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clear

% shoot the moon


G=6.7e-11;                  % gravitational constant
t=0; x=0; y=0;
mEarth = 5.9742e24;         % mass of the earth
rEarth = 6.378e6;           % radius of the earth

rMoon = 1.737e6;            % radius of moon
mMoon = 7.35e22;            % mass of moon

Rmoon = 385000000 + rEarth + rMoon;    % earth moon distance center to center



% initial parameters for moon orbit
t(1) = 0;                   % start time
x(1) = 0;                   % initial x position
y(1) = Rmoon;               % initial y position
vx(1) = -1023;              % initial x velocity
vy(1) = 0;                  % initial x velocity

% initial parameters for rocket

xR(1) = 0;                   % initial x position
yR(1) = rEarth;              % initial y position
vxR(1) = 0;                  % initial x velocity
vyR(1) = 11000;              % initial x velocity

dt=20;

n=2*24*60*60/dt  % fly for 1 days


for i=2:n
    t(i) = t(i-1) + dt;
    x(i) = x(i-1) + vx(i-1)*dt;  % project moon position to start of subinterval i
    y(i) = y(i-1) + vy(i-1)*dt;

    Rm = sqrt(x(i-1)^2+y(i-1)^2);  % calculate moon's accel due to earth gravity
    AgME = G*mEarth/Rm^2;            % interval i-1

    vx(i)= vx(i-1) - AgME*(x(i-1))/Rm*dt;  % project moon's velocity
    vy(i)= vy(i-1) - AgME*(y(i-1))/Rm*dt;


    xR(i) = xR(i-1) + vxR(i-1)*dt;  % project rocket's position to
    yR(i) = yR(i-1) + vyR(i-1)*dt;  % start of interval i

    Rr = sqrt(xR(i-1)^2+yR(i-1)^2);  % calculate rocket's accel due to
    AgRE = G*mEarth/Rr^2;             % earth gravity at start of interval i-1

    Rm = sqrt((xR(i-1)-x(i-1))^2+(yR(i-1)-y(i-1))^2); % calculate rocket accel
    AgRM = G*mMoon/Rm^2;           % due to moon at start of interval i-1

    % update rocket velocity due to accel due to earth and moon
    vxR(i)= vxR(i-1) - AgRE*xR(i-1)/Rr*dt - AgRM*(xR(i-1) - x(i-1))/Rm*dt;
    vyR(i)= vyR(i-1) - AgRE*yR(i-1)/Rr*dt - AgRM*(yR(i-1) - y(i-1))/Rm*dt;


end
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plot(t/(24*60*60), yR)   % convert seconds on x axis to days
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