Title: Examining the misalignment of a linear guideway pair on a feed drive system under different ball screw preload levels with a cost-effective MEMS vibration sensing system

Authors: Guo-Hua Feng, Chia-Chun Wang

PII: S0141-6359(16)30445-7
DOI: http://dx.doi.org/doi:10.1016/j.precisioneng.2017.07.001
Reference: PRE 6611

To appear in: *Precision Engineering*

Received date: 30-12-2016
Revised date: 29-6-2017
Accepted date: 6-7-2017

Please cite this article as: Feng Guo-Hua, Wang Chia-Chun.Examining the misalignment of a linear guideway pair on a feed drive system under different ball screw preload levels with a cost-effective MEMS vibration sensing system.*Precision Engineering* http://dx.doi.org/10.1016/j.precisioneng.2017.07.001

Examining the misalignment of a linear guideway pair on a feed drive system under different ball screw preload levels with a cost-effective MEMS vibration sensing system

Guo-Hua Feng and Chia-Chun Wang

Department of Mechanical Engineering

National Chung Cheng University, Chiayi 621, Taiwan

Tel: 886-5-272-0411, Fax: 886-5-272-0589

Email:imeghf@ccu.edu.tw

Highlights

-
- On-line examining misalignment of a pair of linear guideway rails in a feed drive.
- Embedded MEMS vibration detection modules used for cost-effectively examination.
- Misalignment can be detected by analyzing the vibration signals from MEMS module.
- Characteristic frequency in a certain spectrum can be used as a misalignment index.
- Valuable for machine intelligence applications in the automation industry.

Abstract

This paper presents an innovative and cost-effective scheme for examining on line the degree of misalignment of a pair of linear guideway rails in a feed drive system. Prototype MEMS-based vibration detection modules were constructed and installed on the ball screw nut and linear guideway block. The ball screw preload was adjusted with four settings by changing ball sizes in this feed drive system. For each preload setting, a linear guideway rail was adjusted using feeler gauges to produce 11 misalignment statuses. The y-axis deviation caused by misalignment along the feed direction (x-axis) was measured with a dial gauge. For each preload and misalignment setting, the vibration signal was ascertained from the installed detection modules while the work table was driven by the controller. By analyzing the vibration signals from the detection module on the linear guideway block, we found that the characteristic frequency in a specific spectrum band could be used as a misalignment index. The characteristic frequencies exhibited a descending trend when the deviation was less than 40 μm and an increasing trend when the deviation was 40–120 μm. These findings demonstrate the feasibility of using cost-effective sensing units to examine the parallelism or distinguish the deviation between the linear guideway rails without disassembling the