KTH ROYAL INSTITUTE OF TECHNOLOGY

Advanced Stepped hull design

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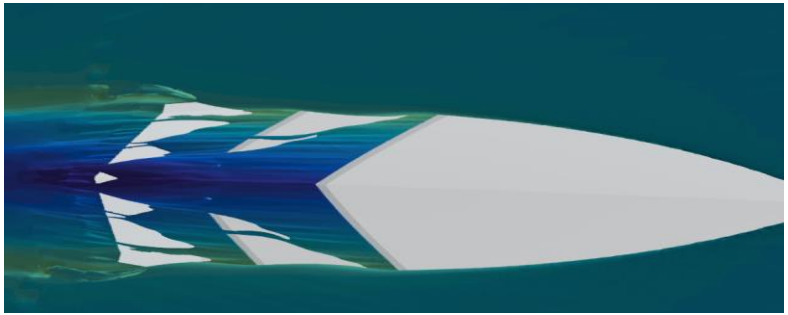
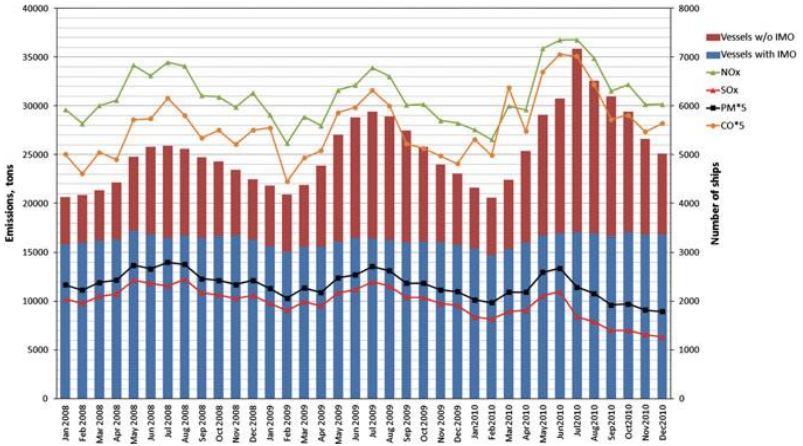
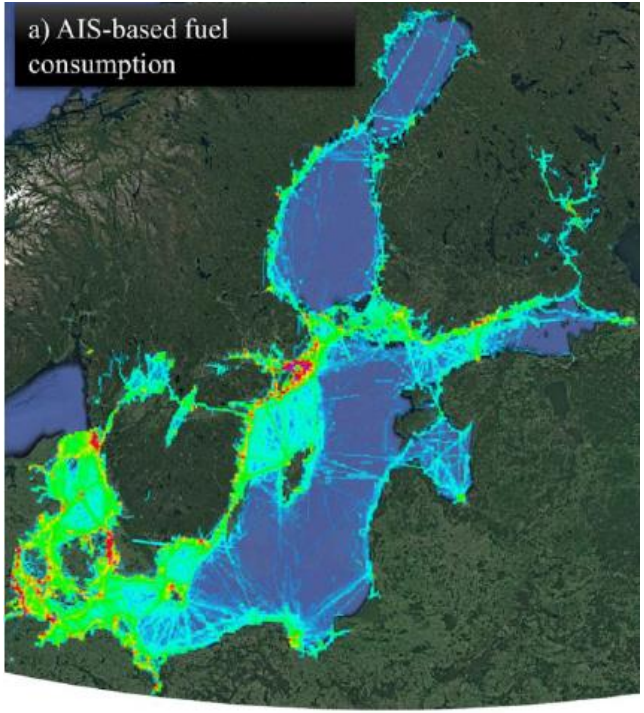


