

IAF SPACE EDUCATION AND OUTREACH SYMPOSIUM (E1)
Interactive Presentations - IAF SPACE EDUCATION AND OUTREACH SYMPOSIUM (IPB)

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TEN YEARS OF THE SPACE PROPULSION LABORATORY AT THE DEPARTMENT OF
MECHANICAL AND AEROSPACE ENGINEERING OF SAPIENZA UNIVERSITY OF ROME

Abstract

As a new space race is upon us, special attention is to be given to continuous development of launchers and their enabling technologies, which requires the training of highly qualified technical-scientific personnel. In this context, the development and design of model rockets and related activities can be considered an exceptional teaching tool, practical and concrete, for the training of young engineers and researchers in space projects.

In this context, at the Department of Mechanical and Aerospace Engineering of Sapienza University of Rome, there is a tradition in educational hands-on activities related to aerospace propulsion: this is the 10th year that the Space Propulsion Laboratory class is offered to 30-35 final-year B.Sc. undergraduate students. From its first edition in 2012, led by prof. Marcello Onofri, the class has then been offered by prof. Bianchi starting from 2014, with the support of Dr. Migliorino starting from 2019. Overall, more than 300 students have been trained and more than 100 small rockets have been launched using a variety of commercially available low-cost solid rocket motors. Recently, the class has been also extended to accommodate a team of high school students and Erasmus students. The Lab is generally offered in the Spring Semester, and it is divided into a first part where the basics of rocket propulsion and flight physics are covered, followed by a second practical part where the students, divided into small groups, design and then build their model rockets. It is important for the students to deliver the preliminary and critical design reviews throughout the design process, as those are taken into account in the final score and contribute significantly to the goal of the course, which is to teach them how to become an aerospace engineer who takes decisions based on design trade-offs and following a tight schedule. The course culminates in the launch day, where 8-12 rockets are launched up to 150 meters by the students (plus one from the instructors) with the objective to protect from lift off to landing a small egg. A post-flight analysis then follows after the recovery of the telemetry data. Students are responsible for team organization by distributing the workload, for choosing the payload design, components integration, operation verification, motor selection, launch preparation and execution, and finally for data analysis, and they develop significantly their team-work and soft skills during the course.

The Space Propulsion Laboratory is the occasion for young students and future engineers to be initiated to the field and to develop a passion towards rocket science at an affordable cost. The process of designing and launching a rocket model yields a problem- and team-based learning process resulting in an effective pedagogical method, which is enriched by the multidisciplinary nature of the activity. Moreover, this is the only hands-on-based class regarding space propulsion and rockets offered throughout the Aerospace (B.Sc.) and Space (M.Sc.) Engineering degrees at Sapienza University of Rome, and provides many lessons learned as to what type of education (lesson-based or problem-based) is more effective for students. Indeed, the

activities are highly inspirational for all students who are generally enthusiastic in their course evaluations, which motivate all of us teachers to strengthen our passion in teaching and to improve constantly our courses. This paper would be the first editorial milestone for the course which would be extremely useful for the future editions of the Lab or for Universities pursuing similar initiatives and/or educational programs.