Implementation of Galerkin's method and modal analysis for unforced vibration response of a tractor suspension model

ABSTRACT

This study provides a numerical tool for modeling and analyzing of a two degree of freedom suspension system that is used in farm tractors. In order to solve the corresponding coupled system of equations, dynamic modal expansion method and matrix transformation technique were first used to formulate the problem and to obtain the natural frequencies and modes of the tractor rear axle suspension. Galerkinôs method over the entire time domain was then employed to analyze the modal equation of motion for the unforced response. It was shown through calculations that the algorithm over entire time domain could not be generalized for computer implementation. In order to develop a stand-alone algorithm implementable in any programming environment, Galerkinôs method was applied over smaller elements of time domain. The modal and vertical equations of motions describing the suspension system were then solved numerically for both with and without damping cases. The program was used successfully to solve the actual coupled equations and to plot the results. Finally, for the damped case, where stability of the system was expected, the numerical results were confirmed through Lyapunov stability theorem.

Keyword: Galerkin's method; Modal analysis; Numerical method; Tractor suspension; Unforced vibration