High Speed Boat Operation Forum Conference
Gothenburg, Sweden, June 7-9, 2023

Background

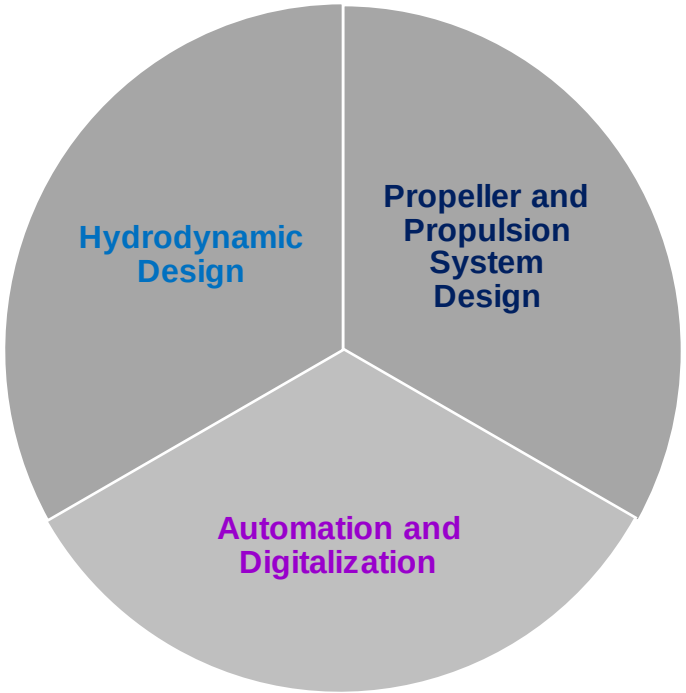


Country	Population	Recreational boats per 1000 inhabitants	Total fleet	Sailboats	Inboard motor boats	Outboard motor boats and other rigid boats	Inflatable boats >2.5 m and >20 kg
Finland	5,300,000	143	734,100	19,000	93,000	620,000	2,100
Germany	82,438,000	5	441,530	120,475	88,932	232,123	n.a.
Poland	37,000,000	2	68,000	64,000	n.a.	n.a.	n.a.
Sweden	9,182,927	83	778,100	97,100	90,800	552,200	38,000



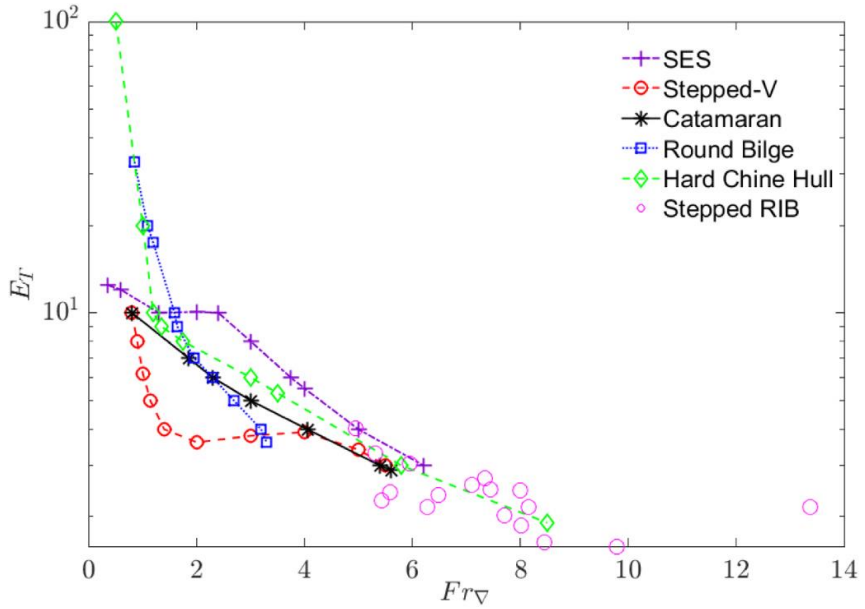
Lasse Johansson et al., Model for leisure boat activities and emissions–implementation for the Baltic Sea, Ocean Science, 16 (5), 2020.

