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Improved simulation of bearing faults using a Finite Element Model reduction technique

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Abstract

The dynamic behaviour of a gearbox system was previously analysed using a Lumped Parameter Model (LPM), a reduced Finite Element Model (FEM) and a combined LPM and FEM model of the gearbox casing and the results presented in last year's conference. Further investigations on the simulation model indicated the presence of aliasing components in the response spectra. The simulation model has since been updated by using a revised FE model of the casing and addressing the errors detected in the previous model including aliasing. The FE model reduction was based on the Craig-Bampton method of Component Mode Synthesis (CMS) which has the ability to include modal properties of the gearbox casing and internals up to a much higher frequency. The reduced mass and stiffness matrices extracted from the FE model were imported into the dynamic model of the gearbox developed in Matlab/Simulink® which has the capability of simulating time-varying stiffness nonlinearities and geometric faults in the gears and bearings. The results of the updated simulation models are compared with a new set of measurements in the presence of extended inner and outer race faults in the bearings. The paper highlights the application of fault simulation techniques in Machine Condition Monitoring (MCM) and in the training of neural networks by being able to generate a large amount of vibration data without the need to conduct a large number of costly and time consuming experiments.

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