15th SYMPOSIUM ON SMALL SATELLITE MISSIONS (B4)
Generic Technologies for Nano/Pico Platforms (6B)

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DESIGN STRATEGIES FOR SUCCESSFUL CUBESAT MISSION DEVELOPMENT

Abstract

The CubeSat Standard was developed by Stanford and Cal Poly, in 1999 to facilitate the development of student satellites. One of the objectives of the standard was reducing cost and development time while increasing launch opportunities. In order to achieve these goals, CubeSats are small (1.33kg and 1000cc) and use a standardized deployment mechanism compatible with many launch vehicles. In the decade since its creation, CubeSat has become a highly successful satellite standard with universities,industry, and government developers with more than 60 CubeSats launched.

In recent years, the CubeSat performance has increased dramatically and the number of missions being proposed for this class of spacecraft has grown exponentially. A number of factors have contributed to this increase in performance including the use of advanced miniaturized electronics, the development of highly creative operation plans, and a significant change in the risk posture of CubeSat developers leading to a reduction in redundancy. However, the largest contributor to the performance advances is the increased popularity of 3U CubeSats with a higher mass limit of 4 kilograms and a volume of 3000cc. These 3U CubeSats reach the mass and volume limits of the CubeSat deployer.

This natural push for growth as a means to overcome the mass and volume limitations of the CubeSat standard has been a part of the program since its early days. However, as the past 10 years have demonstrated, mass and volume are not the main constraints to CubeSat performance. The main constraint is the mindset of the CubeSat developer. In order to maximize the capability of CubeSat class spacecraft, traditional spacecraft design and development strategies cannot be applied. This paper will present strategies and development approaches for the successful CubeSat missions and spacecraft, including:

- Identifying minimum mission requirements to increase mission compatibility with CubeSats (The 80% solution)
- Lowering mission and operational complexity
- Higher risk tolerance resulting from the low cost of CubeSat class spacecraft
- Differenciating mission success from spacecraft success, specially when considering multiple spacecraft constellations
- Utilizing advanced miniature COTS electronics by reducing mission life requirements
- Development of highly integrated spacecraft systems for efficient use of limited resources.

The paper will also present some examples of the application of these design techniques in concept mission trade studies, and current missions under development at Cal Poly.