Formation Trajectory-Planning using Nonlinear Programming and Collocation

Hyung-chul Lim[1,2], Hyochoong Bang[2], Pil-ho Park[1] and Jong-uk Park[1]

[1]GPS Research Group, Korea Astronomy Observatory
[2]Dept. of Aerospace Engineering, KAIST

Satellite formation flying has become a topic of significant interest in the aerospace engineering because its system has several benefits compared to a large spacecraft. Some techniques have been presented to get optimal formation trajectories minimizing fuel consumption in the step of configuration or reconfiguration. In this study, a method is introduced to find fuel-optimal trajectories minimizing cost function that includes the total fuel consumption of all satellites and assignment of fuel consumption rate for each satellite. This method is based on collocation and nonlinear programming which subjects to constraints for collision avoidance and final configuration. New constraints of nonlinear equality or inequality are derived for final configuration and nonlinear inequality constraints are used for collision avoidance. The final configuration constraints are that three or more satellites should form a projected circular orbit and make an equilateral polygon in the horizontal plane. Some problems, including these constraints and the cost function, are simulated using the method to generate optimal trajectories for configuration and reconfiguration of a satellite formation.