Performance measure of satellite flying in coplanar and non-coplanar formation

ABSTRACT

In order to fulfill specific mission objective demand, spacecraft performance can be further optimized by means of various methods or configurations. Like for instance, selection of orbit type and inclination with a periodically repeated ground track will ensure the high efficiency of ground target coverage be accomplished throughout the whole duration of mission. Unfortunately, a single monoli thic satellite most often unable to accommodate the requirement solicitated by many multi background users. So, to deal with the issue, an alternative solution would be to operate a swarm of satellites flying in synchronized formation. In this paper, three satellites flying in co-planar and non-coplanar formation were simulated. Here, the resulting model of two deputy satellites operating in the same orbital plane but different phase angle moved along the orbit path while both still maintaining constant relative distance with the non-coplanar chief spacecraft throughout the whole orbit period were presented. The use of unique projected circular orbit (PCO) formation arrangement allows the assessment of some important performance measure parameters like average overlapping coverage area and optimum swath width coverage distance. For the determination of area on the surface of the Earth overlapped by three satellites, the analys is was done using the multiple boundary overlap condition. Parametric studies were conducted involving different formation distance and formation height to observe pattern variation of average total overlapping area and maximum coverage distance. Preliminary result showed that at a specific Earth central angle, the total overlapped area decreased substantially with the increased distance in formation. Height factor does not have significant influence in the total overlapped area variation due to constraint imposed on satellites operating in Low Earth Orbit (LEO) altitude regime. Results were tabulated using 3-dimensional graphs to study the relationships exist between multiple variables. Finally, conclusions were made based on our findings with regards to the performance of positioning satellites in such configuration.

Keyword: Coverage overlap area; Formation flying; Multiple boundary overlap; Projected circular orbit; Swath width