Animating Newton's Cradle

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1 Aim(Question posed and why its interesting)

The purpose of this project is to animate Newton's Cradle from first princples. Newton's Cradle has been animated before however usually via a 'physics-free' key-frame method or one reliant on a complicated physics engine. It will demonstrate how strikingly real world behavior can be computed with simple, first-principles approach mathematical framework. It will also make apparent the issues which arise with numerical calculus techniques.

2 Method(Basic approach)

"Newton's cradle can be modelled as mutilple pendulums confined to swing along a single axis which undergo elastic collisions with one another. The pendulums rest such that there is a small amount of horizontal displacement between them."

2.1 Equal mass pendulums

- Has its own 1-dimensional co-ordinate system (θ_i)
- Obeys differential equation

$$\ddot{\theta}_i = -\frac{g}{\ell}\sin(\theta_i)$$

- Has some Δx_i along the x-axis, so they are 'almost touching' at rest.

2.2 Equal density pendulums

- Has length ℓ, radius r_i, mass $m_i = \frac{4\pi\rho}{3}r_i^3$ where ρ is a metal density.

3 Results(Notable results - the best or final output of code)

4 Conclusions(Answer to your question/Summary)