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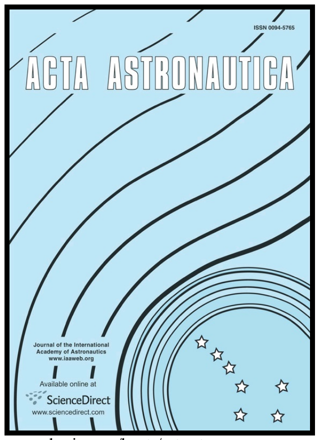

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A University-based Distributed Satellite Mission Control Network for Operating Professional Space Missions

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Abstract – For more than a decade, Santa Clara University's Robotic Systems Laboratory has operated a unique, distributed, internet-based command and control network for providing professional satellite mission control services for a variety of government and industry space missions. The system has been developed and is operated by students who become critical members of the mission teams throughout the development, test, and on-orbit phases of these missions. The mission control system also supports research in satellite control technology and hands-on student aerospace education. This system serves as a benchmark for its comprehensive nature, its student-centric nature, its ability to support NASA and industry space missions, and its longevity in providing a consistent level of professional services. This paper highlights the unique features of this program, reviews the network's design and the supported spacecraft missions, and describes the critical programmatic features of the program that support the control of professional space missions.

Key Words: Spacecraft mission operations, groundstation, nanosatellite, CubeSat

1. Introduction

Distributed satellite mission control networks are in use by a variety of governments and companies in order to support payload operation and health management of their spacecraft. These networks are characterized by being capable of supporting multiple missions around the clock, hosting numerous mission/science/payload operations centers, and having geographically-distributed communication/tracking stations. They also provide networked command and data handling services, database-driven command and telemetry software that consolidates mission data independent of the operations center and communication station used, and modular mission-unique software for satellite-specific processing tasks. Beyond having such equipment and infrastructure, these networks are also characterized by having highly trained personnel and well-defined processes for conducting operational tasks. Although such networks can be costly to support, they offer redundancy, dramatically expanded space-to-ground communications availability, robustness to local service interruptions, and a sharing of infrastructure costs over dozens of space missions.

One example of this type of system is the NASA Deep Space Network (DSN) [1], operated by the Jet Propulsion Laboratory and routinely used to control more than 30 on-orbit spacecraft. In operation for more than 50 years, the DSN specializes in the control of deep space probes, housing the world's most sensitive telecommunications equipment. The Network has a central network control center with distributed mission-specific operations centers, and it includes more than a dozen large scale antennae ranging in sizes up to 70 meters in diameter and deployed primarily at three sites around the world [2]. The U.S. Air Force Satellite Control Network (AFSCN) is used to operate more than 150 ongoing missions for the U.S. government [3]. It has two operational control nodes and nearly 20 antenna systems ranging in sizes up to 18 meters in diameter at 9 locations throughout the world [4]. The European Space Agency operates 10 communication stations throughout the world with antenna ranging in sizes up

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