Computational Physics Problem Set 7

John Ferrante

October 29, 2024

GitHub: https://github.com/jferrante25/physga-2000

1 Problem 1 (Newman 6.16)

Part A: at the Lagrange point, the net gravitational acceleration of the satellite from the earth and the moon on the satellite will equal the centripetal acceleration of the satellite, which is v^2/r assuming circular orbit:
$GM/r^2 - Gm/(R-r)^2 = v^2/r = (r\omega)^2/r = \omega^2 r$.
ω is the angular velocity of the moon about the earth, and satisfies:
$\omega^2 R = GM/R^2$ so,
$\omega = \sqrt{GM/R^3}$ and
$GM/r^2 - Gm/(R-r)^2 = \omega^2 r = (GM/R^3)r$

So the function whose roots are to be found is

$f(r) = GM/r^2 - Gm/(R-r)^2 - (GM/R^3)r$

Defining r'=r/R m'=m/M and rescaling the equation gives equivalently:

$f_{\text{new}}(m', r') = G(1/r'^2 - 2/r' + 1) + -Gm' - G(r' - 2r'^2 + r'^3)$

Part B:
moon-earth L1: r = 326312344.2669856 m
earth-sun L1: r = 147247261593.24622 m
jupiter mass-sun L1: r = 138813464321.1848 m

2 Problem 2

The scipy function and my implementation yield roughly the correct answer of 0.3 when the brackets are placed fairly close around this value, but give different answers when the brackets do not center closely about it. My implementation was not as accurate as the scipy implementation.