Visualization of the Tidal Locking Phenomenon through Simulation

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Tidal lock is a phenomenon that gravitationally “locks” the orientation of an orbiting body toward the other body. A good example is the Moon facing the Earth always with the same face. Moon’s one day is exactly one year. This research seeks to understand and visualize the phenomenon using a computer simulation. First, the accuracy of algorithm for solving a multi-body differential equation is confirmed by solving a three body problem using known quantities: the masses of the Sun, Earth, and Moon as well as their velocities. The well-known and familiar motion was successfully reproduced. Then the Earth was broken into 9 equi-mass bodies arranged in regular octagon plus one in the center. The distance from the center of the octagon to its vertices is set to be the radius of the Earth. These 9 bodies were connected by an imaginary spring of constant k whose value was determined iteratively/empirically. This system of 9 bodies plus the Sun was too much for the algorithm to handle, and the computer ran out of memory. Thus the simulation was simplified to only have the multi-mass regular-polygon-shaped earth with no translation but only rotation at the center. Then symmetric gravity was applied by two stationary Suns at opposite equidistant locations. The simulation in this simplified configuration was able to graphically visualize and demonstrate the effect of tidal lock at different spring constants.

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