

66th International Astronautical Congress 2015

ASTRODYNAMICS SYMPOSIUM (C1)
Guidance, Navigation & Control (3) (9)

Author: Ms. Ciara McGrath
University of Strathclyde/Advanced Space Concepts Laboratory, United Kingdom,
ciara.mcgrath@strath.ac.uk

Dr. Malcolm Macdonald
Advanced Space Concepts Team, United Kingdom, malcolm.macdonald.102@strath.ac.uk

DESIGN OF A RECONFIGURABLE SATELLITE CONSTELLATION

Abstract

This paper describes a new method of design and optimisation for an agile constellation in low Earth orbit capable of rapid reconfiguration, with the aim of providing over-flights of multiple and varying ground-targets.

Conventional spacecraft constellations are static throughout the mission lifetime and generally aim to provide either global or regional Earth coverage. Reconfigurable constellations capable of providing global or regional coverage as required would enable products and services to respond to real-time market demands. This would significantly increase the commercial potential of a system when compared to a static constellation and would allow for unique mission objectives and requirements to be met. In addition, the ability to respond to unexpected events would improve the reliability and robustness of the constellation as a whole.

To date, reconfigurable satellite constellation designs have primarily considered circular orbits and have focussed on transitioning from a non-repeating ground track orbit for global observation to a repeating ground track for regional observation. This allows observation of a region of interest over an extended period, but does not facilitate continuous observation of a high-value ground target.

This paper makes novel use of ground track manipulation techniques previously employed for a single responsive satellite overflying multiple ground targets by applying them to the problem of reconfigurable constellation design. Low-thrust propulsion is used as a baseline and exploitation of the Earth's natural perturbing forces to optimise transfers is considered.

The resulting reconfigurable constellation is shown to offer unique advantages likely to be of significant value to applications as diverse as disaster relief and severe-weather now-casting.

Keywords: reconfigurable constellation, earth observation, satellite constellations, manoeuvrability, responsive space