Process

1. Setup: Load SPICE kernels and define spacecraft parameters (mass, thrust, Isp) and mission parameters (asteroids, start/end dates).
2. Initial Solution: Solve Lambert's problem using grid search to determine v1, v2, flight time, and minimum Δv.
3. Control Initialization: Generate an initial thrust guess based on the departure velocity direction.
4. Trajectory Propagation: Perform forward and backward Keplerian propagation to update state variables and mass at each segment based on control inputs (thrust).
5. Optimization: Use MATLAB's fmincon to iteratively adjust control variables, ensuring trajectory matching while minimizing fuel consumption.
6. Visualization: Plot the optimized trajectory, including forward/backward paths, thrust points, and asteroid orbits.

Input

Kernels files

1. asteroid_kernels.mk
2. naif0012.tls.pc

   These kernels files and ephemerides are obtained from the JPL HORIZONS system.

Spacecraft Parameters

1. initial mass = 3000 kg
2. dry mass = 1000 kg
3. max thrust = 236e-3 N
4. specific impulse = 4000 s
5. g0 = 9.81 m/s^2
6. Sun's gravitational parameter, muC = 1.32712440018e1 km^3·s^-2

Mission Parameters

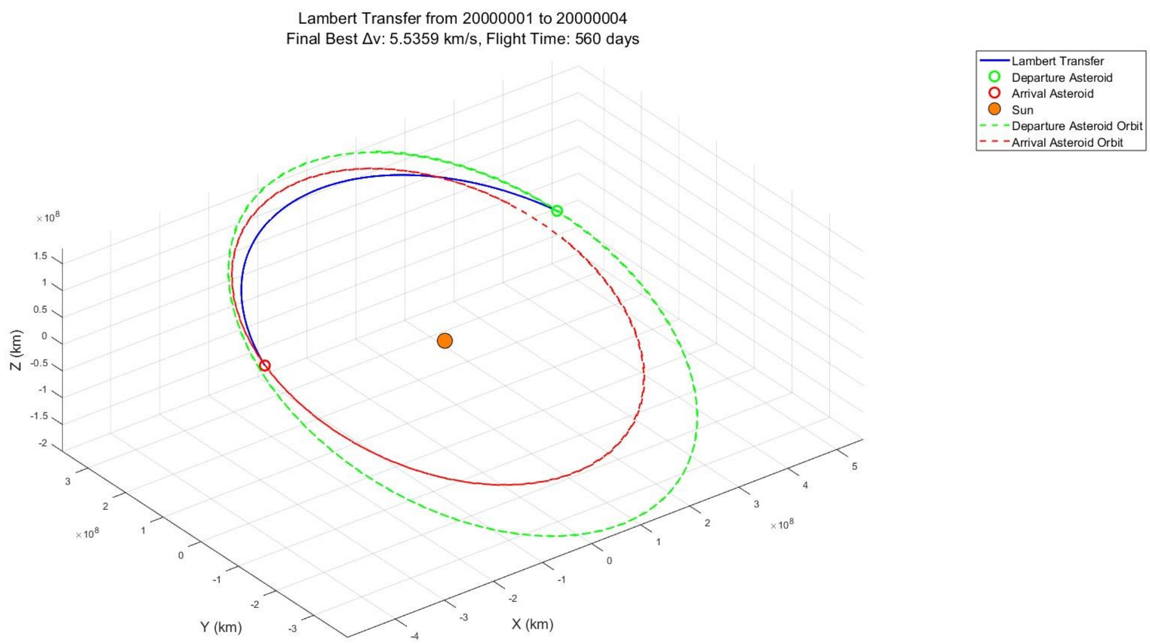
7. Mission start date =2024, 1, 1.
8. Mission end date =2034, 1, 1.

Output

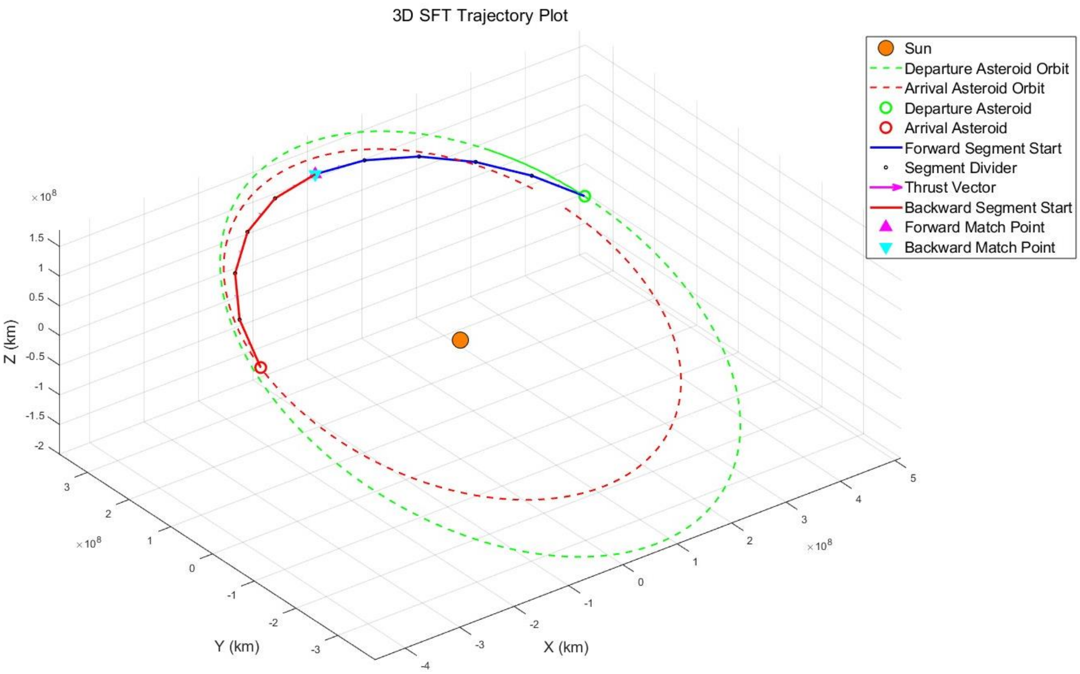
1. Final mass
2. Diagram of Lambert Transfer
3. Diagram of Sims-Flanagan Transcription

Example

01 Ceres to 04 Pallas, use lambert transfer and grid search, we can get an initial trajectory with the delta-v equals to 5.5359 km/s and flight time of 560 days.



Then by using SFT, discretize the trajectory into 10 segments, we can get the optimized trajectory.



The final mass is 2682kg.