Lecture 3: Jump up and down and move it all around

ACM 206, April 20, 2023
Solar system collisions

Figure: “The planets move one and the same way in orbs concentric, some inconsiderable irregularities excepted which may have arisen from the mutual actions of comets and planets on one another, and which will be apt to increase, till this system wants a reformation.” (Newton, 1706)
Model details:

- Used the 4th-order WHCKL symplectic integrator and corrections due to general relativity, with an 8-day time step.
- Added 1cm random perturbations to Mercury’s position every .2 Gyr.

Figure: 8 planetary orbits (astronomical units)
Figure: 2750 simulations: low Mercury frequencies indicate Mercury crashing into Venus or the Sun.
Figure: Expensive N-body simulations.

Figure: Cheap fractional Brownian motion simulations.
Motivation

Fractional Brownian motion model

Model

Figure: Expensive N-body simulations.

Figure: Cheap fractional Brownian motion simulations.