Learn to Optimize

Machine learning assisted adjoint shape optimization

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In Short

- Employ autoencoder methods to mimic propulsor
- Use ML-based surrogate to optimize ship hulls

International maritime shipping is obliged to significantly reduce pollutant emissions in the coming decades. Improving propulsion efficiency is the most technologically promising strategy in this regard. The aim of the BMWK-funded project ProSA (Propulsionsoptimierung von Schiffsrümpfen und Anhängen in der Grossausführung) is to improve the environmental balance by increasing the propulsion efficiency of ships. The project involves a research network of two manufacturers, a ship model basin and the Hamburg University of Technology.

The main focus is on improving the propeller-hull interaction and the related performance through simulation-based shape optimization and propeller integration in combination with machine learning (ML). In the framework of this project, our contribution is concerned with the further development of adjoint methods for determining shape derivatives and with the construction of a digital shape optimization twin. The adjoint methodology allows for a significantly lower number of numerically complex investigations on a large scale and thus supports the required shortened development times. To this extent, the project will investigate a higher degree of propulsion integration in the adjoint shape optimization framework as well as the unsteady propeller-hull analysis in the adjoint calculus. Particular attention is paid in both the geometrically resolved propeller-hull interaction and the optimization of the shape of the hull with active propulsion using ML-based surrogate models.

Figure 1 outlines the ML-strategy which is embedded in an adjoint optimization process.

WWW

`http://www.tuhh.de/fds`

More Information

Project Partners

HSVA, Voith, MMG

Funding

BMWK

DFG Subject Area

404-03

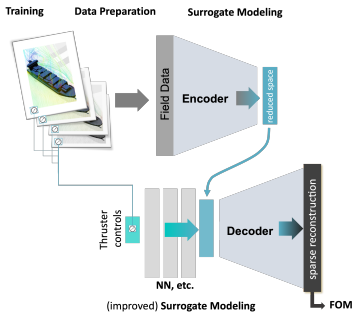

***Figure 1:** Illustration of the employed surrogate modeling strategy.*