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Geometric nonlinear dynamic analysis of curved beams using curved beam element

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Abstract Instead of using the previous straight beam element to approximate the curved beam, in this paper, a curvilinear coordinate is employed to describe the deformations,and a new curved beam element is proposed to model the curved beam. Based on exact nonlinear strain-displacement relation, virtual work principle is used to derive dynamic equations for a rotating curved beam, with the effects of axial extensibility, shear deformation and rotary inertia taken into account. The constant matrices are solved numerically utilizing the Gauss quadrature integration method. Newmark and Newton – Raphson iteration methods are adopted to solve the differential equations of the rigid-flexible coupling system. The present results are compared with those obtained by commercial programs to validate the present finite method. In order to further illustrate the convergence and efficiency characteristics of the present modeling and computation formulation, comparison of the results of the present formulation with those of the ADAMS software are made. Furthermore, the present results obtained from linear formulation are compared with those from nonlinear formulation, and the special dynamic characteristics of the curved beam are concluded by comparison with those of the straight beam.

Keywords: Curved beam element Geometric nonlinear formulation Rigid-flexible coupling

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