Chaotic Behavior in Restricted Three Body Problem

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Project Proposal

A circular restricted three body problem (CR3BP) assumes a system of three masses of which two are in circular motion around each other and another one moving in the field of these two, has negligible effect on the total potential of the system. I consider earth-moon system along with a rocket thrown at an

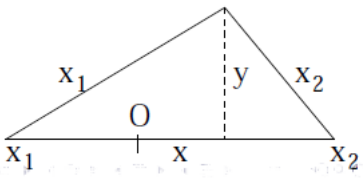

Figure 1: Setting up the coordinate system.

angle ϕ with the x-axis (figure) towards moon in the plane of rotation of the earth and the moon. Hence, this is a planar circular restricted three-body problem (PCR3BP). Let C be the sum of K.E. and an effective potential, r_i

be the distance of the rocket from the two bodies and v be its velocity given as follows:

$$r_i^2 = (x - x_i)^2 + y^2 + z^2 \quad and \quad v^2 = (\frac{dx}{dt})^2 + (\frac{dy}{dt})^2 + (\frac{dz}{dt})^2 \tag{1}$$

$$C = \frac{1}{2}v^2 + V \quad where \quad V(r) = -\frac{1}{2}(x^2 + y^2) - \frac{1-\mu}{r_1} - \frac{\mu}{r_2} \tag{2}$$

For each pair of (C,ϕ) I follow the trajectory

$$\frac{d^2r}{dt^2} = -\Delta V \tag{3}$$

Problem 1: Set of trajectories which reach a distance D from the center of mass after a time T can be found.
Problem 2: I need to find those initial conditions which give rise to chaotic trajectories.
Possible approach: embarrassingly parallel program.