TIME VARYING APPROACHES TO DYNAMIC ANALYSIS OF A PLANETARY GEAR SYSTEM USING A DISCRETE AND A CONTINUOUS MODELS

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Abstract

This study proposes two approaches of the time varying models to analyzing dynamics for an involute planetary gear system, that are respectively using a conventional discrete model of the equivalent mass-damping-spring elements and a continuous geometry model by the finite element method. In the discrete approach, numbers, positions, phasing differences of the meshing tooth pairs are described by time varying and nonlinear meshing stiffnesses. Natural frequencies, deformations, meshing forces, fillet stresses, and dynamic factors can be calculated by using the Jacobi transformation and the Runge-Kutta integration. In the continuum approach, dynamics of the planetary gear system are analyzed using the software, LS-DYNA. The approach of the continuous geometry model can incorporate the time varying properties intrinsically. In this continuum study, not CAD models, high quality mesh elements of the planetary gear system are automatically generated directly using the derived tooth profile equations. After assigning initial and boundary conditions, dynamic responses for the planetary gear system are solved. Fillet stresses resulting from the both approaches are verified by each other comparisons. Potentially, the continuum approach can extensively and sophistically analyze dynamics problems of the planetary gear systems.

Keyword：Planetary gear system, Dynamic analysis, Meshing phase, Finite element, Continuum contact force, LS-DYNA