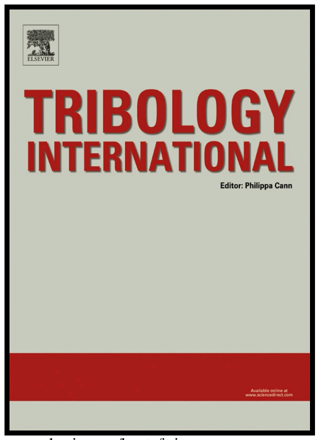
Author's Accepted Manuscript



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PII: S0301-679X(16)00117-1
DOI: http://dx.doi.org/10.1016/j.triboint.2016.02.032
Reference: JTRI4098

To appear in: *Tribiology International*

Received date: 30 October 2015
Revised date: 15 January 2016
Accepted date: 22 February 2016

Modelling Deep Groove Ball Bearing localized defects inducing Instantaneous Angular Speed variations

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Abstract

Instantaneous Angular Speed (IAS) analysis has been presented as an advantageous tool for non-stationary machinery surveillance. The physical analysis indicates that the instantaneous rotating speed variations are caused by torque perturbations. In a previous work, a method for introducing angular periodic disturbances in rotating systems dynamic models was presented. This analysis was based on the introduction of a parametric perturbation applied to the system as an external torque. The current work introduces an original formulation to induce tangential forces to the shaft due to the bearing components dynamics by means of a Hertzian contact roller bearing model. The methodology takes into account rotational bearing races and rolling elements degrees of freedom, making the model suitable for non-stationary conditions.

1. Introduction

The aim of the analysis of the roller bearing dynamics through theoretical models is to strengthen the understanding of the physical phenomena and to serve as a tool for the development of condition monitoring techniques[1]. The increasing development of the non-stationary domain as well as the growing and adaptation of the associated condition monitoring techniques [2–4] makes simulation a strong tool allowing the test of infinite operating conditions and mechanical components with small economical investment.

Among the technology being developed for the non stationary machinery domain, the Instantaneous Angular Speed (IAS) has been recently presented as a novel and promising technique for the surveillance of variable speed rotative machines. This technique has its origins on the methods for measuring transmission error on gearboxes with optical encoders [5]. The use of the angular sampling, which is a direct consequence of the utilization of optical encoders, eases the monitoring of non stationary machines by expressing the analyzed signals onto the angular domain. Different applications for IAS analysis have been explored, going from roller bearing fault detections to surveillance of electric machines [6–10]. The growing interest of the scientific community by this technique is shown in reference [11] where some guidelines are proposed to treat the terminology inherent to the IAS analysis, e.g. angle frequency, angular sampling. Interest readers will find on this reference a general overview of the IAS analysis.

Modelling becomes fundamental to understand the nature of the IAS perturbations leading to a better interpretation of the signals. However, few work have been focused

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