

Dynamic Analyses of Gear Pairs Incorporating the Effect of Time-varying
Lubrication Damping
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Abstract

This study presents a time-varying model to investigate dynamic responses of spur gear pairs. In particular, time-varying damping was directly used to account for the lubrication film of tooth pairs. At first, the governing equations of vibration for gear pairs were expressed in equivalent discrete models of mass, damping, and spring elements. The damping factor which incorporated the lubrication effect was derived using elastohydrodynamic-lubrication and squeezed-film theories. The time-varying property due to the moving meshing position was considered by immediately updating the meshing stiffness, damping factor, meshing force, and frictional force between the tooth pairs at each calculation step. After that, dynamic factors and fillet strains of the gear pairs under various operating conditions were obtained by performing iterative numerical integrations. The lubricant damping factor and its effects on gear dynamics were also discussed. Finally, the effects of the lubricant viscosity and applied torque on the gear dynamics were thoroughly investigated.

Keyword : spur gear pair, lubrication, damping, dynamics, squeezed-film theory