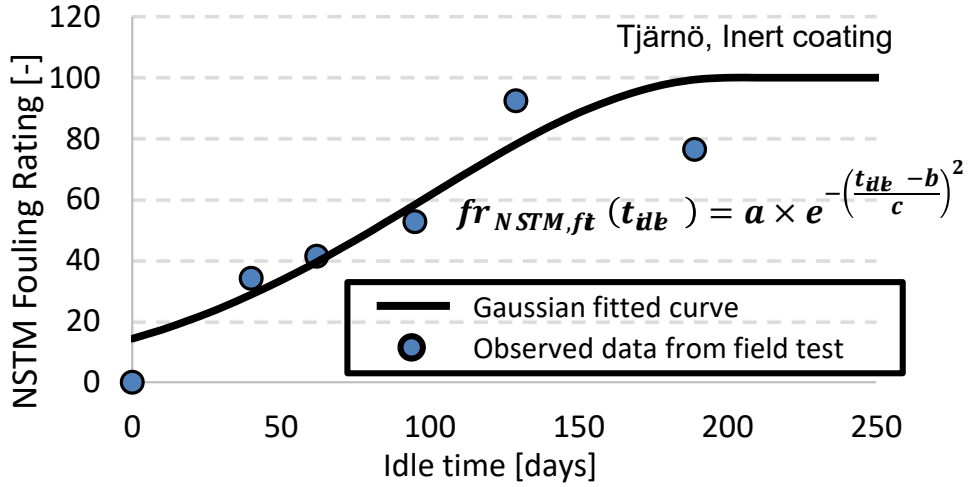
Postdoc research at Chalmers – HÅLL2 project (2023-present)

Sustainable hull maintenance strategies



Field tests at 7 Port terminals in Europe in collaboration with DFDS



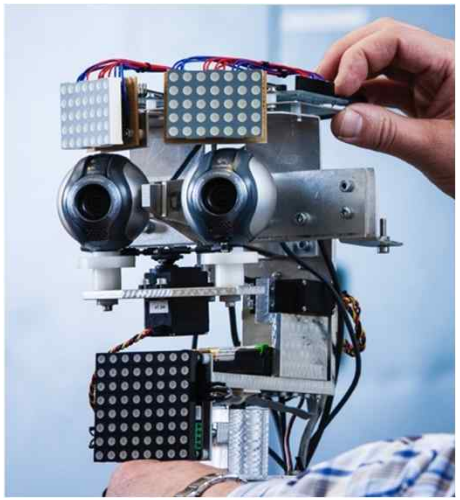




Introduction about Division of Marine Technology

2024-06-06







Department of

Mechanics and Maritime Sciences

conducts fundamental and applied research in all modes of transport to achieve sustainable technology solutions.

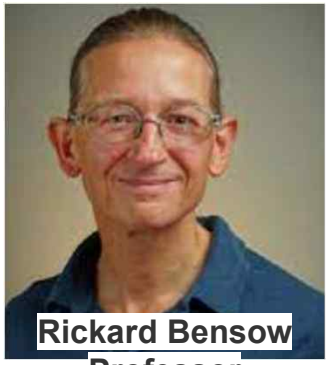
Divisions:

Dynamics
Vehicle Safety
Combustion and Propulsion Systems
Marine Technology
Maritime Studies
Fluid Dynamics
Vehicle Engineering and Autonomous Systems (VEAS)

People in Marine Technology



Jonas Ringsberg
Head of division



Rickard Bensow
Professor



Arash Eslamdoost
Associate Professor



Wengang Mao
Professor



Martin Schreuder
Senior Lecturer



Per Hogström
Senior Lecturer



Huadong Yao
Professor



Zhiyuan Li
Researcher

Research field

- Flow-induced noise using acoustic analogy, CFD & FEM
- Fatigue and reliability of marine structures
- Autonomous shipping
- Statistical modeling of hydrodynamic loads
- Ship weather routing and voyage optimization for energy-efficient shipping
- Propulsor-Hull Interaction
- Waterjet Propulsion
- Numerical simulation of ship collisions
- Sinking/capsize sequence of a damaged ship
- Wave loads and seakeeping and Stability & design basis of marine structures

Research in Marine Technology

Ship design | Marine structures | Hydrodynamics | Security & reliability | Maritime operations