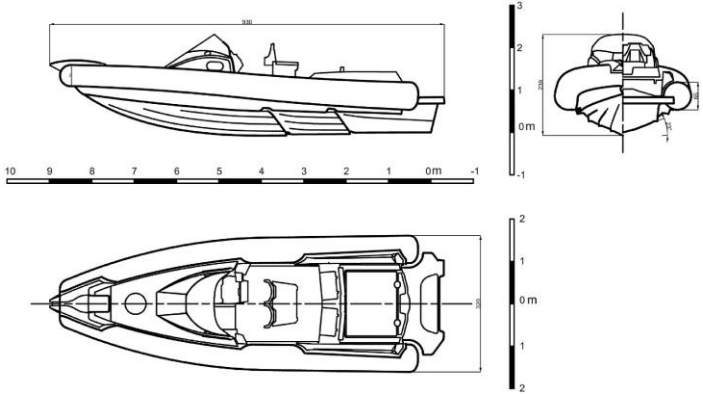
Background



Green Cruising for High-speed Small Craft in the Baltic Sea (Green Small Craft)

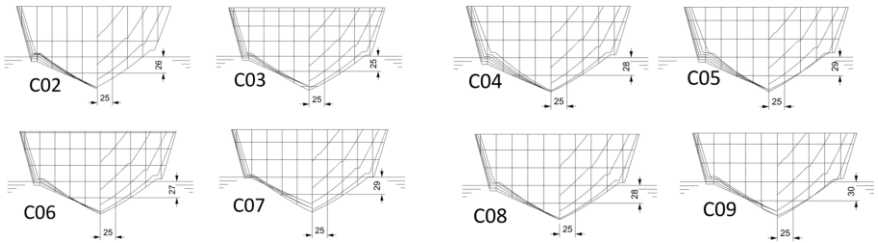
Comparative Study



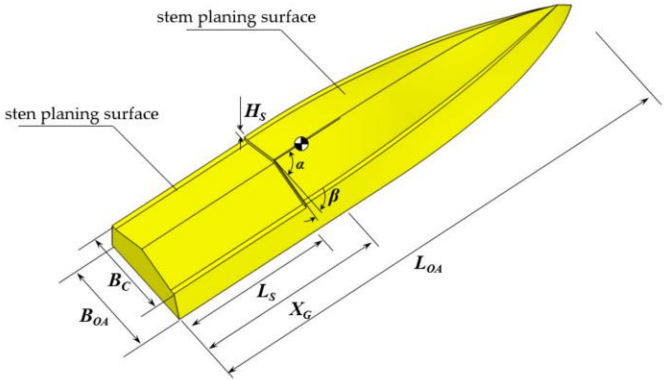


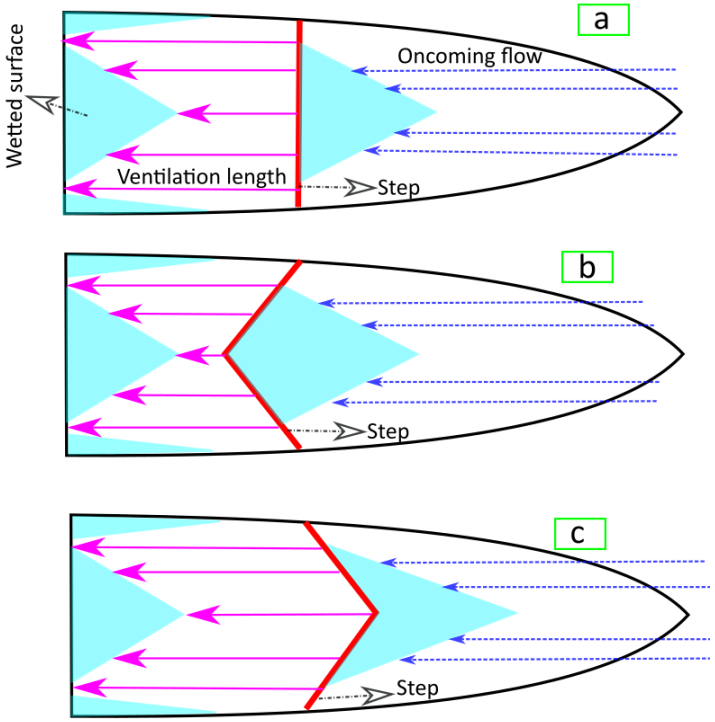
The RIB built by MV-Marine S.r.l., type Mito 31 powered with two outboard engines.

