

High Frequency Demodulation Technique for Instantaneous Angular Speed Estimation

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Many vibration monitoring methods use an accelerometer sensor in order to diagnose the systems. Instantaneous Angular Speed (IAS) has appeared to provide a new source of information on the rotating machine and it is commonly used to diagnose faults such as bearings faults [1], gearboxes [2], ...

Classically, IAS use an optical encoder as a speed sensor. This sensor is available in many rotating machines (especially for speed and position control). It provides a square / sine wave with a frequency proportional to the rotation speed. Thus, this signal is frequency modulated by the system speed variations. There are two major methods for recording IAS signal: timer / counter technics [3], and ADC- based methods [4]. The latter is limited by the capability of the ADC-board to collect the data (sampling frequency) which could restrict the use of higher encoder resolution and introduces spatial aliasing.

In this study, we are interested in IAS estimation using a super-heterodyne like demodulation technique. The idea is to be able to acquire the speed signal with relatively higher resolution without using a higher sampling frequency. The IAS signal is first analogously shifted in frequency domain in order to be acquired at a lower sampling rate. Then, the sampled signal is further treated to get IAS.

A first part recalls the classic IAS estimation methods and their limits. In a second part, a new technique is introduced for IAS estimation. The spectral components of the method are compared to the spectrum of the IAS signal estimated by elapsed time technique. At the end, the effect of noise is shortly discussed.

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