

AI algorithms to improve vibration monitoring analysis of rotating machinery of ships

Challenge Owner: Hat Analytics solutions

Website URL: <https://www.hat-analytics.net>

HAT Analytics commercialises HAT, a Digital Health Monitoring System developed and designed for condition diagnosis and troubleshooting of ships' rotating machinery.

Context

Rotating machines, such as motors, pumps and fans, are critical for the operation of the ship, safety of the crew and the environment. Their maintenance through Vibration Monitoring (VM) is a proven process, employed by major shipping companies worldwide and approved by Classification Societies. It spots rotating machinery faults at early stages allowing better maintenance scheduling, avoid unnecessary openings of machinery, reducing OPEX and at the same time increasing vessel crew resting hours and thus preventing accidents.

The vibration analysis is performed by a certified vibration expert. The vibration analysis examines the machinery vibration signature in order to extract several fault descriptors, based on which machinery condition evaluation is performed. In some cases, the analysis can be a simple task, however, in most cases, several faults are combined and affect several parameters in complex ways. In these cases human experience is required in order to evaluate the vibration recordings and assess the health condition of machinery. An erroneous vibration analysis may lead to expensive and even dangerous machine failures.

Challenge

The main challenge in shipping industry for machinery Condition Monitoring with Vibration Analysis is that it requires an experience 3rd party service engineer to

attend the vessel onboard for vibration data collection and in a second stage onshore vibration analysis and machinery condition reporting. The attendance onboard in many cases is not feasible (e.g., Covid-19 restrictions) or requires significant cost overhead. The usual size of vibration data file per machinery is around 2-3 Mbyte and transmission of large files through vessel internet is not only expensive but also difficult due to synchronization issues. Thus, the above difficulties, demotivate several fleet operators and managers to apply this advance technique despite their understanding of the profits and advantages. A solution for this is the development of “smart” algorithms for real time machinery vibration evaluation and health condition report. AI algorithms combined with proper data acquisition equipment will allow vibration analysis to run on-board the ship thus faster and cheaper, making it accessible to all.

Expected demonstration:

Based on two types of data, namely, fault descriptors and time domain acceleration waveforms, we would like to examine the following:

1. Can we determine the limits of severity zones similar to these provided in ISO10816 for different types of faults and different types of machinery? Are statistics or clustering techniques enough or there are better approaches?
2. Determine and implement an appropriate AI/ML technique/algorithm for our data. Our ultimate target is to have a system that:
 - a. **Will accept as input:** (a) the type of machine, (b) certain operational parameters such as speed, bearing type, coupling type etc and (c) either fault descriptors or time domain waveforms from appropriate measurement points and directions.
 - b. **Produce as output:** the diagnosis among a predetermined set of possible malfunctions.

Available datasets:

- **Vibration fault descriptors:** our company has a large number of vibration fault descriptor files uploaded by HAT device onboard vessels. The data will be anonymized.
- **Time domain waveforms:** the partners will have access to labelled simulated waveforms if required.