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Author: Ms. junko murakami
Kyushu University, Japan

Dr. Shinji Hokamoto
Kyushu University, Japan

APPROACH FOR OPTIMAL MULTI-RENDEZVOUS TRAJECTORY DESIGN FOR ACTIVE DEBRIS REMOVAL

Abstract

In this paper we propose a method for determining the rendezvous trajectory for active debris removal using Lambert's problem. The population of the orbital debris is increasing: some studies predict that even without future launches, the orbital debris population will keep growing. Currently, Inter-Agency Space Debris Coordination Committee recommends that orbital lifetime be reduced to less than25 years at the end of mission. This effort is very important to protect the orbital environment and it can certainly slow down the population growth. However, this provision cannot change the orbital debris environment rapidly. Problem that needs to be solved is the impact of the two big debris collisions might happen for example the satellite collision of the Iridium and Cosmos in 2009. One promising solutions for this problem is active debris removal. To remove debris from orbit, we need to rendezvous with the target debris. And in terms of the mission efficiency and cost, removing multi-debris is preferable. The objectives of this study are 1) which pair of debris can remove in the sequence 2) how to decide the removal order 3)investigating how to make the trajectory from the 1st target debris to the 2nd target. We use Lambert's problem to formulate the equation of motion. The linearized Clohessy-Wiltshire (CW) equations can give a unique solution, but linearization errors, relative to the nonlinear equation, show up when considering long transfer times. On the other hand, it is difficult to find the unique solution using Lambert's problem. Lambert's theorem can set up the transfer time and depends only on the semi-major axis of the transfer orbit and the positions of the start and end point of the rendezvous. Allowing N complete revolutions, there are 2N+1 candidate; therefore we have to give the some condition to find the optimal solution. This study focuses on the debris removal in low earth orbit and considering this condition, our preliminary results show that we can reduce the transfer orbit candidates and find the unique solution for the Lambert's problem in the low earth orbit mission.