ASTRODYNAMICS SYMPOSIUM (C1)
Guidance, Navigation and Control - Part 1 (7)

Author: Dr. Narayanasetti Venkata Vighnesam
Indian Space Research Organization (ISRO), India, vighnesam@gmail.com

Mrs. Anatta Sonney
ISRO Satellite Centre (ISAC), India, asonney@isac.gov.in
Mr. N.S. Gopinath
ISRO Satellite Centre (ISAC), India, nsgopi@isac.gov.in

ELECTRIC PROPULSION ESTIMATION FOR INDIA'S ADVANCED COMMUNICATION SATELLITE

Abstract

One of the ambitious projects of ISRO is to demonstrate an experimental technology for advanced satellite communication systems, which will be a high capacity multi-beam Ku/Ka band spacecraft. India plans to develop its heaviest communication satellite to provide advanced telecom services. The 4500 kg satellite, GSAT-11 will be launched by the end of 2012 on board the Geo-Synchronous Satellite Launch Vehicle (GSLV) and carry about 40 transponders in the Ku-band and Ka-band frequencies. The spacecraft is planned to be placed at 74 deg east longitude in geostationary orbit. It is further being planned the spacecraft contains new technology such as usage of electrical propulsion system (EPS) for north/south station keeping as an augmentation to chemical propulsion to increase the life of spacecraft.

Orbit determination (OD) point of view, the usage of electric propulsion system has a great influence on orbit determination results, because it is very hard to predict or confirm exact performance of the electric propulsion, and its uncertainty degrades the orbit determination accuracy. This paper describes how the electric propulsion acceleration is modeled in ISRO's GEO missions' operational orbit determination system and to estimate the performance of thrusters in addition to state and other model parameters such as solar radiation pressure coefficient and measurement biases.

GSAT-11 electrical propulsion system employs four stationary plasma thrusters (SPT), out of which two facing north and other two facing south. ISRO's GEO missions' operational orbit determination software was updated to estimate electric propulsion. Tracking data from network of tracking stations configured for the mission was simulated for various test cases of SPT values. Orbit determinations were carried out with and without thruster estimation.

The main computation process of the orbit determination system is exercised for the purpose of trajectory generation and estimation. Cowell's method is used for trajectory generation through numerical integration. Weighted least squares technique and iterative differential correction process is used to obtain the refined state and SPT force parameters. This paper describes main computations involved in orbit determination process namely trajectory generation, observation modeling and estimation. To demonstrate raggedness of orbit determination process, very non-nominal initial thrust parameters were considered as initial parameters to OD process. It is observed that the updated orbit determination system for GSAT-11 estimates precise thrust parameters along with precise orbit solutions. The maximum difference between nominal and estimated thrust parameters is found to be within 0.1 mN.