Predicting Underwater Radiated Noise with AI-Driven Virtual Sensor Technology

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Abstract

Abstract: "One of the most challenging problems of the modern marine industry is minimizing the impact of underwater radiation (URN), which can affect user comfort and marine ecosystems, disrupting marine life's behavior and communication.

The primary goal is to utilize these sensors to accurately predict outputs of variables that are significantly more challenging to measure directly, such as URN, which typically requires hydrophones installed at various distances from a vessel.

Traditional methods of predicting URN often revolve around the use of physical measurements and without clear criteria for the evaluation of sound levels. Running these physical models is time-consuming, expensive, and often fraught with inaccuracies.

They also typically focus on isolated factors and fail to account for the interactive effects of multiple variables, such as propeller-hull interaction and reflections from the surface and sea bottom.

Given the complex nature of URN, a holistic approach that can handle noise spectra and high-dimensional data is warranted.

Artificial intelligence, with its ability to discover hidden patterns and relationships in large amounts of data, offers a promising solution.

In this work, we leverage Machine Learning and Deep Learning to demonstrate that a robust and reliable model for predicting URN can be created.

Based on a large data collection campaign performed by the Maritime Research Institute Netherlands, we show that it is possible to predict the URN using practical, easy-to-install, and inexpensive sensors such as accelerometers and gyroscopes mounted on board.

Keywords: Shallow Learning, Virtual Sensor Technology, Deep Learning, Underwater Radiated Noise