

Stable and Unstable Periodic Motions in a Bouncing Ball Model

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Abstract

We consider the vertical motion of a free falling ball bouncing elastically on a racket moving in the vertical direction according to a regular 1-periodic function f . For fixed coprime p, q we study existence, Lyapunov stability and multiplicity of (p, q) -periodic motions. These are p -periodic motions making q bounces in a period. We prove that if $f \in C^3$ and p/q is large, there always exist at least two (p, q) -periodic motions.

We are interested in the stability, in the sense of Lyapunov, of these motions. First we prove that if f is analytic, at least one is unstable. Then, under quantitative conditions on f we prove that there exists an infinite sequence of stable motions with $q = 1$. As a consequence, we get an open and unbounded set of initial conditions giving rise to bounded motions.

References

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