Nonlinear dynamics of a geometrically exact beam subjected to a moving mass

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Abstract

This work derives the governing equations of motion for the Reissner-Simo geometrically exact (GE) beam (1-2) subjected to a moving mass. The motion of the moving mass is externally controlled and specified relative to the beam. These governing equations are applicable to any general motion of the mass. A nonlinear finite element (NLFE) method is developed to obtain the finite element equations of motion for the system, with Newmark's time integration scheme employed to solve these equations. The response of the GE beam and moving mass system is analyzed for scenarios involving uniform motion, acceleration, and controlled actuation of the mass. The formulation is validated using classical example problems from the literature. Finally, the developed method is applied to investigate the nonlinear dynamics of a hanging cable under a moving mass, considering both ascending and descending mass scenarios to solve various initial-boundary value problems (IBVPs).

References:

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