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ADAPTIVE CONTROL FOR FORMATION FLYING UNDER DISTRUBANCES

Abstract

Several space agencies around the World have found in distributed space systems answers to ambitious missions which cannot be accomplished with a single space ship. this approach extent further the technological and scientific challenges. Particularly, Engineering Control Theory for formation flying have explored different control schemes when the space agents undergo through all necessary navigation stages. The objective of this paper is to design an adaptive control using a centralized and non-centralized architecture for space vehicles in formation flying under perturbations in an Earth elliptic orbit considering the delay in the flow of information. Non-central control under a virtual structure is considered for the previous stages to the essential mission goal, while centralized leader-follower optimal control is specifically executed for the actual important mission. The following considerations are made: control considers up to 6 ships with gravitational perturbations, efficient fuel consumption as well as a limited amount of information being transmitted. Test are performed using different initial conditions . The Hill frame of reference is used.

First, a linear model is used with a low eccentricity orbit together with the CW equations considering some constraints. Later, the modified Tschauner-Hempel equations are used as previous work and reference to the corresponding non-linear model. Finally, to take into consideration the perturbation J2, Schweighart-Sedwick equations are introduced in the control model with also considers the information delay amon the agents in the formation.

The state vector for all the space agents involved, is estimated using the Schmidt-Kalman filter as well as the co-variance matrix.

The Satellite Constellation Visualization, the General Mission Analysis Tool and the Satellite Tool Kit are proposed as alternate testing software for the proposed control design.