RESTRICTED 3-BODY PROBLEM

Due date: 2/1/2018, 9am

Continuing with our exploration of ordinary differential equations, here we address the restricted three-body problem in which a massless particle moves in the gravitational field of two massive objects that orbit their mutual center of mass.

a) Plot $\psi(r)$ and $\mathbf{F}(\mathbf{r})$ in 2D and 3D.

b) Determine the location of Lagrangian points and study their stability. In particular, determine the value of $q = M_2/M_1$ for which L_4 and L_5 become unstable.

c) Using the Runge-Kutta and/or Bulirsch-Stoer integrators, study the orbits of Trojan and Greek asteroids. How sensitive are the orbits to initial conditions? Can you find initial conditions that result in periodic orbits?

d) Plot the shapes of stars for different values of the equipotential $\Omega(\rho)$:

$$\Omega = \frac{1}{\rho} + q\left[(\rho^2 + 1 - 2\rho\lambda)^{-1/2} - \rho\lambda\right] + \frac{1}{2}\rho^2(1+q)(1-\nu^2).$$

Do not forget that you are solving this in a rotating coordinate system. Hence you need to be careful about the initial conditions.