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”FDP1#3 - Modelling and diagnosis of a crack of a bearing inner ring”

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Cracking of the inner ring of a bearing can occur for various reasons: poor handling during assembly, thermal stresses during start-up, etc. This results in a loss of tightness between the ring and the shaft with various consequences: fretting corrosion, heating of the inner ring leading to a reduction in the operating clearance and then to the blocking of the bearing, or even the rotation of the shaft in the bearing bore. The collateral damage can therefore be very significant. The difficulty in diagnosing a crack on the inner ring of a bearing is that it will generate a vibratory signature similar to that of other defects located on the inner ring (marking, corrosion, grooves due to the passage of leakage currents, etc.) but with very different consequences. With the experience accumulated at DYNAE in particular on paper machines, some veteran experts are able to identify a cracked ring simply by listening to the measured signal. However, a theoretical formalization of this technique seems desirable in order to achieve a reliable and semi-automated detection. This requires the modelling of the phenomena induced by a cracking and their associated vibratory signature. The method proposed here is based on the concept of Modal Kurtosis, as an improved version of the Spectral Kurtosis allowing to identify the frequency range in which shocks are the most readable, by considering the physical parameters associated with the excitation of the natural modes. The analysis of the envelope signal obtained after filtering is then performed in the spectral and time domains, by estimating the extent of the bearing load zone, the number of shocks per revolution due to rolling elements passing over the crack, and the attenuation factor of the spectral envelope of the modal response. The latter allows to identify another source of shocks, in particular a rotational shock due to a clearance. These processing allow an expert to orientate the diagnosis either towards a ring crack with loss of tightening, or towards other types of defects affecting the inner ring (spalling, grooves). Industrial case studies are presented to illustrate the technique.

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