Spatial Impact of a Beam Attached to a Sliding Structure

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Abstract

Dynamic simulation of impact in multibody system is of great interest for scientists and engineers in many different areas - robotics, biomechanics, computer animations and/or virtual reality are just a few examples. Simple or multiple impacts/collisions - contact event(s) that occurs at a common point of contact – in multibody dynamics presents many challenges. Due to the complexity of the impact dynamics, the development of various methods for predicting the behavior multibody systems (as for example kinematic chains) after collision is considered desirable. Analytical solutions of the post impact velocities (in terms of pre-impact velocities) may be obtained through the use of the classical rigid body collision theory formulated in terms of Newton's fundamental principles (law of motion) and Coulomb's friction model. In addition, the knowledge of some material constants such as coefficient of restitution and coefficient of friction are required.

In this paper, the dynamics of a spatial impact of a rigid beam attached to a sliding structure - two-link chain - with an external surface (Fig. 1) is considered. The normal impulsive forces – considered in differential formulation of the equations of impact – are determined by combining the elastic-plastic indentation theory (Johnson [5]) with the classical Hertzian contact theory (Goldsmith [2]). To reflect dissipation in the contact/impact area and energy loss during impact the force-deformation model includes damping. Velocity, impact force and kinetic energy are investigated for different incident impact angles of the beam in an impact process which consider friction at the contact point. The two-link chain impact is studied numerically and the results are compared against the experimental data for validation.

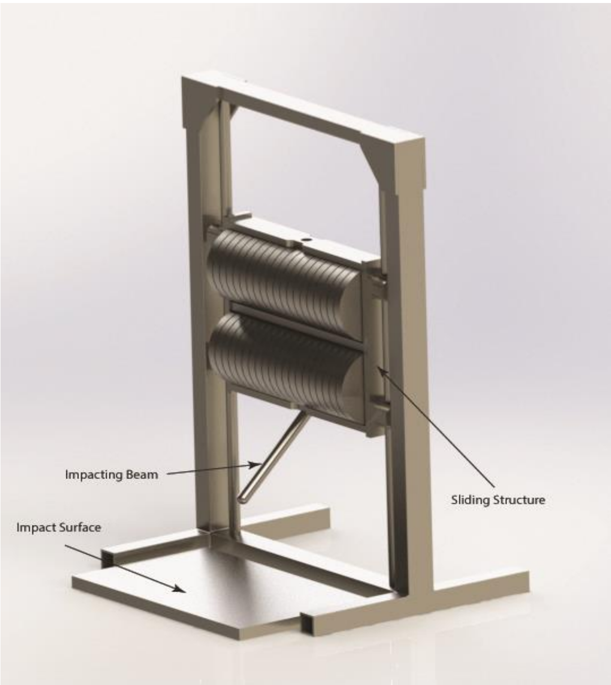

Figure 1: Impacting rigid beam attached to a sliding structure

References

[1] R. M. Brach, “Rigid Body Collisions”, ASME J. of Appl. Mech., 56, 133-138, (1989)

[2] P. Flores, J. Ambrosio, J.C.P. Claro, H M Lankarani, Influence of the contact–impact force model on the dynamic response of multi-body systems, Proc. IMechE Part K: J. Multi-body Dynamics, Vol. 220, 21-34, 2006

[3] K. L. Johnson, Contact Mechanics. (Cambridge University Press, 1985)

[4] J. B. Keller, “Impact with Friction”, ASME Journal of Applied Mechanics, 53, 1-4 (1986)

[5] W. J. Stronge, “Rigid Body Collisions with Friction”, In Proceedings of Royal Society, London, A 431, 169-181, (1990)