Seakeeping analysis of monohull ships at preliminary design using artificial neural networks

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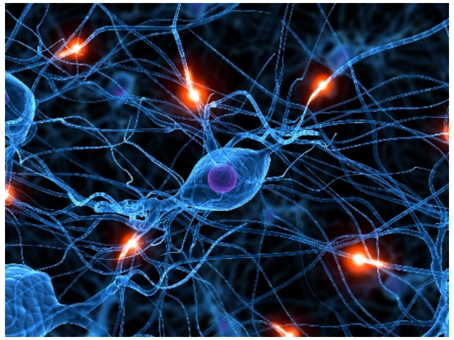
- Conclusions


Introduction



The result of the work will be a set of ANN algorithms that allow the pre-assessment of a ship's **seakeeping** with **very short pre-processing and solver times**, and to determine the added masses, damping and external forces required to compute the seakeeping of conventional monohulls.

$$(M + A_{ij})\ddot{\eta}_j + B_{ij}\dot{\eta}_j + K_{ij}\eta_j = F_j \cdot e^{-i\omega t}$$

Objectives

The main idea is to obtain a **Generalized Algorithm based** on Artificial Neural Network to predict the seakeeping of any type of monohull vessel.

The design in early stages should be based on seakeeping.

To obtain an initial result, in a short time and without high computational cost, to solve the problem in the design phase and consequently design taking into account the seakeeping.

Methodology

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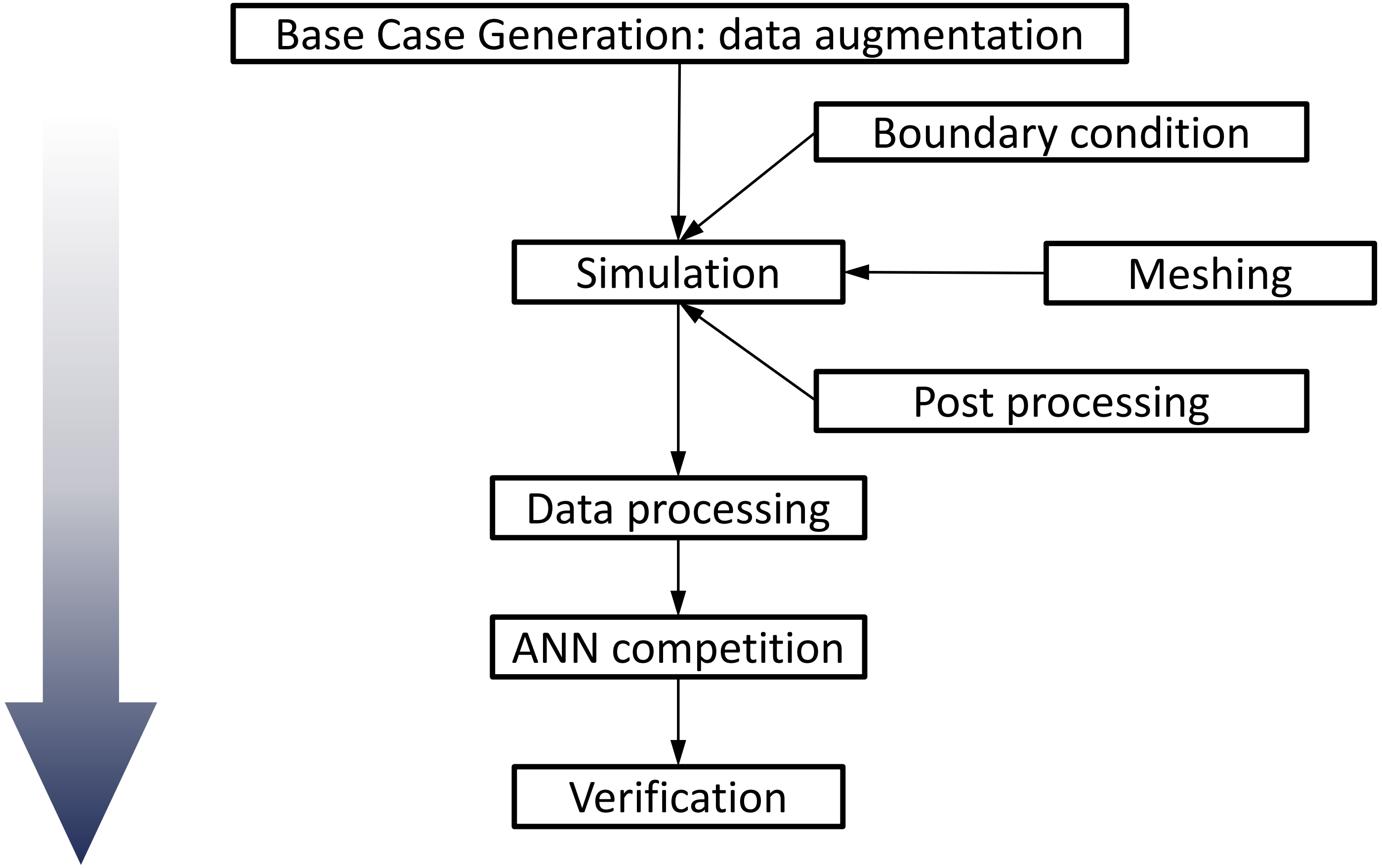

