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DETECTION OF GEAR TOOTH DEFECT BY FEA TECHNIQUE

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Abstract – *In gearboxes, load fluctuations on the gearbox and gear defects are two major sources of vibration. Further, at times, the measurement of vibration in the gearbox is not easy because of the inaccessibility in mounting the vibration transducers. Vibration analysis techniques used for detection of fault in the gear system. Fluctuation in gear load such as a method for monitoring the evolution of gear faults based on the newly developed time-frequency analysis through FEA, in which analysis is carried out with the decomposed current signal to trace the sidebands of the high frequencies of vibration.*

It is also a helpful tool for health monitoring of gears. The acoustic signal can be used effectively along vibration signal to detect the various local faults in gearboxes using the wavelet transform technique. Two commonly encountered local faults, Scoring, Pitting, Tooth Breakage and Tooth Fracture, were simulated. In fault simulating, two very similar models of worn gear have been considered with a partial difference for evaluating the preciseness of the proposed algorithm. Moreover, the processing of vibration signals has become much more difficult because a full-of-oil complex gearbox system has been considered to record raw vibration signals. It is observed that vibration analysis is a very popular technique. Vibration analysis technique shows that the defects in the gearbox can be detected at very early (embryonic stages), which reduces the cost of detection and diagnosis.

Key Words: **Gearbox, Defects, Vibration, Acoustics, Diagnosis, Raw vibration Signals**

1. INTRODUCTION

Gear Box constitutes a very vital link in the transmission chain of a variety of equipment and machinery. The earliest drives used cylindrical rods inserted radically in one wheel meshing with similar rods mounted axially in another wheel. This type of drive performed satisfactory, though inefficiently, at low speeds and low loads but the trouble was encountered as soon as load or speed was raised. The increasing trend towards predictive maintenance has led to the development of a vast number of machine condition monitoring techniques. Of these techniques, vibration analysis and oil analysis are the two distinct and most readily used methods in determining mechanical failures in common components of industrial machinery such as gears and bearings. Gear mechanisms are an important element in a variety of mechanical systems. For that reason, early fault detection in gears has been the subject of intensive investigation, and many methods based on vibration signal analysis have been developed. Conventional methods include crest factor, kurtosis, power spectrum estimation, time-domain averaging and demodulation, which have proved to be effective in fault diagnosis and are now well established.

1.1. ACOUSTIC EMISSION

Acoustic emission(AE) for condition monitoring in rotating machinery is relatively new and has grown significantly over the last decade. As AE mainly detects high-frequency elastic waves, it is not affected by structural resonances and typical mechanical background noise (under 20 kHz). The AE from helical gears based mainly in the root-mean-square of the recorded signals.AE to spur gears in a gearbox test-rig. They simulated pits of constant depth, but the variable size and AE parameters such as energy, amplitude and counts were monitored during the test. AE was proved superior over vibration data on early detection of small defects in gears.

1.2 Vibration analysis

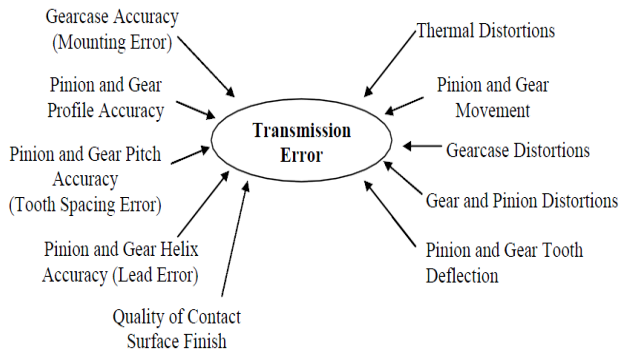
Vibration analysis is a well-developed technique for machinery fault diagnosis. A large number of research papers on vibration-based fault detection and diagnosis have been published. When there is a force variation in a gearbox, the component will generate a vibration. This vibration is then transmitted to the surrounding structure, and therefore noise and vibration will be generated in the gearbox.

2. Transmission Error

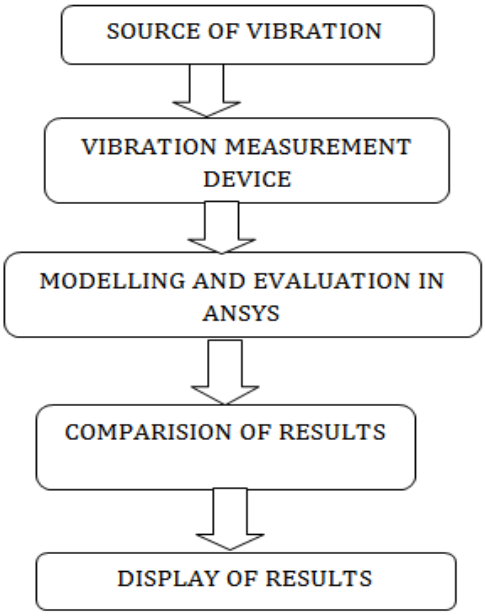
In this paper, we study vibration analysis & transmission error for detecting gear tooth defect.

Transmission error (TE) is generally considered to be the primary excitation mechanism for gear noise and vibration. According to, a transmission error is defined as ―the difference between the actual position of the output gear and the position it would occupy if the gear drive were perfectly conjugate‖. Vibration signal analysis is an important tool to experimentally investigate gear vibration because gears generate vibrations at specific frequencies, which are related to the number of gear teeth and the rotational speed of the gear shaft.

Factors affecting transmission error:



Steps for detecting a fault in the system



Project Methodology

– To collect vibration signature of good gears and defective gear (missing tooth) from Gearbox Dynamics Simulator (GDS).

– Real-time vibration signatures of good and defective gears are to be acquired with the help of accelerometers using Data Acquisition System (DAS).

– Solid Works been used for modelling of gearbox containing good and defective.

– The same model will then exported to ANSYS 14 for simulation and further analysis.

– Transient analysis would be carried out initially with only two spur gears, gearbox housing and the two shafts to get the feel of simulation and analysis in FEM environment.

3. CONCLUSIONS

It observed that vibration analysis is better compared to other monitoring techniques. Vibration analysis is a very popular technique to reduce costs and facilitate diagnosis. When the meshing characteristics are disturbed by a defective tooth, this will change the noise content of the acoustic signal when compared with the sound of healthy operation. The objective of this project is to identify the defects in gearbox in embryonic stages to minimize the damage by the method of early detection of gearbox faults.

Hence, the validation and vibration analysis technique shows that the defects in the gearbox can be detected at very early (embryonic stages), which reduces the cost of detection and diagnosis.

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REFERENCES

1. S. M. Metev and V. P. Veiko, Laser Assisted Microtechnology, 2nd ed., R. M. Osgood, Jr., Ed. Berlin, Germany: Springer-Verlag, 1998.

2. J. Breckling, Ed., The Analysis of Directional Time Series: Applications to Wind Speed and Direction, ser. Lecture Notes in Statistics. Berlin, Germany: Springer, 1989, vol. 61..

3. M. Shell. (2002) IEEEtran homepage on CTAN. [Online]. Available:http://www.ctan.org/texarchive/Macros/latex/contrib/supported/IEEEtran/

4. FLEX Chip Signal Processor (MC68175/D), Motorola, 1996.

5. R. E. Sorace, V. S. Reinhardt, and S. A. Vaughn, "Highspeed digital-to-RF converter," U.S. Patent 5 668 842, Sept. 16, 1997.