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Enhancing STEM Education through CubeSats: Using Satellite Integration as a Teaching Tool at a Non-Tech School

David L. Cotten[*1,2], Sergio Bernardes[#1,2], Deepak Mishra[1,2], Caleb Adams[2], Hollis Neel[2], Khoa Ngo[2], Megan LeCorre[2], Paige Copenhaver[2], Nirav Ilango[2], Adam King[2], Graham Grable[2], Paul Hwang[2]

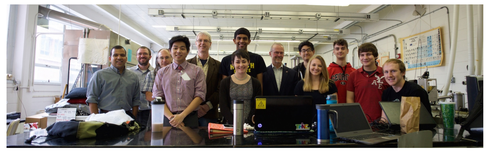
[*]dcotte1@uga.edu, [#]sbernard@uga.edu, [1]Center for Geospatial Research, University of Georgia, [2]Small Satellite Research Laboratory, University of Georgia

SUMMARY

University-based satellite programs have been successfully used as platforms for teaching STEM related fields, bringing tremendous benefits to graduate and undergraduate education. Considering their infrastructure and curricula, tech schools have traditionally been considered logical candidates for hosting such programs. More recently, with the dissemination of small satellites initiatives, non-tech schools have been presented the opportunity of developing satellite design and implementation programs. This work reports on the experiences and challenges associated with implementing a satellite program at the University of Georgia (UGA), a non-tech university. With funding from the Air Force Research Laboratory's (AFRL) University Nanosat Program (UNP) and NASA's Undergraduate Student Instrument Project (USIP) a team of undergraduates at UGA has recently been tasked with building two small satellites, or CubeSats, and helping to create a Small Satellite Research Laboratory (SSRL) at the University.

HISTORY

- Independent of each other, an undergraduate team aspired putting a small "phone sat" into orbit, and a group of faculty wanted to design a satellite specifically for monitoring coastal Georgia.
- In the summer of 2015 the undergraduate group met with faculty and SSRL, an undergraduate lead satellite lab, was created.
- In January 2016 SSRL received funding from AFRL to build a 3U CubeSat called MOCI (Mapping and Ocean Color Imager).
- In May 2016 SSRL received funding from NASA USIP to build a second 3U CubeSat called the SPOC (SPectral Ocean Color) satellite.



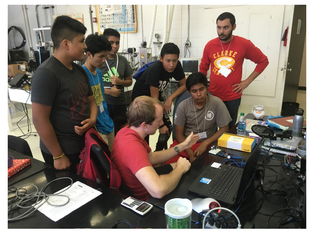
Figures showing some team members, including both faculty and students, at different stages of the project. The figure on the left is from March 2016 in our temporary lab space. The figure on the right is from June 2016 at a banquet for a non-UGA CubeSat (photo credit: Marguerite Madden).

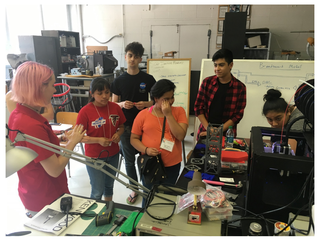
OUTREACH

The primary mission of SSRL is to train undergraduate students in STEM related fields through satellite based projects. Specifically the satellite projects are investigating optimal data transmission techniques, georeferencing imagery for mapping, conducting photogrammetric processing of images acquired from space based imagers, developing community outreach programs, and learning general aerospace manufacturing/testing/designing skills.

Outreach activities include:

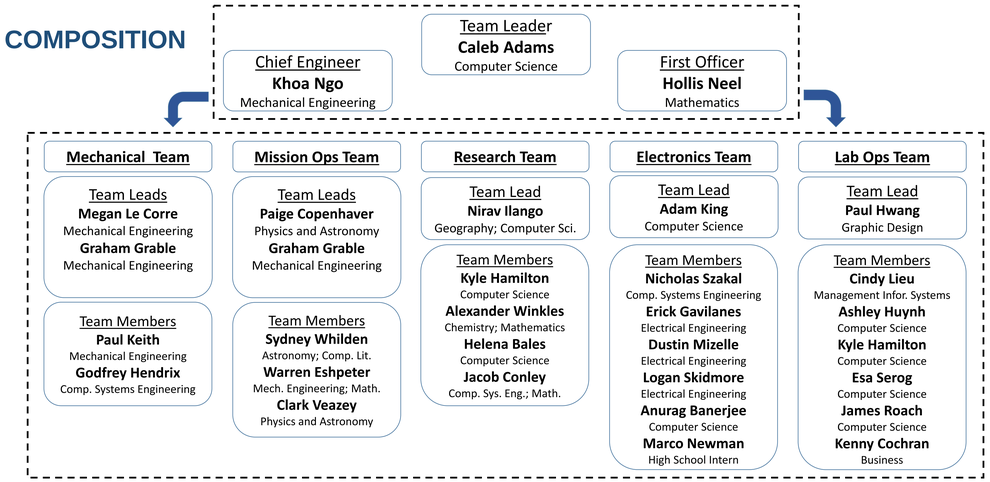
- Giving K-12 guest lectures at local schools.
- Participating in community science workshops.
- Creating and running women in technology workshops with Chick-Tech Atlanta for Spring 2017.
- Producing space based educational podcasts. https://soundcloud.com/uga-small-sat-lab





The figures above are from SSRL's participation in the NSF-Lisell-B community workshops from May and October 2016.

TEAM COMPOSITION



- The undergraduate team is comprised of an interdisciplinary group of students from all over campus, see above (majors are listed under each student's name).
- They are led by 11 faculty mentors from around campus: Geography (5), Physics and Astronomy (2), Mathematics (1), Marine science (1), and Engineering (2).

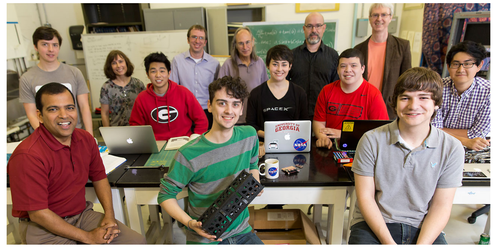
STARTING A SATELLITE PROGRAM AT A NON-TECHNICAL UNIVERSITY

CHALLENGES

- Finding appropriate facilities and expertise in satellite integration
- More expensive to start a new program
- Missing a strong engineering mentoring component
- Having to rely heavily on independent research
- Getting departments to work together

ADVANTAGES

- Students involved in designing/choosing equipment and components
- Entire student team is involved in every aspect of the project including: proposal writing, lab renovations, reviews, and discussions
- "Outside the box" approaches to problem solving
- Numerous non-STEM majors involved in space based projects
- Easier to attract highly motivated and intelligent students from all majors not just engineering, less intimidating
- Students involved in immersive/experiential learning opportunities that cannot be found else where around campus
- Using gained knowledge to create new courses, provide internships for high school students, and create outreach material



The figures above show a) part of the student and faculty team from May 2016 (photo credit: www.uga.edu, May 8, 2016), b) undergraduate students in March 2016 meeting and discussing satellite design decisions in the temporary lab space (photo credit: Paul Hwang), and c) 3D printed model of one of the first MOCI designs (photo credit: Khoa Ngo).