Stepped Hull Systematic Series



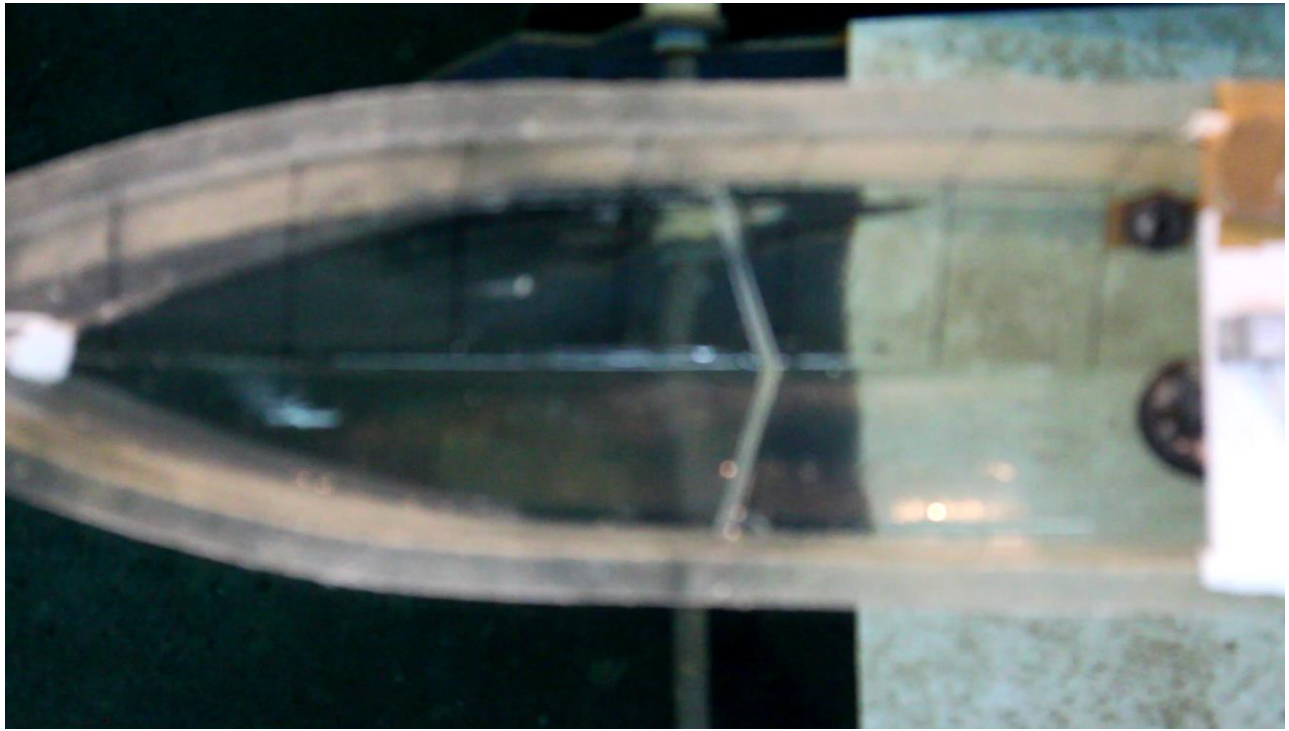
https://github.com/LuigiVitielloDll/Stepped-Hulls-Towing-Tank-Test

