Approximations in an investigation of the vibro-impact dynamics of rolling bodies in successive central collisions on curvilinear trace

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Abstract

Paper present methodology of a possible interrogation of the vibro-impact nonlinear dynamics of two rolling bodies in series of the successive central collisions on curvilinear trace. Curvilinear trace consists of thee circle arches. Two rigid rolling bodies are with an axis of symmetry and one plane of symmetry and with different dimensions of circle cross section in the plane of symmetry. Each collision in series of the successive collision between rolling bodies is central collision. Between two successive collisions of two bodies are in rolling motion along corresponding branch of curvilinear tracing. For investigation of the kinetic parameters and discrete singular phenomena of vibro-impact dynamics of defined system, we use method of phase trajectory portraits, surface of system total mechanical energy and portraits of system constant total mechanical energy curves of rolling motion of each of bodies on curvilinear trace between two successive collisions from the series of the successive collisions. Also, theory of collision between rolling bodies is used for determination outgoing angular velocities after each collision necessary, as initial condition for each next phase trajectory branch between two successive collisions. For obtaining position of each rolling body on curvilinear trace at corresponding collision between two rolling bodies it is necessary to use approximations of the series of elliptic integrals and solving numerically series of the nonlinear transcendent equations. These numerical tasks are not simple, because need previously prognosis of the possible position of each of two bodies in position of collision along each of the circle arch as an branch of the complex curvilinear trace. Then it is necessary to summarize corresponding time intervals of motion of each of bodies up to corresponding position of collision. Next ii is to compose corresponding nonlinear transcendent equation by sums time intervals of each of rolling body along circle arches. For defined mechanical model, depending of radiuses of circle arches in curvilinear rolling trace, and radiuses of circle cross section in plane of body symmetry of each

of rolling bodies, different combinations of phase trajectory portraits appeared. These phase trajectory portraits are with different positions of singular points and different forms of separatrix - homoclinic phase trajectories. We take into investigation one particular case with trigger of coupled three singular points and with an homoclinic phase trajectory in the form of number eight. Same conclusion of energy jumps between rolling bodies in series of successive collisions are presented. For same basic elements and details for obtaining new research result presented in this contribution see the following list of the References: [1], [2], [3], [4], [5], [6], [7], [8] .

Keywords: Vibro-impact dynamics, Rolling bodies, Approximation

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