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Inaugural Mission Concepts-1 Program

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Abstract

Learn about the innovative mission design collaboration between the Department of the Air Force Research Laboratory's University Nanosatellite Program (UNP) and NASA that will broaden access to space and strengthen the capabilities and knowledge of higher education institutions, faculty, and students. The presentation will include an overview of the inaugural program, summary of the activities conducted with participating universities, and plans for future programs.

Keywords: university programs, education, mission concepts, Air Force University Nanosatellite Program, NASA Cubesat Launch Initiative, NASA Exploration Research & Technology Programs

1. Introduction

The Small Satellite Market size is expected to reach USD 7.0 Billion by 2028 from USD 3.2 Billion in 2023 growing at a Compound Annual Growth Rate (CAGR) of 16.8% [1]. However, a lack of trained staff in any one of the numerous disciplines required for spacecraft design or other resources required for in-house development restricts entry into the small satellite industry to those who can afford expensive COTS hardware or pay for significant design expenses [2]. And although Perumal [3] indicated in his analytical review of the performance of 866 earth observing satellites that small satellites launched after 2010 were identified to have higher reliability after five years in orbit. The reality is that there's much improvement that can be made on the reliability of cubesats. One organization at the forefront of small satellite education in the numerous disciplines required for concepting, design, development, integration, testing, and operations is the Air Force Research Laboratory's (AFRL) University Nanosatellite Program (UNP). For over 20 years, UNP's objective has been to train the next generation of space professionals by providing a rigorous concept-to-flight-ready spacecraft development process centered on systems engineering principles and practices [4]. Their training program which is based on a competitive solicitation, lasts 2 to 6 years and many successful university/student missions have come from it. However, how can we increase engagement with universities/students for getting them interested into developing a reliable small sat? Many universities (and high schools) want to start a program, but they simply don't know how to. This entry level mission concepts program will not only help them learn about the process but will also foster enthusiasm and help them thru the steep learning curve and in the process increase engagement.

Method

A multi-year training program is very thorough, but if we needed to engage more universities/students we needed a faster/shorter program that will get them interested/motivated sooner than later. Thus, the idea of having a summer program that would capture the essence of the 2-year cohort training was brainstormed between the authors above. UNP had plans of doing such in the past, and the NASA engagement only helped in making that happened. After much deliberation, the solicitation was advertised thru many channels, namely: The Air Force University Nanosatellite Program (UNP) Solicitations Website, the NASA Minority University Research and Education Program (MUREP) Minority Serving Institution (MSI) Exchange, the NASA Small

Spacecraft Virtual Institute, NASA Days at Texas Southern University, the Oak Ridge Associated Universities (ORAU) Consortium and the NASA Space Grant Consortium.
We received 21 university proposals which were reviewed by 28 different experienced Air Force/NASA/Contractor evaluators. The selected universities were chosen on the following criteria:

- Educational impact
- University program impact/development
- Minority outreach/support
- NASA/DoD relevance

The selected proposals included the faculty (Principal Investigator) and up to 4 students who would participate at the Mission Concept kick-off at the Kennedy Space Center's Visitor Center May 23rd - 25th, 2023, followed by a month long in-person internship with Space Dynamics Laboratory and UNP in Albuquerque, NM. An additional month will be spent with the students back at their universities, sharing their knowledge with the rest of the students on the team. Final presentations and closing will take place at the end of July, following by attendance at the Small Satellite Conference. Throughout the summer, educational exercises, will be held with in-person and remote students, and all participants will receive daily guidance and help from highly experienced small satellite engineers from UNP, the AFRL Space Vehicles Directorate, NASA's CubeSat Launch Initiative (CSLI) and Exploration Research & Technology (ER&T) Programs, Space Dynamics Lab, Axient Corporation, and others.

2. Results

At the point of this paper submittal, the initial kick-off with the university faculty and students (mentioned above) had not taken place, however, the following eight universities were selected, and logistical plans are currently underway for the kick-off meeting.

- Florida Institute of Technology
- University of the Virgin Islands – Historically Black College University (HBCU)
- University of South Florida
- University of New Mexico – Minority Serving Institution – Hispanic Serving Institution (HSI)
- Missouri University of Science and Technology
- New Mexico State University – Minority Serving Institution – Hispanic Serving Institution (HSI)
- Columbia University
- Tarleton State University – Minority Serving Institution – Hispanic Serving Institution (HSI)

4. Discussion

To be provided at the 37th Small Sat Conference in Logan, Utah.

5. Conclusions

In summary, engaging more universities/students to take on the development of a small satellite will not only help better prepare the workforce of the future to meet the demands of the market, but help improve the reliability of small sats that will be designed/flown in the future. We hope that this program will become an annual event after a successful inaugural program.

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