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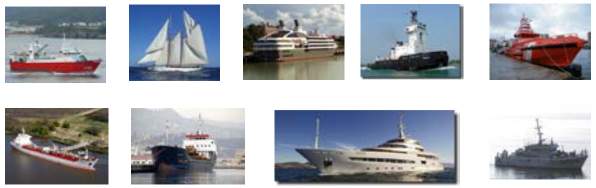
Base Case Generation

Selection up to 50 base ships



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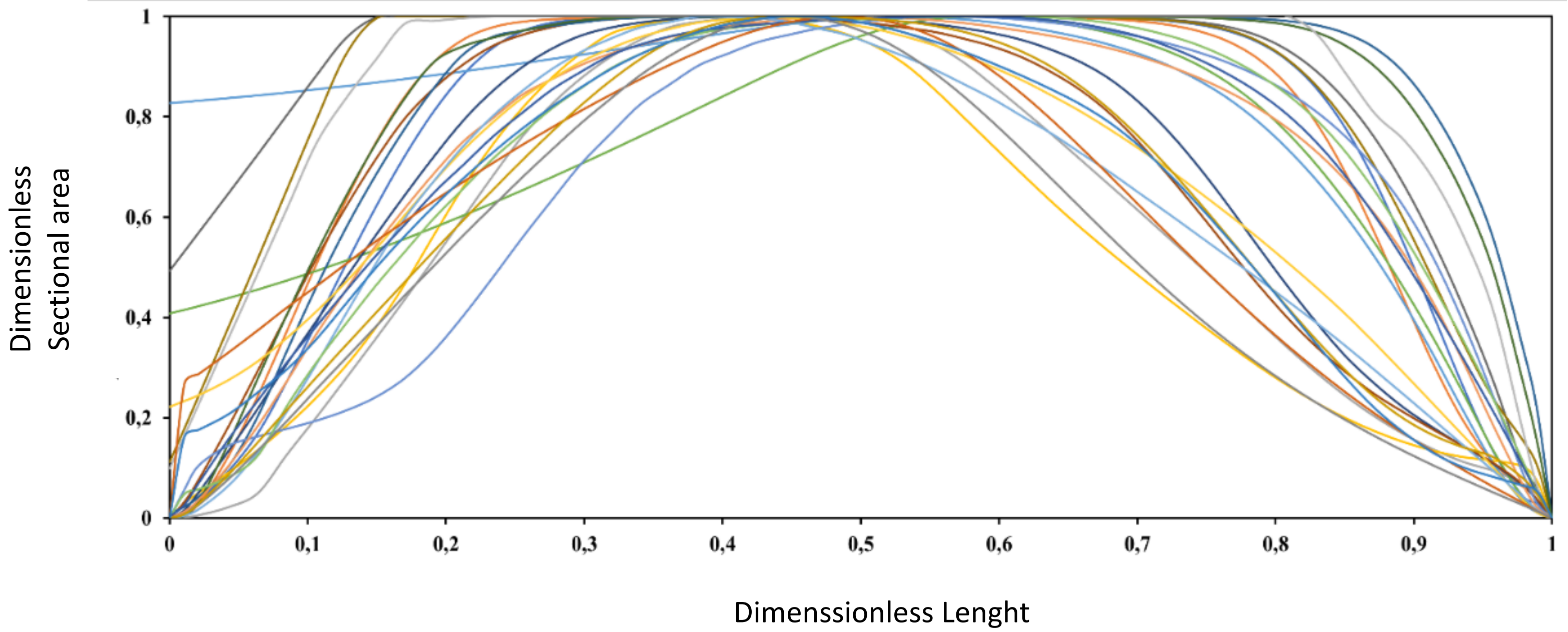
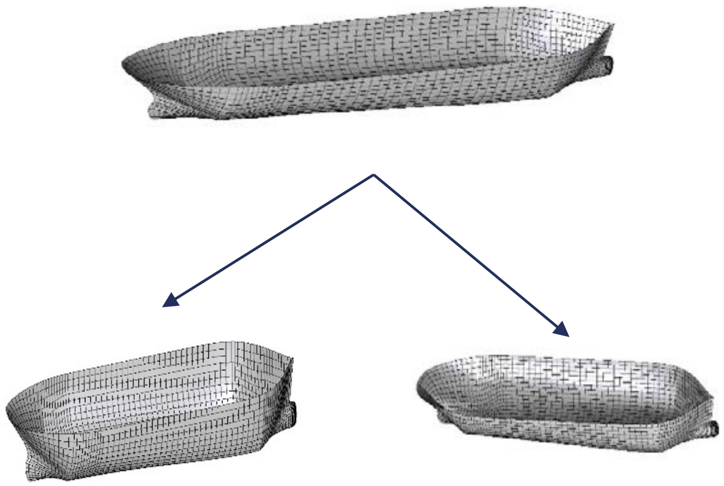
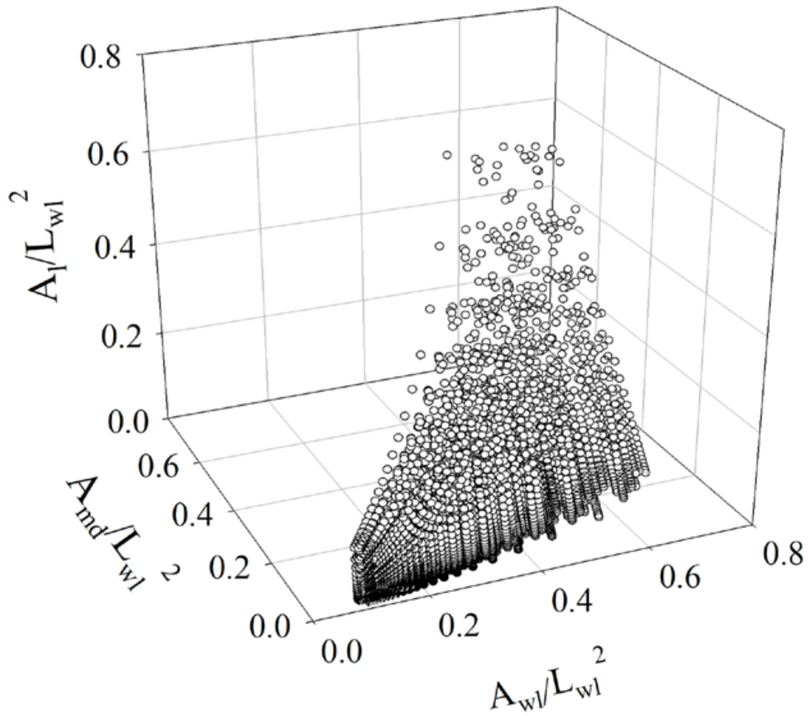


Methodology

Base Case Generation: data augmentation

Up to $2{,}0 \cdot 10^4$ simulation cases





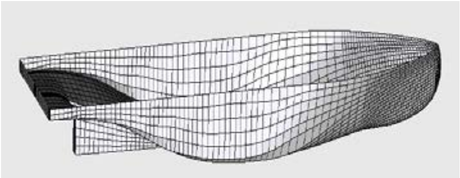
400 Geometry variations (L/B; B/T; L/T)

Methodology

Base Case Generation: Simulations & data processing

Simulations

- Potential solver simulation in frequency domain ($> 2.0 \times 10^4$ simulations)
- 7 wave heading from 0 to π rad
- Up to 30 frequencies $k \in \left[\frac{2\pi}{0.1 \cdot L_{wl}}, \frac{2\pi}{2.0 \cdot L_{wl}}\right]$



Data processing

- Principal component analysis
- Selection main parameters regarding ship particulars
- Break down seakeeping components: added masses, damping, excitation forces, diffraction forces.

