

IAF SPACE EDUCATION AND OUTREACH SYMPOSIUM (E1)
In Orbit - Postgraduate Space Education (4)

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LESSONS LEARNED FROM THE S5LAB HANDS-ON STUDENT ACTIVITIES ON THE LEDSAT,
GREENCUBE AND WILDTRACKCUBE-SIMBA NANOSATELLITES**Abstract**

Hands-on activities on University nano-satellites can be complementary to more theoretical education for engineering students at all stages of their academic curriculum. The development cycle of a nano-satellite, from design and paperwork to testing, launch and operations, allows the students to acquire practical skills and hands-on knowledge that will create the foundations for their professional career in bigger aerospace engineering projects. When coping with a simultaneous development of multiple nano-satellites, more advanced production concepts and study topics shall be explored, allowing students for

access to a broader knowledge on manufacturing skills and hands-on projects management. The S5Lab (Sapienza Space Systems and Space Surveillance Laboratory) research team at Sapienza University of Rome is currently developing three CubeSats, to be launched between Q2 2020 and Q1 2021, involving students in space engineering at all academic levels in the development process. The three satellites present different mission objectives, form factors and payloads, but they share the same bus which has been already operated by the S5Lab team with the participation in the 1KUNS-PF CubeSat, launched in May 2018. LEDSAT (LED-based small SATellite) is a 1U CubeSat project conceived by S5Lab and University of Michigan equipping a Light-Emitting Diodes payload for ground-based optical observations. The project is participating in the ESA Fly Your Satellite! Programme and in the ASI IKUNS Programme. WildTrackCube-SIMBA (Wildlife Tracking CubeSat–System for Improved Monitoring of the Behavior of Animals) is a 1U CubeSat equipping spread spectrum modulation receivers for improving the tracking of wildlife in the Kenyan National Parks. The satellite, developed by Sapienza, University of Nairobi and Machakos University, has won the IAC 2019 Launch Opportunity offered by IAF and GK Launch Services. GREENCUBE is a 3U CubeSat developed by Sapienza, ENEA and University of Naples “Federico II”, with the support of ASI, that will test an autonomous laboratory for the cultivation of microgreens on-board a CubeSat platform. The satellite has been selected by ESA for a launch opportunity on-board the VEGA-C maiden launch. This paper presents the major lessons learned by the students participating in the three satellites project. After a brief description of the three satellites design, manufacturing and testing, the lessons learned related to the simultaneous development and testing of different satellites sharing the same bus will be provided. The paper will describe the activities with focus on the students involvement in the hands-on activities for completing testing and qualification for the mentioned international CubeSat projects.