University of Oulu
Astronomy and Space Physics
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Exercise Problems — Part 7, computer exercise

(Due Date: Wednesday, 02.12.15, *before* the exercise. For the computer exercise send me the IDL code per mail.)

1. Dynamics in the restricted circular three body problem

Download from the noppa page of the course the `IDL` routine `RTBDynamics.pro`. This routine provides a template for the integration of the dynamical equations of the restricted circular three body problem. The routine contains already the main loop for the numerical integration and it is setting up initial conditions.

(a) First you need to code up in the function `rhs` the set of *first order* ordinary differential equations that correspond to the equations of motion of the problem *in the plane*, as we have derived them in the lecture

$$\begin{aligned} \ddot{x} &= 2n\dot{y} + n^2 x + \mu_1 \frac{x_1 - x}{r_1^3} + \mu_2 \frac{x_2 - x}{r_2^3} \\ \ddot{y} &= -2n\dot{x} + n^2 y - \mu_1 \frac{y}{r_1^3} - \mu_2 \frac{y}{r_2^3} \,. \end{aligned}$$

These are second order and we must transform them into a set of first order equations. The coordinates x and y are defined in the rotating reference frame. Here, n is the mean motion (which we set $n = 1$), μ_1 and μ_2 are the *scaled* (see lecture) masses of the primaries, and $r_1^2 = (x - x_1)^2 + y^2$, $r_2^2 = (x - x_2)^2 + y^2$. Run the routine and try out several test cases (call the routine with keywords `horseshoe` and `tadpole` set to 1 or 2, respectively).

(b) The routine has the keyword `inertial`, which, if set, shall transform the coordinates for the plot on the screen to the *inertial* frame. But the transformation rules must still be coded. Search in the routine for the comment `TRANSFORMATIONS TO THE INERTIAL FRAME`. These are the places where the transformation must be made. You find the transformation rules in the lecture notes.