Research Project 1 - Bounded and Linear Quadratic Optimal Low-Thrust Collision Avoidance in Circular Orbits

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This project recreates the work performed by Tom Itzhaki on collision avoidance in space. The work suggests two optimal algorithms that provide optimal controllers for given conditions. The spacecraft is considered to be maneuvering with respect to its original circular orbit with the aim of increasing its miss-distance at the time of closest. This approach enables the use of the Clohessy-Wiltshire (CW) equations, which linearize the system dynamics and significantly reduce the computational demands on onboard resources. The first control law is designed to maximize the miss-distance with a bounded controller. For this solution, a zero-finding numeric solution is required. The second control law minimizes the control effort used in order to reach a chosen miss-distance. Applying this law involves finding the roots of a sixth-order polynomial. Simulations demonstrate that these laws yield excellent results. A direct comparison shows that the bounded thrust controller saves time; however, it also consumes significantly more propellant with respect to optimizing both control effort and miss-distance. Therefore, choosing which controller is preferable depends on the given mission.

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