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Theoretical and Experimental Investigation of the Interaction Behavior of a Bouncing Ball Upon a Flexible Surface Impacted in Two Dimensions

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Abstract : The ball bouncing problem is a well-known problem in physics involving a ball dropped from a height to the ground. In this paper, the work investigates the theoretical and experimental setup that describes the dynamics of a rigid body on a chaotic elastic surface under air-damp conditions. Examination of four different types of balls is made, including marble, metal ball, tennis ball, and ping-pong ball. In this experiment, the effect of impact velocities is not considered; the ball is dropped from a fixed height. The method in this work employs the Rayleigh Dissipation Function to specify the effects of dissipative forces in Lagrangian mechanics. Our discoveries reveal that the dynamics of the ball exhibit horizontal motion while damping oscillation occurs during the destabilized vertical pinch-off motion. Moreover, rotational motion is studied. According to the studies of four different balls, the outcomes illustrate that greater mass results in more frequent dynamics, and the experimental results at some points align with the theoretical model. This knowledge contributes to our understanding of the complex fluid system and could serve as a foundation for further developments in water droplet simulation.

Keywords : droplet, damping oscillation, nonlinear damping oscillation, bouncing ball problem, elastic surface
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