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

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Content
- Introduction
- Seakeeping
- Objectives
- Methodology
- Verification and Results
- Conclusions

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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

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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.

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

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Methodology

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Base Case Generation: data augmentation
Boundary condition
Simulation
Meshing
Post processing
Data processing
ANN competition
Verification

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Methodology

Selection up to 50 base ships

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Methodology

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Base Case Generation: data augmentation

Up to $2.0 \cdot 10^4$ simulation cases

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

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Base Case Generation: Simulations & data processing

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

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

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Methodology

ANN competition

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<th>Normalised</th>
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<td>Overfitting</td>
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Verification ships

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

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Forces and moments:
• 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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