Diagnostic Approaches for Gears and Bearings

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ABSTRACT

The aim of this study is to detect and to identify the presence of faults on elements of a mechanical system. The considered mechanism is a one stage geared system. It is constituted of two shafts, each supported by two bearings and coupled with helical gears. Rotating speeds can be varied up to 6000 rpm and loads from 0 to 150 Nm. The work takes place in a research program dealing with the definition of maintenance procedures applied on gearbox.

Faults are simulated on both gears and bearings. Local and uniformly distributed faults were considered for helical gear; the local fault (spalling) was created as a strip of metal removal along the pitch line on one tooth, uniformly distributed fault (scuffing) was created by gradually removing lubrication. Local faults were created on roller and ball bearings inner race.

The measured system responses were accelerations and transmission error. Accelerometers were placed near each defective bearing and 'through shaft' optical encoders were mounted at each shaft end. Several combinations of faults were studied. Operating conditions are two speeds (1300, and 2300 rpm) and two loads (60 and 120 Nm).

Acceleration measurements provide the essential of the information about the bearing condition, while transmission error measurements provide the suitable information about gear condition. Signals were processed in spectrum and cepstrum domains. The presence of faults induces modification for the measured responses. Indicators were established by comparing the system responses with and without faults in the different analysis domains. Further investigations were made in order to optimize the number of used sensors.

The combined measurements and the applied procedures provide a powerful tool for the detection and the identification of the combined faults.

Keywords: Preventive Maintenance, Diagnostics, Fault Detection, Experimental simulation, signal Processing.