RESHIP (2022-2025) Energy saving solutions for newbuilds and retrofits in marine and inland waterways, **hydrogen-compatible energy saving devices** (ESD)

GEMINI (2023-2026) GEneric Multidiscaplinary optimization for sail INstallation on **wind-assisted ships**

Artificial intelligence for enhanced **hydraulic turbine lifetime** & **Hydropower operation** and lifetime analysis (2023-2027)

Safe and Sustainable Sea Transport Through Development of Test Method for **Foiling Craft** (2024-2025)

 Source: https://research.chalmers.se

Research in Marine Technology

Ship design | Marine structures | Hydrodynamics | Security & reliability | Maritime operations

Prediction methods for **underwater noise radiated noise** from ships (2022-2024)

PINNs -- Multi-Fidelity Physics-Informed **Neural Network** to Solve Partial Differential Equations (2023-2027)

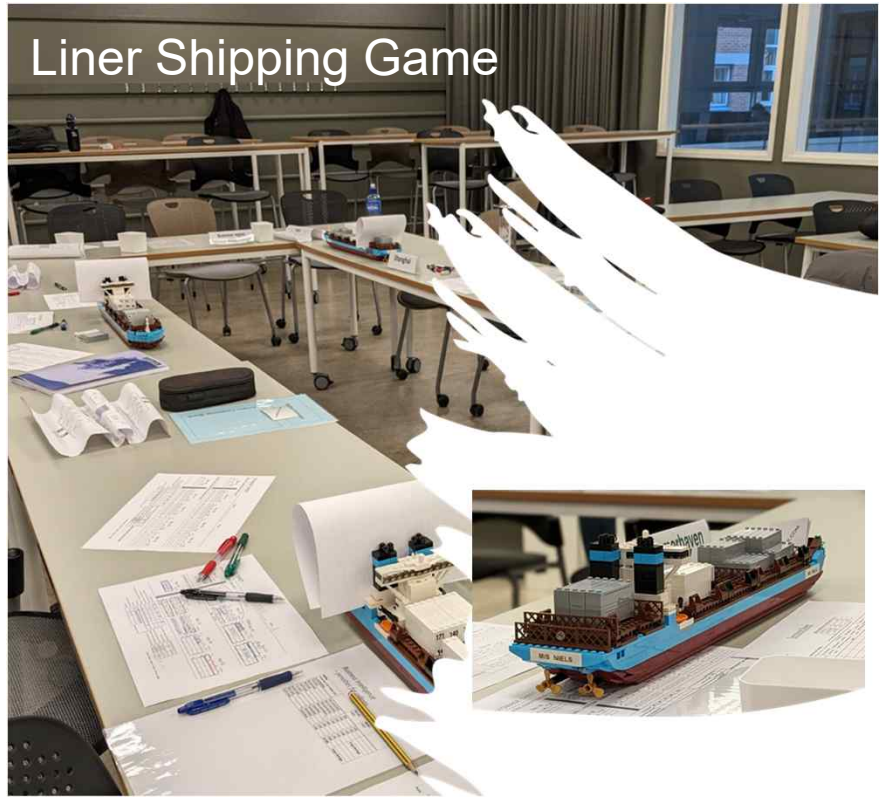
AUTOBarge - European training and research network on **Autonomous Barges** for Smart Inland Shipping (2021-2025)

 Source: https://research.chalmers.se

Education in Marine Technology

- Included in a 2 year Master program, ‘Mobility Engineering’ since 2021
- Around 10 students apply the ‘Naval Architecture’ track

No.	Course name
1	Wave loads and seakeeping
2	Stability and design basis for marine structures
3	Structural engineering
4	Computational fluid dynamics (CFD)
5	Ship resistance and propulsion
6	Marine design projects
7	Naval architecture



