Evaluation of a Knock Sensor for Gearbox Diagnosis

Keon Kim[1], Jong M. Ha[2], Jungho Park[3], and Byeng D. Youn[4]

[1,2,3,4]*Department of Mechanical and Aerospace Engineering, Seoul National University, Seoul, 08826, Republic of Korea*

keon.kim@snu.ac.kr,
billyhjm@snu.ac.kr,
hihijung@snu.ac.kr,
bdyoun@snu.ac.kr

ABSTRACT

A gearbox is one of the critical components in rotating machinery. Timely prediction of gearbox faults become of great importance to minimizing unscheduled machine downtime. Most of gearbox diagnosis studies are focused on the development of gearbox diagnosis algorithms using costly vibration sensors. However, vibration sensor cost matters in some applications, thus pushing to the use of a low-cost accelerometer, such as a knock sensor. This study develops a sensor evaluation process for the purpose of diagnosis. This study uses a planetary gearbox with a knock sensor, known to be cheap and good for high frequency applications (i.e., diesel engines). First, gearbox feature engineering is thoroughly studied through time domain and frequency domain analyses. This study uses the features that are most sensitive to gearbox faults, such as pitting and surface damages. Second, some sensor evaluation metrics (i.e., signal-to-noise ratio (*SNR*)) are overviewed for the purpose of diagnosis. The sensor evaluation study suggests a frequency range of the knock sensor that can be reliably used for fault diagnosis. Two case studies are presented to demonstrate the effectiveness of the proposed sensor evaluation process and metric: 1) one-stage planetary gearbox and 2) a swing reduction gear (two-stage planetary gearbox) in an excavator. It is concluded that a knock sensor can be used for the fault diagnosis of a gearbox.