Monitoring Loads Severity and its Consequences from a ML Perspective

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ABSTRACT

In this paper, the outline of a smart system capable of detecting critical load conditions and consequently triggering the interrogation of sensors to verify the occurrence of damage onboard ships is considered. The target ship for is a ro-ro fast vessel, which suffers relevant slamming phenomena. The slamming detection can be obtained in a robust way by training Machine Learning (ML) algorithms according to physics-based criteria on data from a scaled model of the same ship. The on-board sensors measure rigid-body motion, global dynamic stress due to transient vibrations and relative wave elevation. If classification of these events is properly carried out, information on slamming type drives the identification of damage by using data-driven hybrid methods. The type of damage experimentally analysed consists of a local variation of stiffness in hull panels. The choice of relevant and robust features for damage assessment is based on modal strain energy through the definition of a damage index. They require setting up a reference (intact) configuration which the damaged structure is compared with. The process requires preliminary the identification of structural modes, which are obtained from the accelerometers installed on the hull panels. Pattern Recognition methods based on the use of Machine Learning algorithms are developed and trained on numerical simulations including a variety of damage scenarios. The combination of information about slamming and direct damage detection shows the idea behind the development of such expert systems to assess the structural integrity of the ship.