Paper ID: 84122
student

52nd IAF STUDENT CONFERENCE (E2)
Interactive Presentations - 52nd IAF STUDENT CONFERENCE (IP)

Author: Mr. Luca Lion
CISAS – "G. Colombo" Center of Studies and Activities for Space, University of Padova, Italy

Ms. Savina Tsichli
University of Padova, Greece
Mr. Mattia Sambo
Universita di Padova, Italy
Mr. Federico Basana
CISAS – "G. Colombo" Center of Studies and Activities for Space, University of Padova, Italy
Ms. Sofia Farinella
University of Padova, Italy
Prof. Alessandro Francesconi
University of Padova - DII/CISAS, Italy

TRACK YOUR SATELLITE BEFORE IT IS TOO LATE: A LASER RANGING ENABLED STUDENT CUBESAT PROJECT

Abstract

The proliferation of small satellites orbiting the Earth marks an exciting era in space exploration, offering greater opportunities for students and academic institutions to get involved. However, this increase in the number of satellites also raises serious concerns, particularly regarding the growing problem of space debris in low Earth orbit (LEO). With over 3000 Resident Space Objects (RSOs) larger than 10 cm and an estimated 120 million smaller fragments, the risk to operational spacecraft and future missions is significant, requiring innovative solutions for debris management and satellite tracking. In the midst of these challenges, the AlbaSat mission aims to improve the capabilities of small satellites through the integration of laser ranging tracking systems. The mission is currently under development at the University of Padova by the Alba CubeSat UniPD student team. The satellite incorporates commercial off-the-shelf (COTS) Corner Cube Retroreflectors (CCRs) on three of its six faces, carefully designed to minimise interference with other subsystems and components. Simple, off-the-shelf solar panels and other payload positioning guide the placement of the CCRs, reducing the complexity of the system. The satellite hosts three types of corner cubes on board: an uncoated 12.7mm, an aluminium-coated 12.7mm and a 25.4mm uncoated Active Modulated Retro Reflector, which is recycled as a standard CCR when not in use by another payload of the mission. This variety of CCRs enables accurate orbit determination by laser ranging and basic attitude determination by identifying the specific face illuminated by the laser, thereby improving the quantity and quality of information available from ground laser observations. This paper outlines the development process, including feasibility studies and link budget analyses, carried out to ensure optimal system performance under real-world conditions. Advanced simulation tools such as IOTA (In-Orbit Tumbling Analysis), developed by Hyperschall Technologie Goettingen GmbH under an ESA contract in 2022, were used to model satellite tumbling dynamics and simulate laser ranging measurements to refine the tracking system's operational parameters. The AlbaSat mission represents a collaborative effort to advance small satellite technology. Following the successful completion of ESA's Fly Your Satellite! Design Booster programme, the mission is progressing towards the Critical Design Review and is poised to make a practical and impactful contribution to satellite tracking capabilities and space debris mitigation efforts.