Methodology

ANN competition

Normalised	**Layers**	1 - 3
	Neurons	1 - 30
	Optimizer	Adam, RMS…
Non-normalised	**Activation**	Sigmoid, ReLU,…
	Epoch	10 - 300
	Overfiting	Dropout, bachnorm, …

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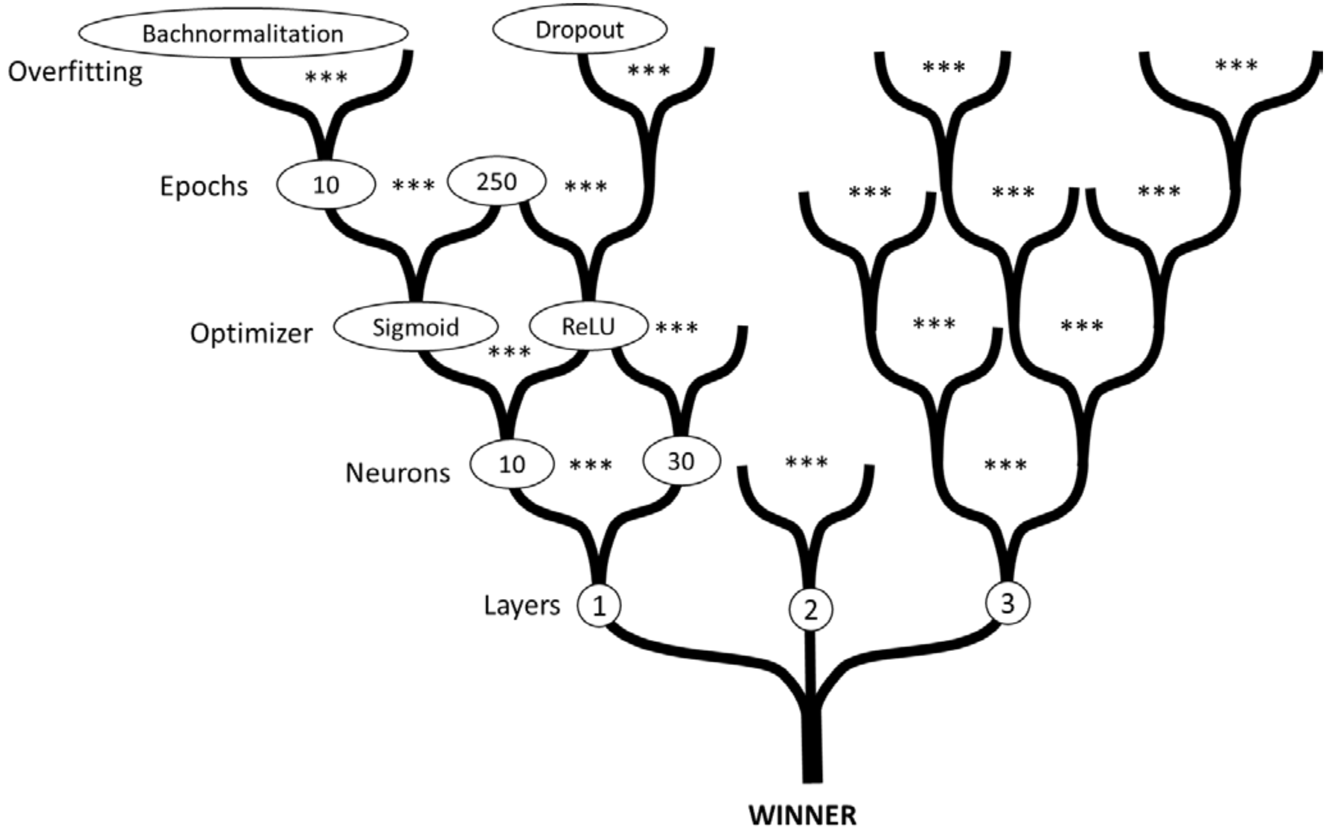
ANN competition



