Research Project 2 - Optimal Low-Thrust Spacecraft Interception Guidance Law with Terminal Velocity Constraints

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In this project, the problem of spacecraft interception by a low-thrust spacecraft is considered. This project addresses the terminal phase of the interception for two relatively close spacecraft near a circular orbit, such that the problem can be described by the Clohessy-Wiltshire equations. The problem is formulated as a linear-quadratic optimal control problem with soft constraints on the terminal relative position and velocity. An analytical, closed-loop, minimum fuel consumption optimal guidance law with a constrained terminal velocity is then derived. Subsequently, a secondary optimization problem is formulated, based on the optimal guidance law solution, to constrain either the magnitude or direction of the terminal velocity. The performance of the derived guidance law under each velocity constraint is evaluated in simulations and compared to a numerical direct optimization solution. It is shown that the solution satisfies the constraints with a minimal cost and that the solution of the proposed guidance law fits the numeric solution.

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