30th IAA SYMPOSIUM ON SMALL SATELLITE MISSIONS (B4)
Interactive Presentations - 30th IAA SYMPOSIUM ON SMALL SATELLITE MISSIONS (IP)

Author: Mr. Hongyu Yu
Northwestern Polytechnical University, China

MULTI-PULSE-BASED SATELLITE SERIAL FORMATION CONTROL IN LUNAR ORBIT

Abstract

Currently, small satellite formation is widely used in different aerospace missions to replace the conventional formation in which functional integrated satellite is more expensive and complex. Serial formation is typical as it is relatively simple and suitable for small satellite's limited central computer. This work focuses on the control problem of serial formation when the distance between the satellites has periodic change due to the impulse thrust. For the formation problem of this practical work, the serial formation consists of nine satellites in lunar orbit. The first is a main satellite as the base of whole formation, and the other satellites are small and expected to govern the prescribed periodic distance with the main satellite. The small satellite has the microwave distance measurement to achieve the relative position with the main satellite. The whole formation length will be kept from 10km to 100km. This work will call this change of formation the 'Breath'. First, the relative orbital dynamics model based on C-W equation is established and modified to fit the long relative distance and the weak lunar gravity in this problem, and the modified model is compared with the central gravity model with its error estimated. Then, a multi-pulse-based control scheme for the small satellite in the formation is proposed. During every period of 'Breath', small satellites will execute lambert problem solution in C-W equation first, then at some specified point, the small satellite will measure and analyze the relative distance and calculate the compensating impulse thrust based on C-W equation to reduce the error with the target trajectory. Finally, taking navigation error, execution error and other perturbations into consideration, simulations based on the central gravity model are performed to show the running state of the whole serial formation.