

ASEN 4057 - Assignment 6

Group 1: Nathan Herr*, Weston Luke†February 6, 2019
University of Colorado Boulder

I. Part 1

In order to solve the given three body problem, Newton's second law and Newton's law of gravitation, along with all given constants and initial conditions, were employed. The design process is detailed function by function below.

Events Function

This function was a condition checker used to check whether the spacecraft had contacted the moon, contacted the Earth, or flown off into space, as specified by the assignment document. Additionally, a condition was added which would stop the simulation if it had been running for more than 3 weeks, in order to put a time limit on the simulation.

Numerical Integration Function

The numerical integration technique used was a first order Euler's method as detailed in the assignment document. As this is a first order method, it is limited in its accuracy, but this is mitigated by a sufficiently small time step, set to 30 seconds for the purposes of this assignment. Within a while loop, accelerations, calculated from Newton's law, were integrated to get velocities, and velocities were integrated to get positions. All position values were written to a file associated with the simulation.

Grid Search function

The grid search function performed a two step grid search, with slightly different functionalities depending on whether objective 1 or objective 2 is chosen. The first step is a coarse grid search, which varied x and y velocity components by 5 m/s from the minimum to the maximum value. This records an initial guess for either the minimum velocity, or the velocity that would minimize time, depending on the objective chosen. From this guess, the area around it is searched to determine a solution which will be within the user specified tolerance.

Main Function

The main function checks that all inputs are valid, then calls all previously defined functions to complete the specified objective with the given clearance and tolerance. The result is an output file following the naming convention given in the assignment document.

II. Part 2

As requested, the problem was solved for both objectives, with a clearance of 10,000 meters, and a tolerance of 0.5 m/s. The output text files from these simulations were input to Matlab in order to plot the trajectory. The resulting plots are shown below:

