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”SIGPRO#2 - Time and angle analysis of Instantaneous Angular Speed signal: impact on average velocity and order spectrums”

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To this day, monitoring of rotating machinery by vibration signals has often relied on time-domain signal analysis, for bearing or gear faults to be recognized by the frequency at which they create their very specific impact. However, time domain analysis is not ideal for it implies assuming that the shaft rotates at a constant speed. Even if in certain conditions the rotating speed may be forced around a constant value for the need of the test, the assumption is not valid as long as the defects we are looking for have an impact on the rotating speed. To overcome this problem, an emerging approach consists in measuring the signal of Instantaneous Angular Speed (IAS) directly on the shaft, by the means of an angular coder: the €œElapse-Time€ method gives the angle-time relationship which allows one to get rid of the constant speed assumption, and analyze the system based on its true velocity. Knowing the true velocity also allows signal processing in the domain of angular frequencies, particularly useful for fault detection. In this paper, a one-degree-of-freedom rotating system is simulated under different periodic excitations, in order to extract its IAS signal. A study of the corresponding spectrums in terms of time-domain and angle-domain frequencies shows a shift in peak locations from one domain to the other. This interrogates the constant speed assumption used for order spectrum analysis, and shows a distinction between angle-averaged and time-averaged velocity.

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