SM25L_12694

XXI International Congress of Theoretical and Applied Mechanics
Warsaw, Poland, August 15–21, 2004

Discontinuous Transformations and Averaging for Vibro-Impact Analysis

Jon Juel Thomsen[(1)], Alexander Fidlin[(2)]

(1) *Technical University of Denmark, Kgs. Lyngby, Denmark*
(2) *LuK GmbH & Co. oHG, Buehl, Denmark*

Certain vibro-impact problems can be conveniently solved by discontinuous transformations combined with averaging. We briefly outline the background for this, and then focus on illustrating the procedure for specific examples: A self-excited friction oscillator with one- or two-sided stops, and a particle on a vibrating plane. Vibro-impact systems are characterized by repeated collisions. Applications include devices to crush, grind, forge, drill, punch, tamp, pile, cut, and surface treat a variety of objects, and vibrating machinery or structures with slips and stops. Compared to the classical method of stitching (together non-impacting solution parts), the suggested procedure works even in the presence of additional nonlinearities, and provides analytical solutions without switching conditions. By contrast to the method of equivalent linearisation, it assumes a kinematic rather than kinetic impact formulation. Approximate methods in this area are necessary, and averaging with discontinuous transformations is believed to be a useful supplement.

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