Education in Marine Technology

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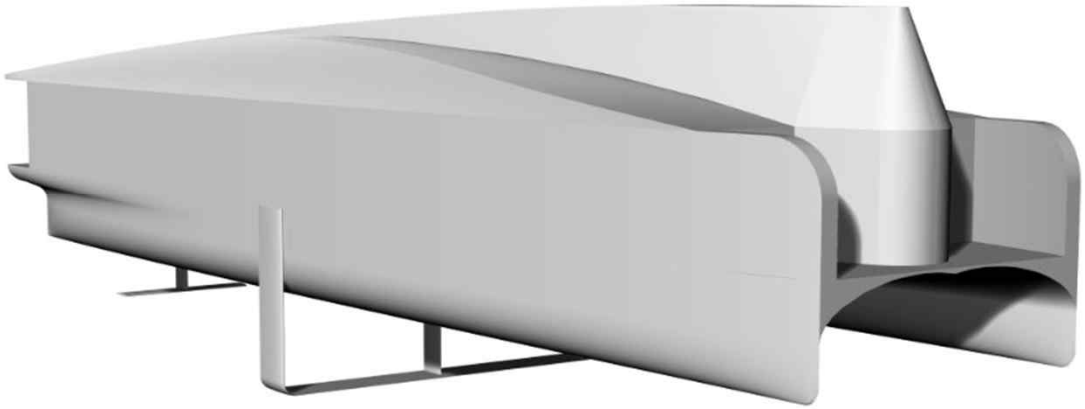
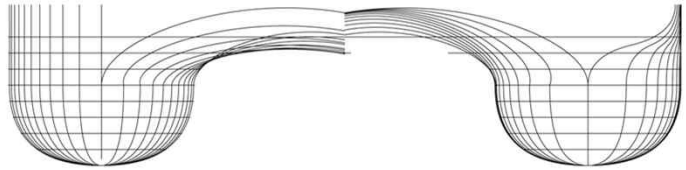
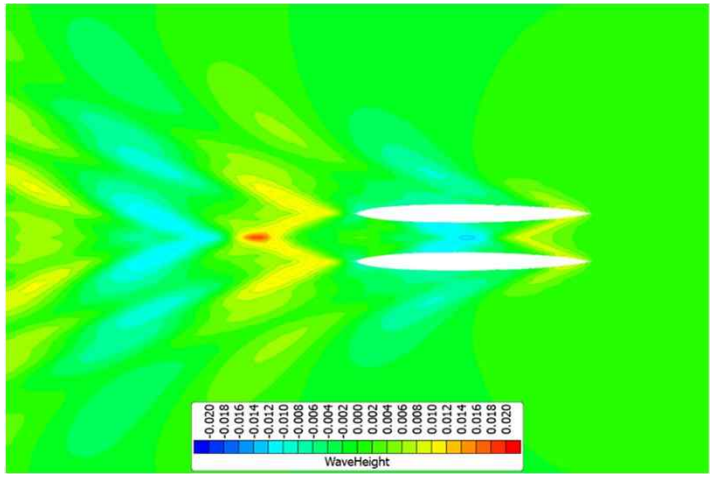
[Marine Design Project] Battery driven ferry for the archipelago







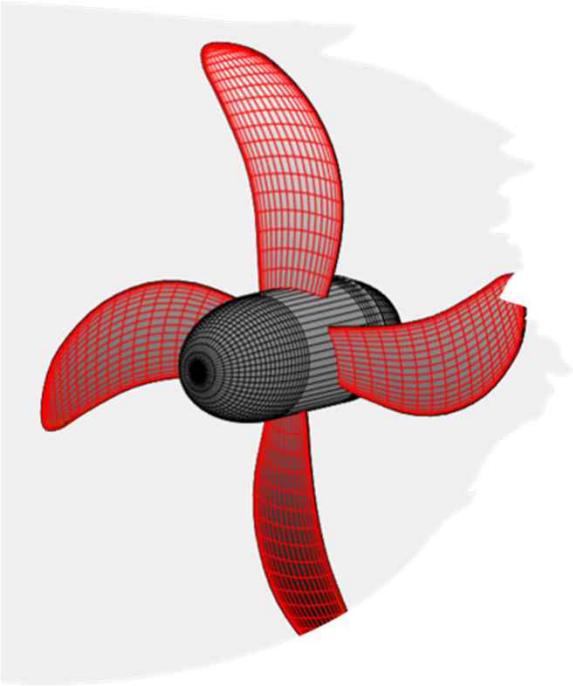
Read more:

