Numerical analysis of the bouncing ball on the elastic beam

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Modeling non-smooth mechanical systems with unilateral constraints presents significant challenges, particularly in accurately representing contact dynamics and handling velocity discontinuities. This research investigates a dynamic scenario involving a ball bouncing on a deformable beam, illustrating the complexity of contact interactions between rigid and deformable bodies. In this study, the deformable beam is modeled using the finite element method, while the contact interactions are resolved using the Moreau–Jean method [1]. This time-stepping approach maintains a constant time step during simulations, making it particularly effective for systems with frequent contacts. It offers greater efficiency and accuracy compared to event-driven schemes that require very small time steps to handle frequent contact events. Special attention is dedicated to analyzing the effects of different beam stiffness values to precisely evaluate their influence on system dynamics. Additionally, the research investigates how variations in Newton's coefficient of restitution influence the overall behavior of the system. The study also addresses numerical damping phenomena that arise during simulations when employing the Moreau–Jean method, providing a comprehensive understanding of its implications on the accuracy and stability of the results.

References

1. Jean, M. (1999). "The non-smooth contact dynamics method". Comput. Methods Appl. Mech. Engrg. 177, 235–257.

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