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COOPERATIVE NODE NETWORK COMMAND TEST (CONNECT)

Abstract

Current space segment design emphasizes two popular choices: a single spacecraft or a constellation of widely separated spacecraft. However, recent research on unmanned aerial vehicle (UAV) technology is leading to swarms of relatively tightly spaced, autonomous, and affordable UAVs. We seek to expand this capability to space missions through Cooperative Node Network Command Test (CONNECT) in 3 ways.

First, we will demonstrate the viability of arbitrary populations of swarms to autonomously form and station-keep. CPOD, in contrast, will involve two 3U CubeSats. The communications methods and hardware investigated by the teams behind all three reference projects are the foundation of this mission component.

Second, it will demonstrate redundant autonomous functionality under simulated failure modes. Under ground control-initiated faults, the swarm shall be able to autonomously recognize and respond to the failure of one or more swarm members to follow swarm protocols. The swarm protocols, failure response protocols, and recognition software will all be novel developments within CONNECT. The remote sensing capabilities required to initiate each protocol shall be off-the-shelf technology or expand upon one or more of the reference projects.

Lastly, it will serve as a test platform for any advances and lessons learned by the reference project teams. Advances in GNC packages, intersatellite communications and tasking, and the CPOD team's universal docking device are of particular interest. We emphasize that this mission offers the opportunity for multiple teams and facets of CubeSat technology to advance in parallel. At the same time, this is likely to improve CONNECT reliability by harnessing already-tested designs.

CONNECT will also, by our design, encourage greater collaboration in two ways.

First, CONNECT CubeSat design and software will be open-source where proprietary interests allow. We cannot foresee all of the applications of swarm technology within the smallsat community, so we believe keeping this information in the public domain does the most good for all affected parties.

Second, we will publicly list the swarm's orbital parameters. This will facilitate swarm growth from CubeSats contributed by interested external organizations. We anticipate that the immediate benefit offered by this choice is the faster growth of the physical swarm. This growth offers more opportunities for both experience-based hardware improvements on the ground and test-based software development for the swarm protocols. We anticipate that our mission will advance multiple parallel technologies with each passing day of data collection.