

# AERONAUTICAL AND ASTRONAUTICAL ENGINEER

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## OPTIMIZATION OF LOW THRUST TRAJECTORIES WITH TERMINAL AEROCAPTURE

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This thesis explores using a direct pseudospectral method for the solution of optimal control problems with mixed dynamics. An easy to use MATLAB optimization package known as DIDO is used to obtain the solutions. The modeling of both low thrust interplanetary trajectories as well as aerocapture trajectories is detailed and the solutions for low thrust minimum time and minimum fuel trajectories are explored with particular emphasis on verification of the optimality of the obtained solution. Optimal aerocapture trajectories are solved for rotating atmospheres over a range of arrival V-infinities. Solutions are obtained using various performance indices, including minimum fuel, minimum heat load, and minimum total aerocapture mass. Finally, the problem formulation and solutions for the mixed dynamic problem of low thrust trajectories with a terminal aerocapture maneuver are addressed yielding new trajectories maximizing the total scientific mass at arrival.

**KEYWORDS:** Low Thrust, Aerocapture, Trajectory Design