IAF SPACE SYSTEMS SYMPOSIUM (D1)
Space Systems Architectures (2)

Author: Dr. Hyeongjun Park
New Mexico State University, United States, hjpark@nmsu.edu

Dr. Dae Young Lee
Iowa State University, United States, daylee@iastate.edu
Dr. Steven Stochaj
New Mexico State University, United States, sstochaj@nmsu.edu
Mr. Youngro Lee
Iowa State University, United States, youngro@iastate.edu
Mr. Kyle Rankin
New Mexico State University, United States, krankii@nmsu.edu

DESIGN OPTIMIZATION OF A SPACE VIRTUAL TELESCOPE MISSION USING A CUBESAT SWARM

Abstract

There is a growing trend in pursuing to develop virtual telescoping missions using multiple small satellites. The Virtual Telescope for X-ray Observations (VTXO) program of New Mexico State University and Miniaturized Distributed Occulter/Telescope (mDOT) mission of Stanford University are good examples of this trend. For example, in the VTXO program a virtual telescope is designed to acquire images by aligning two small satellites such as an optics satellite and a detector satellite in distance. One of the main challenges for these telescoping missions is to align the optics satellite and the detector satellite precisely for the fine imaging. To form a virtual telescope with a focal length within the range from hundreds of meters to a few kilometers, the detector satellite must maneuver to hold the formation whenever the optics satellite's attitude changes. This frequent maneuvering for adjusting the position and the attitude of the detector satellite exhausts resources, therefore, shorten the mission lifetime of the virtual telescope system.

In this paper, to enhance mission lifetime and capability, we propose to develop the architecture of a space virtual telescope mission using a CubeSat swarm. The main characteristic of the proposed architecture is to increase possible combinations between detecting and observing satellites. For instance, one or two optics satellites with ten to twenty small detector satellites could achieve better performance by covering a larger observation area with reduced maneuvering, better reliability, and longer life span of the virtual telescope system. Towards this goal, we first define the mission requirement based on feasible scenarios, then optimize the mission architecture using system modeling and multidisciplinary design optimization technologies. The obtained mission architecture includes critical mission design factors such as an optimal number of the detector satellites and distances among the detector satellites in formation flying. Finally, the developed architecture is verified by simulating satellite data with quality comparable to that of VTXO.