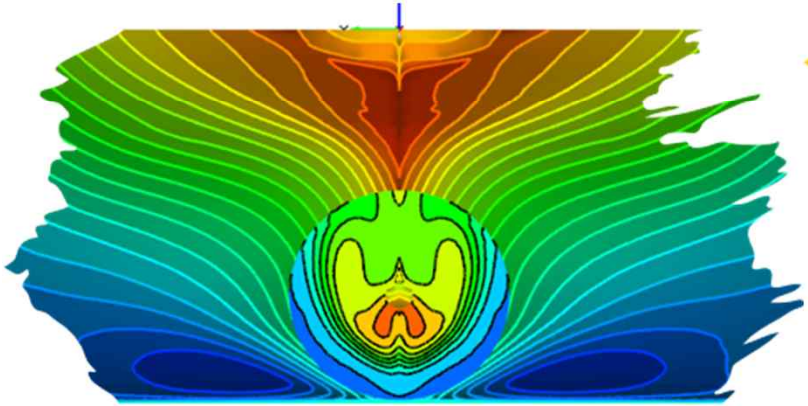
https://www.chalmers.se/en/current/news/m2-students-design-battery-driven-ferry-for-the-archipelago/

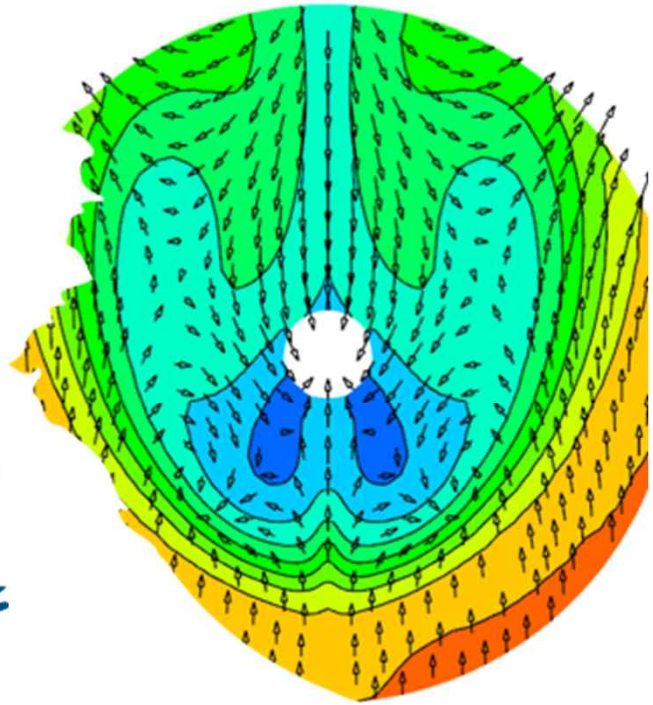
Education in Marine Technology

- Included in a 2 year Master program, ‘Mobility Engineering’ since 2021
- Around 10 students apply the ‘Naval Architecture’ track

