World Academy of Science, Engineering and Technology
International Journal of Electrical and Computer Engineering
Vol:16, No:03, 2022

Intelligent Fault Diagnosis for the Connection Elements of Modular Offshore Platforms

Authors : Jixiang Lei, Alexander Fuchs, Franz Pernkopf, Katrin Ellermann

Abstract : Within the Space@Sea project, funded by the Horizon 2020 program, an island consisting of multiple platforms was designed. The platforms are connected by ropes and fenders. The connection is critical with respect to the safety of the whole system. Therefore, fault detection systems are investigated, which could detect early warning signs for a possible failure in the connection elements. Previously, a model-based method called Extended Kalman Filter was developed to detect the reduction of rope stiffness. This method detected several types of faults reliably, but some types of faults were much more difficult to detect. Furthermore, the model-based method is sensitive to environmental noise. When the wave height is low, a long time is needed to detect a fault and the accuracy is not always satisfactory. In this sense, it is necessary to develop a more accurate and robust technique that can detect all rope faults under a wide range of operational conditions. Inspired by this work on the Space at Sea design, we introduce a fault diagnosis method based on deep neural networks. Our method cannot only detect rope degradation by using the acceleration data from each platform but also estimate the contributions of the specific acceleration sensors using methods from explainable AI. In order to adapt to different operational conditions, the domain adaptation technique DANN is applied. The proposed model can accurately estimate rope degradation under a wide range of environmental conditions and help users understand the relationship between the output and the contributions of each acceleration sensor.

Keywords : fault diagnosis, deep learning, domain adaptation, explainable AI
Conference Title : ICCRFDM 2022 : International Conference on Control Reconfiguration, Fault Diagnosis and Modeling
Conference Location : Paris, France
Conference Dates : March 28-29, 2022