Scopus

Documents

Sawalhi, N., Wang, W., Becker, A.

Vibration signal processing for spall size estimation in rolling element bearings using autoregressive inverse filtration combined with bearing signal synchronous averaging

(2017) *Advances in Mechanical Engineering*, 9 (5), . Cited 5 times.

Abstract
The main challenging area in the health monitoring of rolling element bearings is the quantification of the spall size using vibration data analysis. This is very crucial for maintenance planning and management decisions. In this article, we present a signal processing scheme for estimating spall sizes in rolling element bearings using autoregressive inverse filtration combined with bearing signal synchronous averaging. The squared envelope of the synchronously averaged signal and its autocorrelation function are used to estimate the spall size. The focus of the preprocessing algorithm using autoregressive inverse filtration resides in enhancing the weak step response events originating from the entry of a rolling element into the spalled region and balancing these with prominent impulse responses which occur when a rolling element strikes the trailing edge. Preprocessing is attained through whitening the shaft order tracked (angular resampled) signal using an autoregressive model based on the shaft synchronously averaged part (autoregressive inverse filtration). Autoregressive inverse filtration is compared to autoregressive filtration based on the raw vibration signal. The selection of the autoregressive model order is realized using Akaike criterion. The efficacy of the two autoregressive filtration algorithms is established by comparing time-domain signals, bearing signal synchronous averages, and their squared envelopes and autocorrelation function. This is done on simulated signals with well-known characteristics and on two sizes of naturally originated and propagated inner race spalls from a high-speed test rig. The sizes of these faults were large in a sense that the rolling element did not bridge over the spall, and this required an adjustment to the size quantification equation to fit this case, which has not been presented before. The combination of autoregressive inverse filtration and the squared envelope of the bearing synchronous averaging gives a superior enhancement to the step response and balances it with the impulse response. This provides the best accuracy in estimating the size of the spall, and unlike other existing algorithms, there exist no need for further processing using wavelets for instance. © The Author(s) 2017.

2-s2.0-85020046992
Document Type: Article
Publication Stage: Final
Source: Scopus
Access Type: Open Access