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Numerical Analysis of Lubricant Viscosity Variations on Operating Condition of Helical Gear System

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Abstract

This study presents dynamic model to investigate the effects of lubricant viscosity variations due to oil degradations or oxidations on both power supply parameters and vibration signals of helical gear system. The modelling has been extended to consider the effect of elastohydrodynamic lubrication (EHL) conditions to include the frictional effects between the meshed helical gear. A ten degree-of-freedom (10-DOF) model has developed to combine lateral, torsional and axial vibrations induced in helical gear transmissions with supporting bearings, powerful motor and applied load system. Additionally, it takes into accounts the effect of viscosity variations on both power supply parameters and vibration characteristics through the time-varying of EHL friction coefficient. The results conclude that an increase in the lubricant viscosity will increase internal fluid friction, which results in additional excitation of vibration, especially in the off-line-of-action (OLOA) direction. Also, the required input power of the motor is increased to overcome the higher friction power that occurred with using thicker lubricant. However, the vibration responses from both rotational and translational movements can be good indicators for lubrication conditions, where the translational one is more sensitive even though the rotational responses are generally more nonlinear. These changes mean that it is possible to use vibration signature to monitor the lubrication conditions and obtain an accurate diagnostic result for tooth surface defects.

Keywords

dynamic model; vibration response; elastohydrodynamic friction; oil viscosity.