MODAL AND DYNAMIC ANALYSES OF PLANETARY GEAR SYSTEMS BY A FINITE ELEMENT APPROACH

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Abstract

This study investigates the dynamic behavior of planetary gear systems (PGSs) using a finite element (FE) package. Using the derived tooth profile equations, analysis elements of gears can be parametrically created. Then, the dynamic 2D/3D FE models of planetary gear system (PGS) are constructed under assembly constraints. After adequately assigning the materials, boundary conditions, and tooth contact conditions, structural natural frequencies and modal shapes are firstly resulted. A defined index, dimensionless slope, is used to characterize the relation of the PGS modal property and stiffness. Therefore, influence of component or system bearing stiffnesses on modal behaviors are abundantly investigated including the carrier material as well. Accordingly, several results relating the modal characteristics of PGSs to material and bearing stiffnesses are attained. Additionally, dynamic responses of PGSs are also calculated. Dynamic fillet stress and loading inequality among gear pairs due to bearing stiffness deviation are analyzed. This FE approach can conveniently demonstrate the modal and dynamic behavior of PGSs. Its extension to the dynamic problems of wide PGS categories is also expected.

Keyword：Planetary gear system, stiffness, modal analysis, finite element, dynamics