Verification and Results

Verification ships

Six monohulls totally different from data base to face with potential solver

Verification and Results

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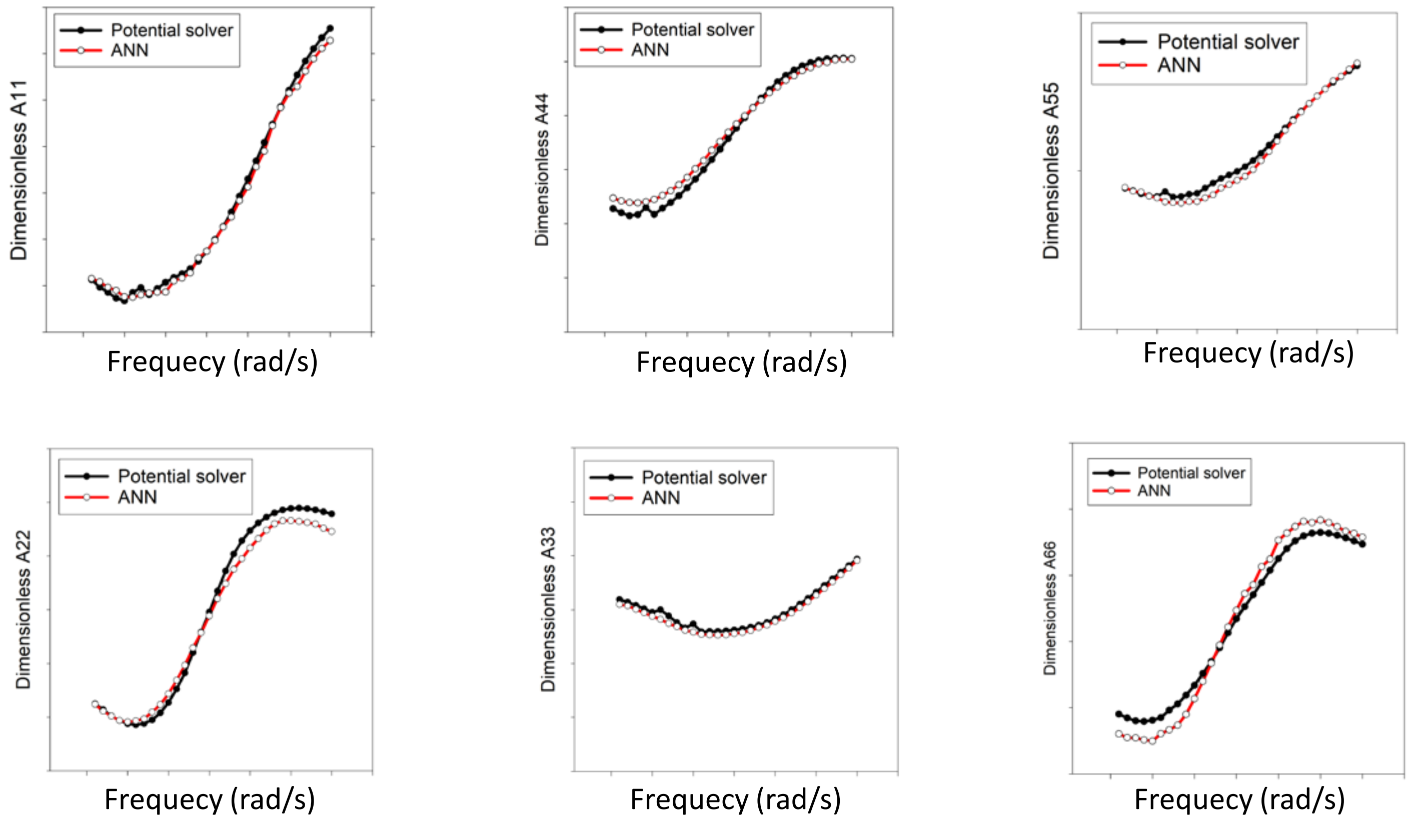
Added masses and dampings:



