Documents

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Gearbox bearing fault simulation using a finite element model reduction technique

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Abstract

The dynamics of a mechanical system such as a gearbox assembly comprising shafts, gears and bearings can be simulated using Lumped Parameter Models (LPMs). Finite Element Method (FEM) reduction techniques based on the Craig-Bampton method of Component Mode Synthesis (CMS) are useful in creating more accurate dynamic models. These models, despite having more degrees-of-freedom for the individual components than the LPM, make very much larger FE models computationally tractable. In this paper both these approaches, namely LPM and reduced FEM, are compared to create a dynamic model of a gearbox. Earlier simulation models (both LPM and combined LPM and reduced FEM) are further improved to better match the geometry of the bearing faults used in the experimental measurements, and the experimental results from a gearbox test rig. The dynamic model is used to simulate the vibration signals in the presence of localised inner and outer race faults. The new results show better correspondence with the measured signals, in particular with respect to the detailed response to entry and exit from the fault, which can be used to determine fault size. The paper highlights the plausibility of fault simulation in Machine Condition Monitoring (MCM) where a large amount of data can be gathered without experiencing large numbers of actual failures or carrying out costly and time consuming experiments until failure with seeded faults. The simulation data can be used to train neural networks to automate the diagnostic and prognostic processes.

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