

Documents

Deshpande, L., Sawalhi, N., Randall, R.B.

Gearbox fault simulation using finite element model reduction technique

(2011) *Australian Acoustical Society Conference 2011, Acoustics 2011: Breaking New Ground*, pp. 322-328. Cited 2 times.

Abstract

Lumped Parameter Models (LPMs) are widely used to simulate the dynamics of mechanical systems such as shafts and gears in a gearbox. In addition to simulating the complex behaviour between the various components, LPMs can also be used to simulate vibration signals in the presence of gear and bearing faults. However, the limited representation of the modes of the gearbox casing and the internals (shafts and gears) in the LPM model results in poor spectral matching over a wide frequency range. Finite element analysis (FEA) provides an alternative approach to simulate the dynamic behaviour of the structure. However, the use of FEA results in a large number of degrees-of-freedom (DOF), requires large computing resources and presents additional difficulties to simulate the entire system's response in the presence of nonlinearities and gear and bearing faults. The limitations of LPM and FE models are addressed in this paper by using finite element model reduction techniques. FE model reduction based on Craig-Bampton component mode synthesis (CMS) is used to extract greatly reduced mass and stiffness matrices of the gearbox components (internals and casing) based on the frequency range of interest. The extracted mass and stiffness matrices are imported and assembled into the dynamic model of the gearbox previously developed using Simulink®. The model has the capability of simulating time-varying stiffness nonlinearities and geometric faults for both gears and bearings. The reduced matrices comprising both physical and modal coordinates enable inclusion of component flexibility in the dynamic model up to a specified frequency defined by the number of modes included. The dynamic model was solved interactively to obtain simulated vibration signals in the presence of extended inner and outer race bearing faults and compared with the measured signals.

2-s2.0-84871271011

Document Type: Conference Paper

Publication Stage: Final

Source: Scopus