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IAF SPACE EDUCATION AND OUTREACH SYMPOSIUM (E1)
Enabling the Future: Developing the Space Workforce (5)

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HANDS-ON S&MA TRAINING WITH EMBEDDED ANOMALIES USING HEPTA-SAT: A RAPID-INTENSIVE PROGRAM TO ACCELERATE GLOBAL SPACE WORKFORCE DEVELOPMENT

Abstract

As small satellite missions continue to expand worldwide, the need for practical and efficient training in Safety Mission Assurance (SMA) is becoming increasingly important. In response, we have developed a new hands-on workshop program that integrates SMA principles into the HEPTA-SAT platform, a widely used 1U CubeSat training kit. A key feature is the deliberate insertion of physical hardware anomalies—such as reversed GPS signal harnesses, solder defects, faulty operational amplifiers, and release switch malfunctions—into the satellite kit. These visually identifiable flaws enable participants from diverse backgrounds (including both engineering and liberal arts) to share a common focal point for rapid, collaborative problem-solving and discussion. During the workshop, participants discover and diagnose the embedded anomalies within a short, two-day intensive schedule. This approach allows them to experience the entire anomaly response cycle—from initial detection and root-cause analysis to corrective action—under realistic constraints. In a session conducted for the Japan Aerospace Exploration Agency (JAXA), post-workshop evaluations revealed high satisfaction, particularly with regard to the hands-on aspect that facilitated repeated practice in identifying and resolving tangible failures. Many participants reported an enhanced understanding of risk management, system reliability, and the interdisciplinary nature of small satellite projects. In contrast to traditional lecture-based training, our program emphasizes experiential learning. Physically handling hardware anomalies under time pressure highlights the importance of clear communication and teamwork, as well as the broader lifecycle perspective crucial in satellite missions. By illustrating how a single faulty component can affect the entire system, participants gain firsthand appreciation of robust SMA processes. In this presentation, we will share the rationale behind our training design, key findings from participant surveys, and lessons learned for future improvements—such as extending coverage to operational phases and incorporating additional anomaly types. From a global standpoint, this model can be adopted by other organizations and educational institutions to cultivate a workforce adept in small satellite development and safety considerations. We believe that collectively overcoming embedded anomalies not only fosters holistic system thinking, but also contributes to the reliability of space missions worldwide. Ultimately, such hands-on SMA training strengthens the international space community by nurturing professionals who are both skilled and risk-aware.