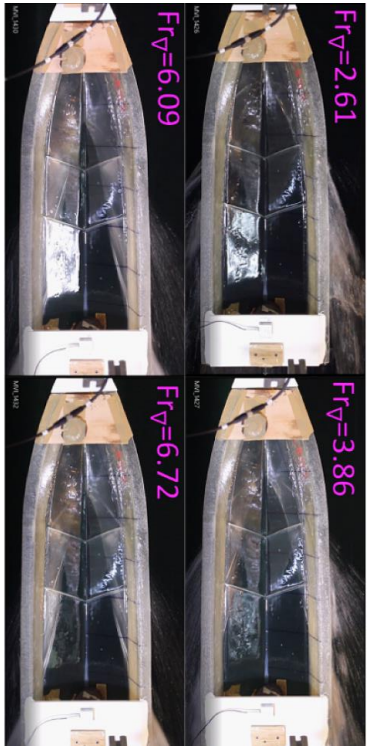




a) straight step, b) forward swept step, c) backward swept step.

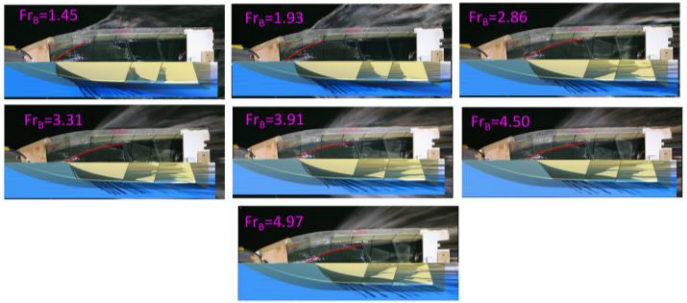
Experimental Campaign

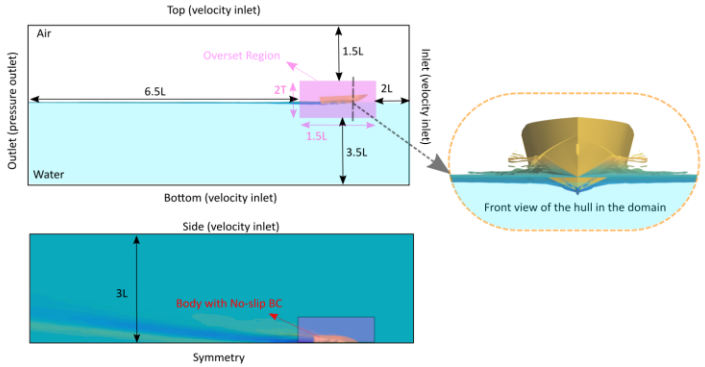


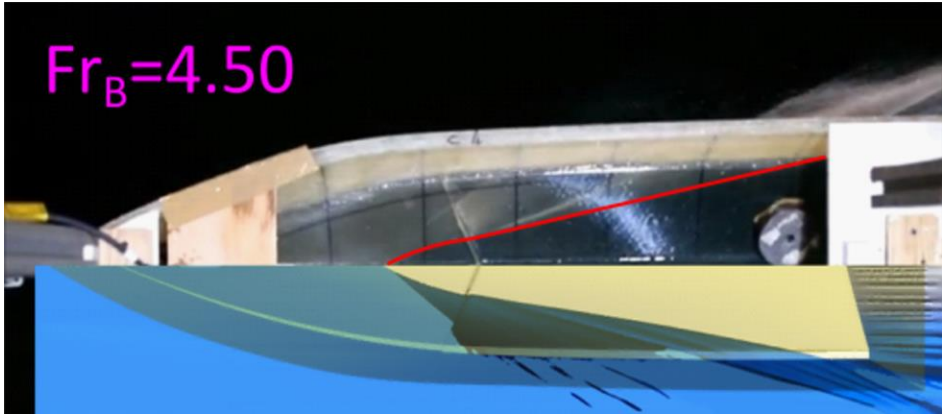


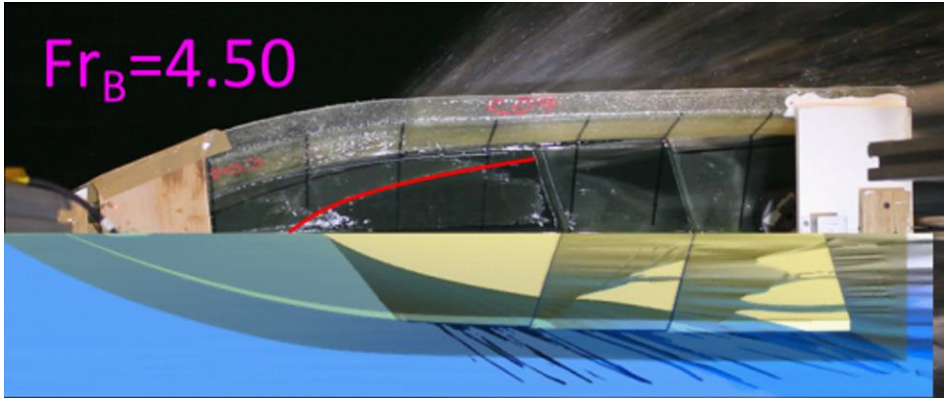
Vitiello, L., Mancini, S., Niazmand Bilandi, R., Dashtimanesh, A., De Luca, F., Nappo, V., 2022. A comprehensive stepped planing hull systematic series: Part 1 - resistance test. Ocean Eng. 266, 112242.

CFD Campaign









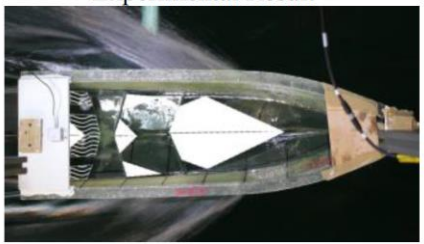
