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Vibration energy trending and speed-frequency transformation in run-up/coast-down tests
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Abstract
Vibration data collected during a run-up and/or coast-down of machines gives useful indicators about their critical speeds and resonances. In this paper, a signal processing approach to interpret and utilize the start-up and coast-down data in an efficient and effective style is proposed. The vibration root mean squared values (RMS) for each shaft rotation is first trended by the aid of a tachometer signal. This RMS-speed trending provides a simple first examination of the transient data and proves very helpful if the system passes through a critical speed. A more detailed approach is used next, in which the power spectrum of each shaft rotation (speed) is extracted and plotted. This provides a speed-frequency transformation, analogous to the Short Time Fourier Transformation (STFT), in the sense that the frequency content is obtained for short time durations, but with the resolution that is very well comparable to the use of wavelets. The frequency content is taken on a shaft rotation basis, guided by the instances of the start of each shaft rotation. The window length is selected based on the lowest speed to maintain a uniform resolution, which means that the signal is zero padded at higher speeds where the actual shaft rotation length is shorter than the window length. The essence of this approach is illustrated and results in form of contour plots are compared to traditional STFT and Morlet wavelet analysis. © The Society for Experimental Mechanics, Inc. 2014.

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