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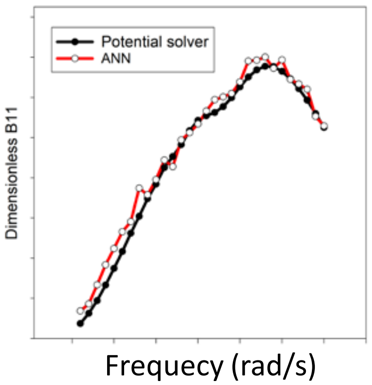
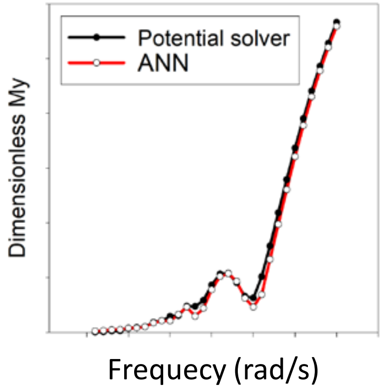
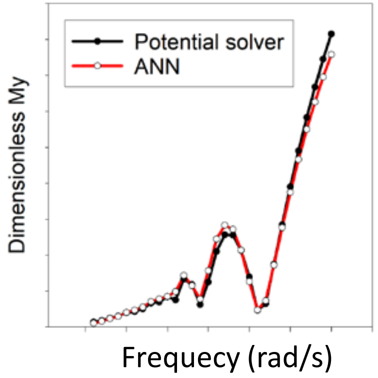
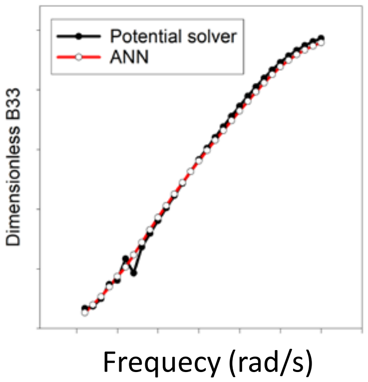
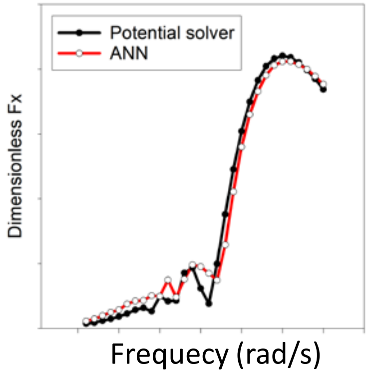
Forces and moments:

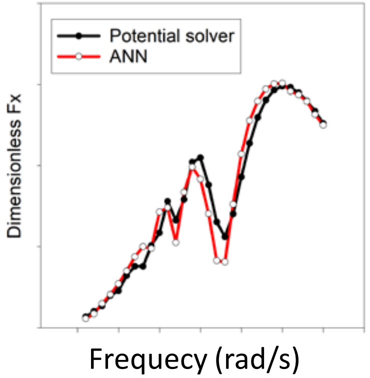










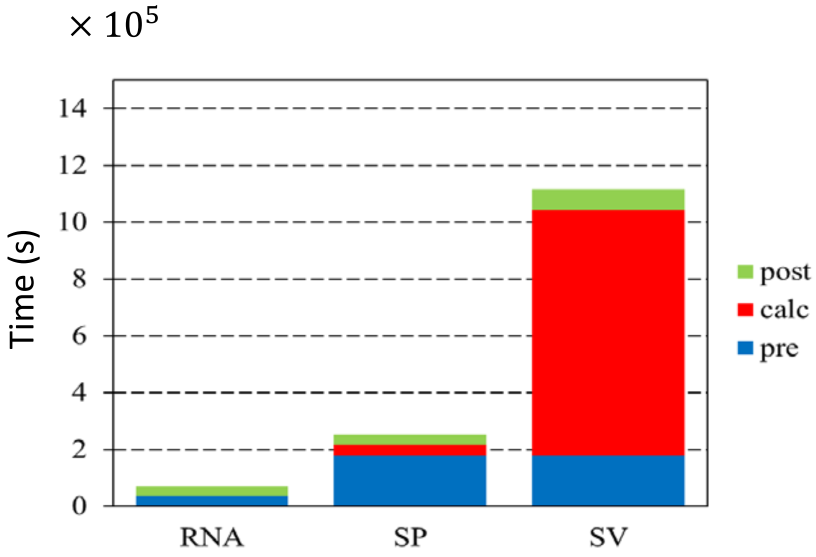


Conclusions

- Difficulty in obtaining a sufficient number of vessels to apply these techniques, thousands of hours of computing.

- Ability to predict the seakeeping behaviour of any conventional monohull, with uncertainty similar to that of a potential solver and considerable time savings.

- Vessel data required for the study, principal characteristics.



Thanks for your attention

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