Niazmand, R., Dashtimanesh, A., Mancini, S., Vitiello, L., Comparative study of experimental and CFD results for stepped planing hulls, Ocean Engineering, Vol. 280, 2023.

CFD Campaign

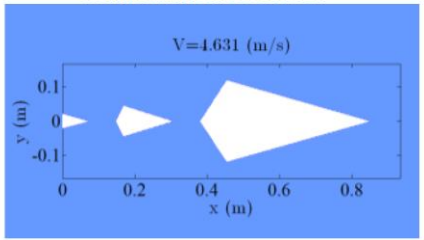
Simulation of planing hull in irregular waves

Mathematical Modelling (2D+t)

Experimental Result



Mathematical Method



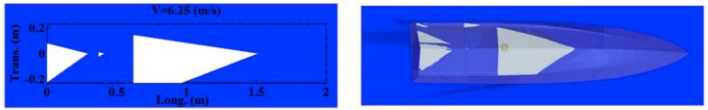
Calm Water

Regular Waves

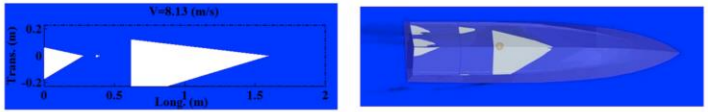
Manoeuvring

Heel angle of 10°

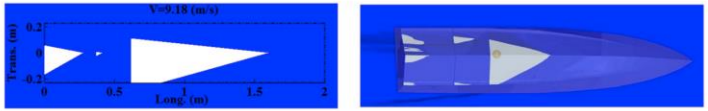
2D+T method | CFD



Fr_B=2.94



Fr_B=3.83



Fr_B=4.32

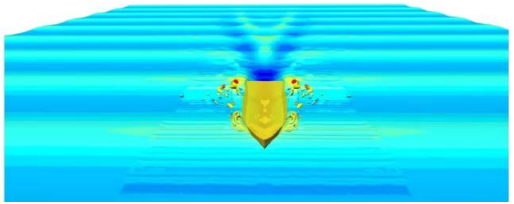
TAL TECH

Seakeeping of Stepped planing hull in regular waves: Comparison of 2D+t and CFD simulation

