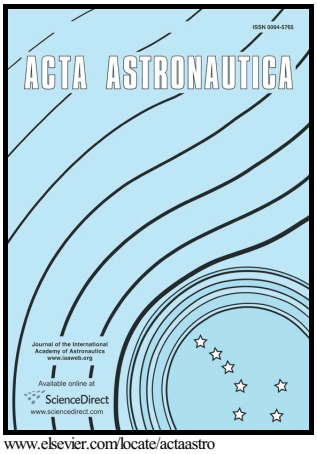

www.elsevier.com/locate/actaastro

Dipole Solution and Angular-Momentum Minimization for Two-satellite Electromagnetic Formation Flight

Xian-Lin Huang, Chun Zhang, Xiao-Jun Ban

PII: S0094-5765(15)00405-1
DOI: http://dx.doi.org/10.1016/j.actaastro.2015.11.009
Reference: AA5597

To appear in: *Acta Astronautica*

Received date: 3 January 2015
Revised date: 28 July 2015
Accepted date: 2 November 2015

Cite this article as: Xian-Lin Huang, Chun Zhang and Xiao-Jun Ban, Dipol Solution and Angular-Momentum Minimization for Two-satellite Electromagnetic Formation Flight, *Acta Astronautica* http://dx.doi.org/10.1016/j.actaastro.2015.11.009

Dipole Solution and Angular-Momentum Minimization for Two-satellite Electromagnetic Formation Flight

Xian-Lin Huang, Chun Zhang*, Xiao-Jun Ban

Center for Control Theory and Guidance Technology, Harbin Institute of Technology, Harbin 150001, China

Abstract

Electromagnetic formation flight is very attractive for no fuel expenditure, and may become an alternative to traditional propellant-based spacecraft formation flying. When electromagnetic forces are used to determine relative satellite positions, electromagnetic torques are created simultaneously and result in angular-momentum buildup. This paper investigates dipole computation and angular-momentum minimization for a two-satellite formation. Instead of using dipole vectors, a group of parameters are introduced to represent the relation between the electromagnetic force and torque. These parameters enable a certain freedom of allocating electromagnetic torques, and help find an analytical dipole solution to minimize total electromagnetic torque action. It is shown that an electromagnetic force is unconstrained only if associated torque ratios ranges from 0.5 to 2. The impact of formation configuration and control is also investigated. Torque-free formations are obtained where electromagnetic torques can be simply removed. A parameter optimization model is derived under the framework of sliding mode control to minimize angular-momentum buildup. Simulation results demonstrate the effect of the proposed angular-momentum minimization method.

Keywords: Electromagnetic formation flight, Dipole, Angular momentum, Sliding mode control

*Corresponding author. Tel.: +86 13654587006
Email address: zhangchun0055@126.com (Chun Zhang)