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# Selection of Condition Indicators for Improved Gear Fault Detection

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## Abstract

Abstract: This study focuses on improving gear fault detection through improved the selection of condition indicators (CIs) used in component health determination. Given a set of CIs, a gear health indicator is built which is a function of the CI distributions. The health index value is then a composite of the CIs and represents a threshold setting process. In practice the CI used for gear fault detection were: residual kurtosis, residual crest factor, energy operator kurtosis, Figure of Merit 0, Amplitude Modulation Kurtosis and Frequency Modulation RMS. While no single CI can detect all gear failure modes, through testing, it was found that these analyses were sensitive to a wide variety of damage, such a soft tooth, cracked tooth and scuffing.

Residual RMS : 10.4913

NB Kurt : 8.1316

NB CF : 7.6465

G2 : 6.6145

Residual CF : 6.1483

Residual Kurt: 5.4878

SMLF : 5.0228

FM Kurt : 4.3065

FM RMS : 4.3028

AM RMS : 3.7933

AM Kurt : 2.3861

FM0 : 2.0513

Energy Kurt : 1.5531

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Energy CF : 1.3219

Gear Mesh : 0.8424

Energy Ratio : -0.33925

Recently, a deployed system recorded a large data set from three nominal gearboxes (approximately 100 acquisitions each), and a gearbox with a cracked tooth (270 acquisitions). This is a statically large data set which allows determining the statically separability between the nominal and damage gear CIs. This test was done for sixteen condition indicators. The results of the testing are given:

Clearly, the testing suggested a different mix of CI could improve the performance, as some analysis did not perform as well as other. The selection of the new set of CI is explained, as consideration for specificity (the residual and energy operator are not shaft specific, while G2, SL, NB, FM and AM analysis are specific to a gear), and the desire to provide limit risk using different types of analysis are taken. The new set of CIs were: Residual RMS, Energy Operator Kurtosis, Sideband Lifting, Narrowband Kurtosis, AM RMS and FM RMS.

Subsequently, data was taken for a two stage, bevel gearbox that had a propagating gear fault. This allowed the comparison in the gear health index between the new and old set of CI. Using the new CI set, the gear health index was approximately 3x more sensitive to gear fault.

Ref:

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