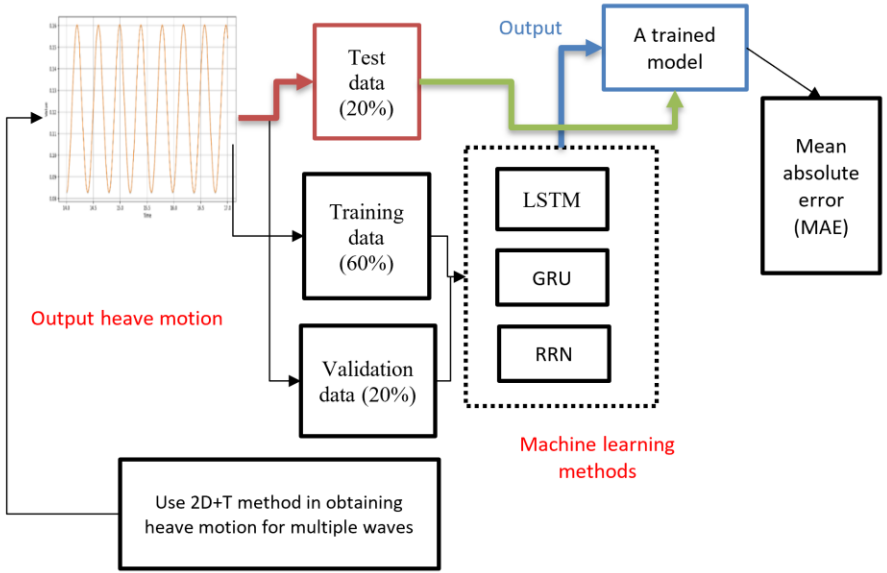
TAL TECH 100 ESTONIAN MARITIME ACADEMY

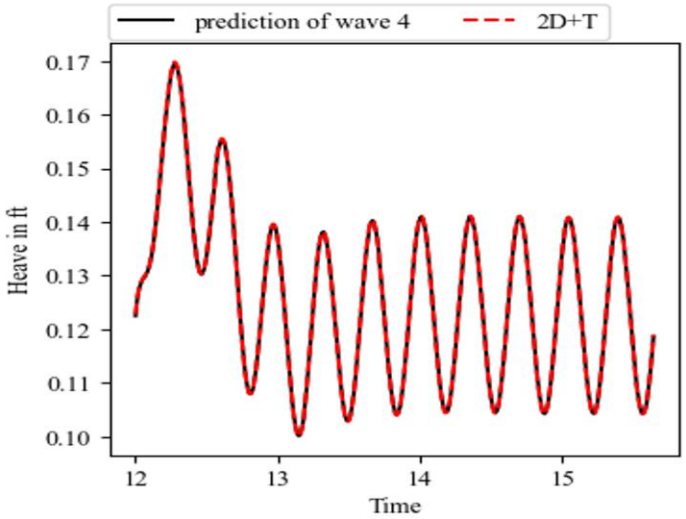
Fr_B=3.83, v=8.13 m/s

F=0.5 Hz, A=35 mm



Machine Learning





WE ARE LOOKING FOR DATA!

Conclusion and Future Outlook

- A comprehensive stepped hull systematic series;
- Maturity in CFD simulations except in case of irregular waves;
- Mathematical models are almost mature except in wetted surface modelling;
- Lack of experimental data for stepped hulls in waves;
- Maneuvering motions of stepped hulls;
- Implementation of emerging ML methods.

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