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### Abstract

In recent years, there has been a desire to develop space-based optical telescopes with large primary apertures. Current monolithic large telescopes, as exemplified by 6.5m aperture James Webb Space Telescope, are limited by the diameter of the launch vehicle – despite their ability to unfold and deploy mirror elements. One method to overcome this obstacle is to autonomously assemble small independent spacecraft, each with their own mirror, while in orbit. In doing so, a telescope with a large, segmented primary mirror can be constructed. Furthermore, if each of these mirrors is manufactured to have an identical initial shape and then adjusted upon assembly, a substantial reduction in manufacturing costs can be realized. In order to prove the feasibility of such a concept, a collaborative effort between the California Institute of Technology, the University of Surrey, and the Indian Institute of Space Science and Technology has been formed to produce and fly the "Autonomous Assembly of a Reconfigurable Space Telescope" (AAReST) mission. AAReST comprises two 3U Cubesat-like nanosatellites ("MirrorSats") each carrying an electrically actuated adaptive mirror, and each capable of autonomous un-docking and re-docking with a small central "9U" class nanosatellite ("CoreSat"), which houses two fixed mirrors and a boom-deployed focal plane assembly (camera). All three spacecraft will be launched as a single 40kg microsatellite package. The central premise is that the satellite components can manoeuvre and dock in different configurations and the mirrors can change shape and move to form focused images on the camera focal plane. The autonomous manoeuvres and docking will be under the control of the Surrey developed electro-magnetic docking system and near infra-red lidar/machine-vision based relative navigation sensors. On orbit, the mission profile will firstly establish the imaging capability of the compound spacecraft before undocking, and then autonomously re-docking a single MirrorSat. This will test the docking system, autonomous navigation and system identification technology. If successful, the next stage will see the second MirrorSat spacecraft undock and re-dock to the core spacecraft to form a wide linear formation which represents a large (but sparse) aperture for high resolution imaging. Celestial targets will be imaged. Currently, the flight hardware is under construction and launch is planned for 2019. This paper details the mission concept, technology involved and its testing and progress on the production of the flight hardware.