[Ship resistance and propulsion] Hull and propeller design



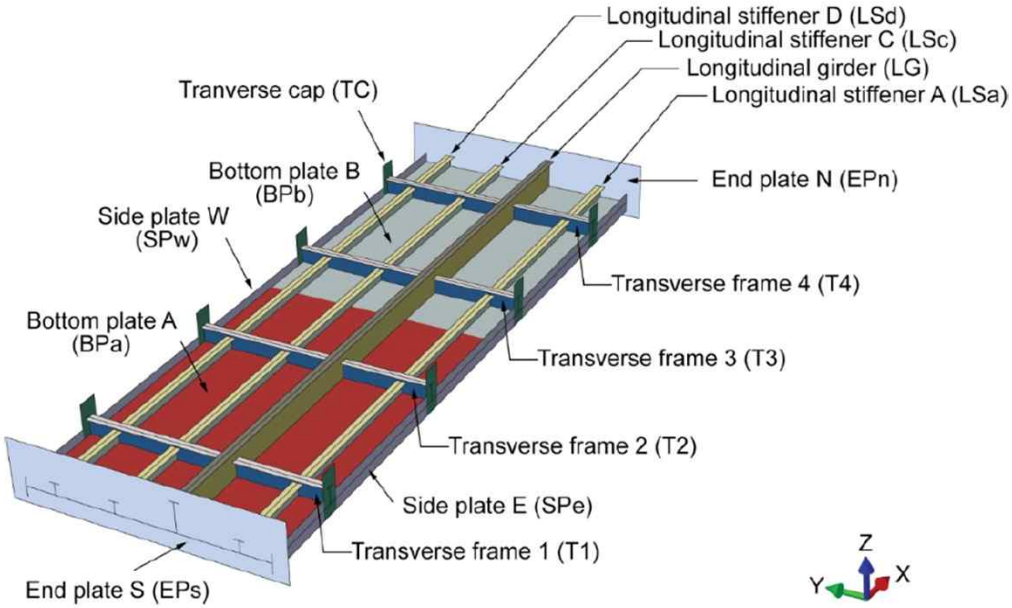


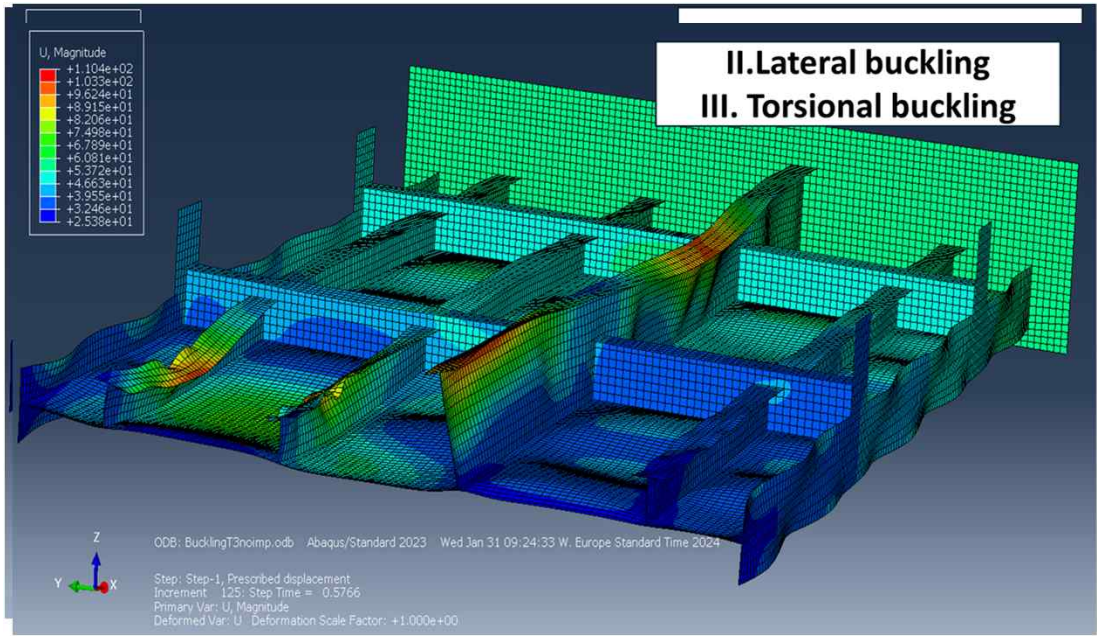


Education in Marine Technology

- Included in a 2 year Master program, ‘Mobility Engineering’ since 2021
- Around 10 students apply the ‘Naval Architecture’ track

[Naval architecture] - Compressive strength of a stiffened panel





Source: Workshop-computer assignment, Course material in the Naval Architecture (MMS205), Chalmers University of Technology, 2024.

Introduction about Jaseung's Research Topics

2024-06-06

Jaseung's Research - Objective

Tripod-shaped support structure for offshore wind turbine



Fig. Single tower model (left) and tripod model (right) in the software, Ashes 3.20

Benefits

- Reduced bending stress at the bottom

Need to be improved

- **Heavy weight or high material usages**
- Risk of fatigue failure due to tensile loading on a pivot leg

