Numerical Validation of Analytical Solution to Optimal Reconfiguration of Satellite Formation Flying in Arbitrary Elliptical Oribits

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Satellite formation flying with an eccentric reference orbit has several advantages in scientific missions, such as the magnetospheric multiscale (MMS) mission and the auroral multiscale midex (AMM) mission. To achieve these requirements, satellites execute thrust commands to move the cluster from one stable formation to another. In a previous study, we developed an analytical solution to optimal reconfiguration of satellite formation flying in arbitrary elliptical orbits. In the current study, we validate the analytical solution by numerical simulations with a direct transcription method and mesh refinement algorithm. we consider reconfiguration problems having periodicity conditions in reference orbits of eccentricity e=0, 0.1 and 0.7 respectively. According to the result, thrust accelerations resulting from the analytical method are found to be consistent with those resulting from numerical method within less than 0.02% error. Thus, it can be concluded that analytical solutions are found to match very closely with results obtained by numerical method.