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Abstract

The advances in technology involving internet of things, cloud computing and big data mean a new perspective in the calculation of reliability, maintainability, availability and safety by combining physics-based modelling with data-driven modelling. This paper proposes an architecture to implement hybrid modelling based on the fusion of real data and synthetic data obtained in simulations using a physics-based model. This architecture has two levels of analysis: an online process carried out locally and virtual commissioning performed in the cloud. The former results in failure detection analysis to avoid upcoming failures whereas the latter leads to both diagnosis and prognosis. The proposed hybrid modelling architecture is validated in the field of rotating machinery using time-domain and frequency-domain analysis. A multi-body model and a semi-supervised learning algorithm are used to perform the hybrid modelling. The state of a rolling element bearing is analysed and accurate results for fault detection, localisation and quantification are obtained. The contextual information increases the accuracy of the results; the results obtained by the model can help improve maintenance decision making and production scheduling. Future work includes a prescriptive analysis approach.

Keywords: hybrid modelling, diagnosis, prognosis, synthetic data, condition based maintenance, rolling element bearing

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