Developing a Vibration Analysis System for Optimised Pump Performance in Marine Anti-Heeling Systems

Introduction

Efficient and reliable pump operation is essential in marine anti-heeling systems, where stability control depends on rapid fluid transfer. Traditional maintenance strategies often rely on scheduled inspections or reactive interventions, which can lead to unplanned downtime and reduced operational reliability. To overcome these limitations, Hoppe Marine GmbH is developing a vibration analysis system designed to enable predictive maintenance and improve overall system performance in anti-heeling applications.

Motivation and Need

Digital transformation is reshaping maintenance operations in the maritime industry, yet many organisations don't integrate remote service technologies effectively. Hoppe Marine GmbH offers already a functional reliable remote service platform. By simply equipping existing pumps with a suitable vibration sensor, predictive insights into pump health can be achieved without extensive system modification.

Objectives and Methodology

The project aims to evaluate the diagnostic potential of vibration monitoring for anti-heeling pump systems. A dedicated test rig equipped with IFM software enables the collection of structure-borne noise readings from any pump onboard a ship and allows analysis of pump behaviour under various operating conditions. Using ISO 20816-3 as a guideline, the health of each pump can be assessed in line with industry standards, providing continual evaluation of its lifespan and supporting condition-based maintenance decisions.

Initial experiments focus on verifying sensor accuracy and data acquisition reliability. Cooperation with the pump manufacturer allows setting up a test facility to capture initial data during the production phase. In subsequent phases, the analysed vibration data will be used to identify fault patterns and define diagnostic thresholds by comparing maximum values and normal operating behaviour.

A secondary aim was to assess the accessibility of the collected data for both customers and Hoppe through our MIoT connect device, ensuring that information is readily available at any time. Additionally, we examined the type of data gathered and how it can be effectively visualised to ensure diagnostic results are easily

understandable. By maintaining a continuous log of vibration data, the long-term health of the pumps can be clearly reflected. This ongoing data collection allows trends to be identified, emerging issues to be detected early, and accurate assessments to be made without the need to stop the system or dismantle the pump. Furthermore, maximum values and normal operating behaviour were evaluated to establish clear diagnostic thresholds.

Preliminary Findings

Although still at an early stage, the results are promising. The implemented setup successfully records vibration data and allows remote access to measurement results. With future vessels having pumps with an updated design to allow a vibrational sensor to be fitted, more data can be collected allowing for a wider range of data to present a wider framework.

Key outcomes

So far, we have found a method of recording vibrational data successfully and having remote viewing of that data. We identified a frequency-specific vibration patterns at the anti-heeling pumps which requires further investigation. Further investigations of the recorded data and the installation of additional vibrational sensors will lay the groundwork for predictive maintenance strategies, thereby improving operational reliability and service efficiency of anti-heeling pumps.