*SID: 106545930

†SID: 109340224

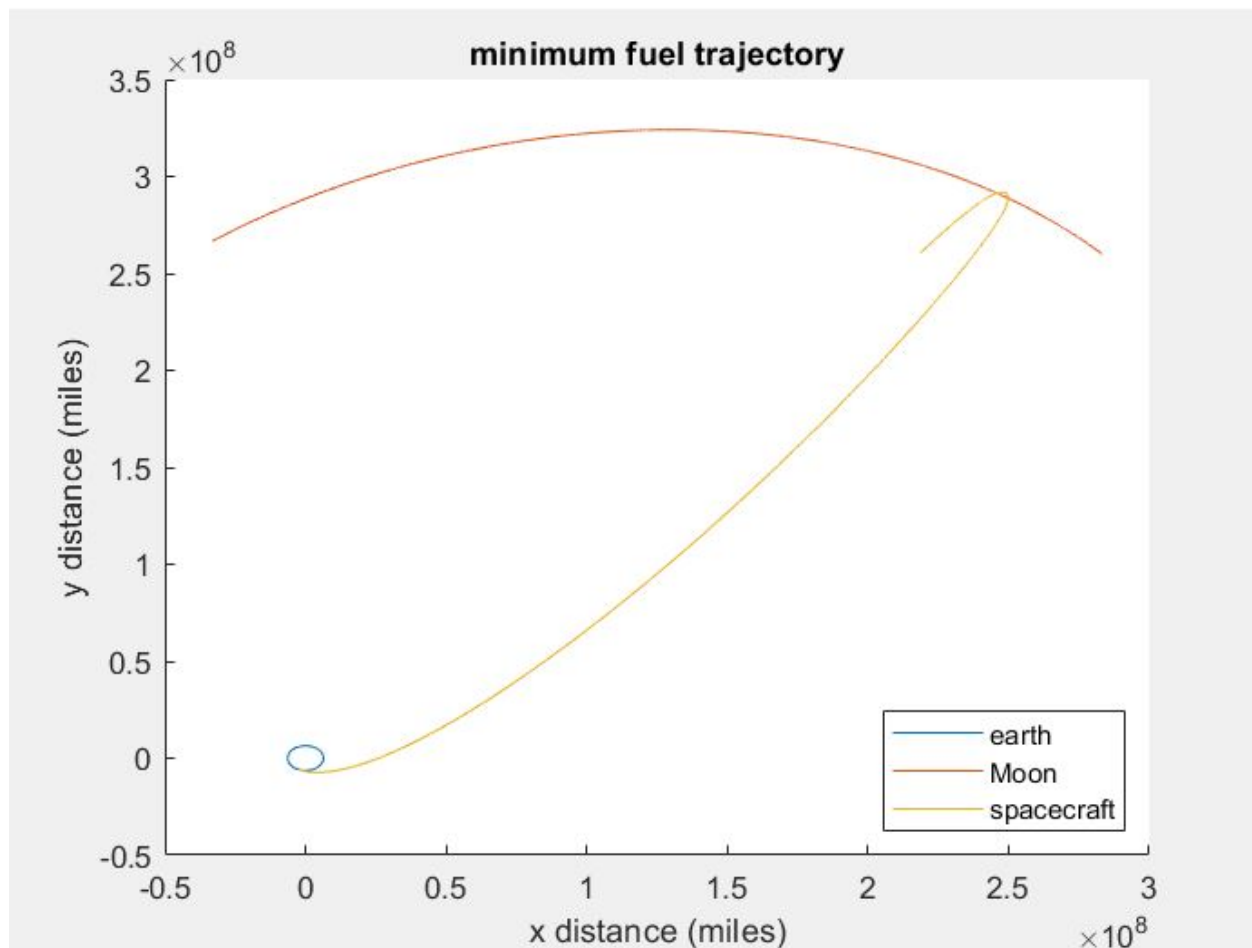


Figure 1: Trajectory for Objective 1

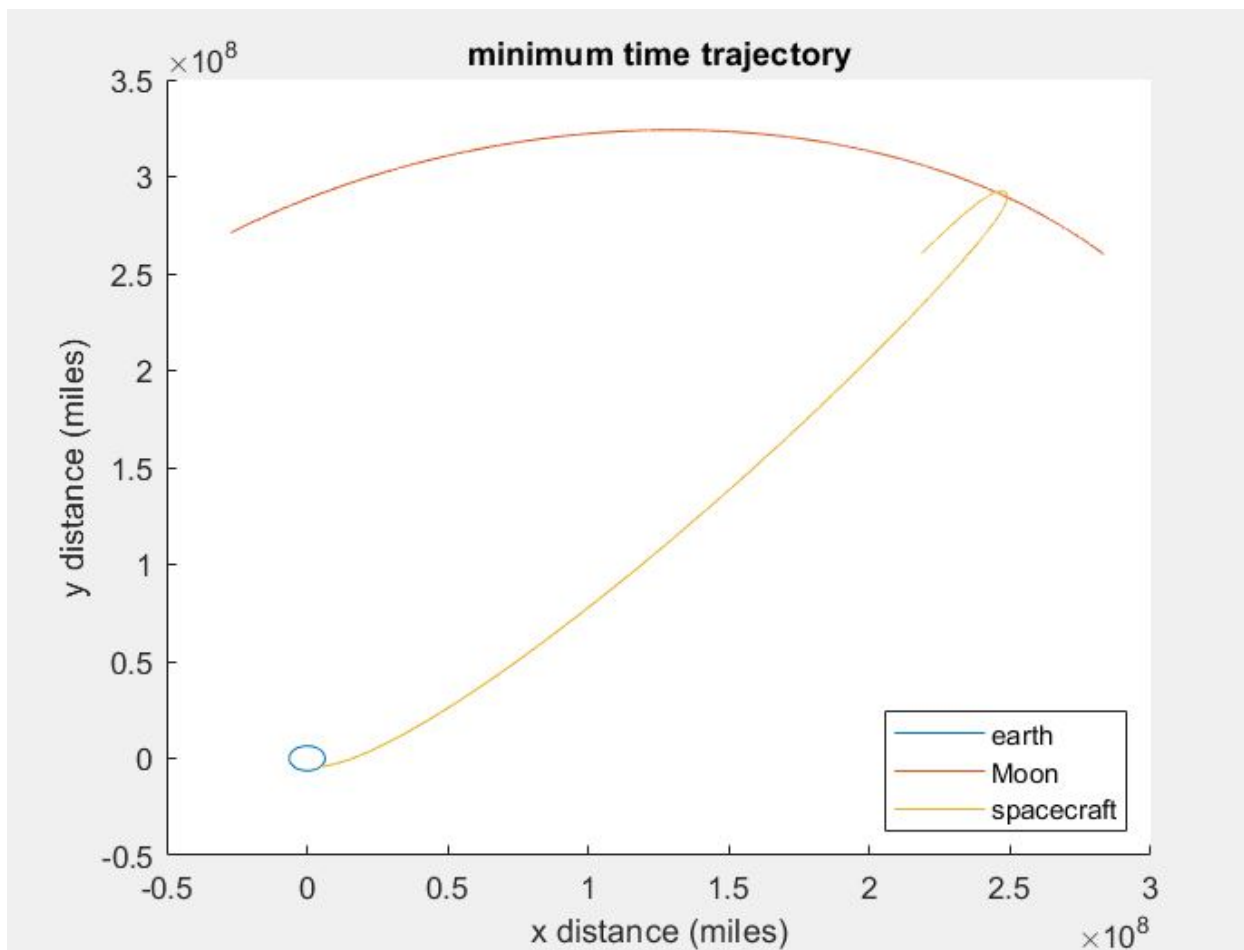


Figure 2: Trajectory for Objective 2

III. Part 3

A Bash script was written in order to perform the simulation for the given range of clearances for both objectives. This Bash script uses one for loop for each objective, and compiles and runs the ThreeBody program with each of the different clearances. The result is output files following the naming convention given in the assignment document.