Jaseung's Research - Progress

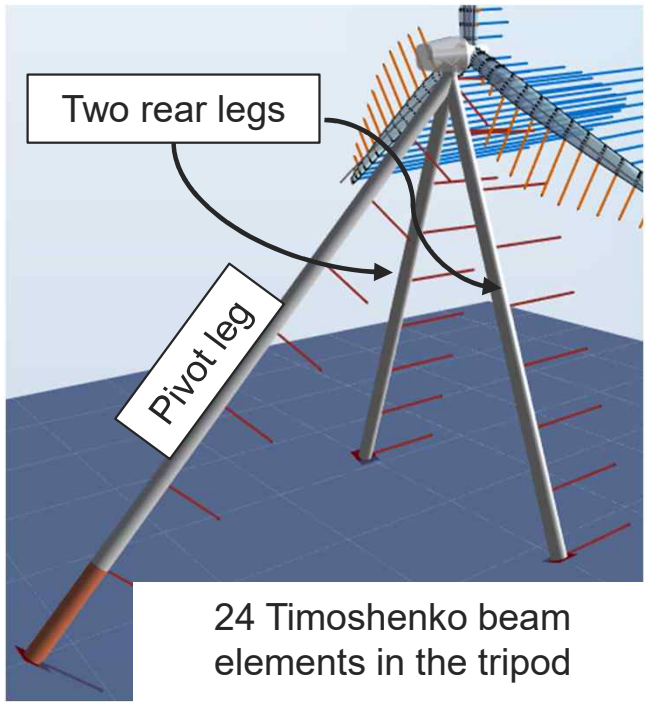
Optimization of tripod-shaped support structure for weight-efficient offshore wind turbine

- Design variables: D & D/T of pivot leg & rear legs

  (D: Outer diameter, T: thickness)

- Optimization method: Particle Swarm Optimization

- Loading condition: (1) Maximum rotor thrust by uniform wind loads, (2) Gravitational loads



24 Timoshenko beam elements in the tripod

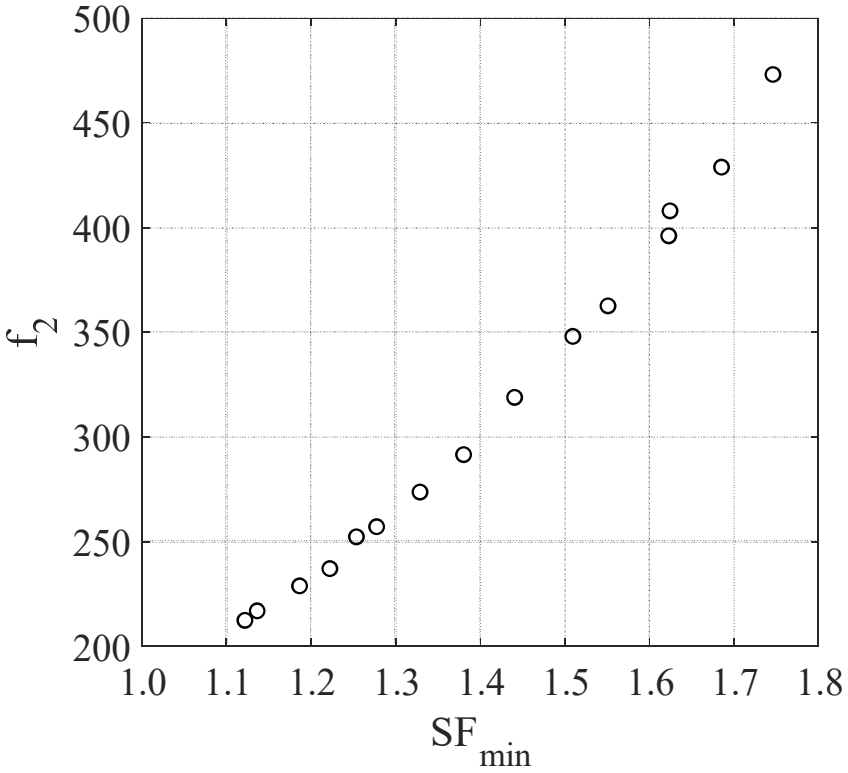
Jaseung's Research - Progress

- Minimize $f_1 = 1/\mathrm{SF}_{\min}$ and $f_2 =$ Total mass of a tripod

[API-RP-2A guideline]

$$\begin{cases} \dfrac{f_a \cdot \mathrm{SF}}{F_a} + \dfrac{C_m f_b \cdot \mathrm{SF}}{\left(1 - \dfrac{f_a \cdot \mathrm{SF}}{F_e'}\right) F_b} = 1.0 & \text{Compression \& b} \\ \dfrac{f_a \cdot \mathrm{SF}}{0.6F_y} + \dfrac{f_b \cdot \mathrm{SF}}{F_b} = 1.0 & \text{Tension \& bendi} \end{cases}$$

$\mathrm{SF}_{\min}$: a minimum value of SF from 24 tripod leg elements



- More detailed research will be shared at EKC2024 and RENEW2024

Thank you,
and Welcome to your questions.

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