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THE TROLL: PRIVATELY FUNDED MISSION FOR INNOVATIVE SATELLITE INTEGRATION, HYPERSPECTRAL SENSING AND LIDAR IN-ORBIT DEMONSTRATION

Abstract

The TROLL is a 6U demonstration and in-orbit testing satellite privately funded and built by TRL Space that will be launched in the summer of 2024. It serves to validate several technologies (hyperspectral sensing and high precision LiDAR) and processes (complete satellite integration and launch) with high added value. Firstly, the TROLL represents an internal investment of TRL Space company to validate the cooperation between the teams, establishment of value chains, flexibility of procurement, speed of integration launch. Different teams in the company have been assigned various designated roles in order to simulate the commercial environment, where satellite manufacturers, payload and subsystem providers and customers meet conflicting demands, expectations and capabilities. Further, a strict deadline was designed to evaluate the speed at which a full cycle starting from customer demands through procurement, development, reviews, testing, and integration to launch is completed at a fast pace and according to ECSS standards.

Hyperspectral sensing consists of an off-the-shelf hyperspectral camera and a customized on-board data processing unit. Two bottlenecks for utilizing hyperspectral sensing are addressed. Firstly, the heterogeneity in spectral reflectance across different environments requires local in-situ measurements, validation and calibrations to identify reliable spectral signatures for their detection from satellite imagery. Secondly, the utilization of the vast amount of data produced by hyperspectral remote sensing is limited by available data downlinks, especially for small satellites. Using in-situ measurements and hyperspectral drone mapping, we are able to identify spectral signatures of various phenomena (crops, indices) in different environments. Thanks to onboard data processing, we can lower the data load by filtering cloudy images but also by sorting out the spectral bands with relevant information.

LiDARs have become valuable technology for a variety of applications, including two targeted areas we are developing: Space Traffic Management (STM) and high-resolution topography mapping of Celestial bodies. To achieve a high-performance but low mass, size and power demand of the LiDAR, we use a high-power laser emitter based on an erbium-doped fiber amplifier (EDFA) that can withstand space conditions, including the most damaging proton radiation. The TROLL will test the power output and power degradation of the EDFA laser in time and qualify our powerful laser emitter as the essential component of the final LiDAR system.

The paper will describe the current state of the TROLL satellite and its above-mentioned processes and technologies, lessons learned, identified risks and challenges and current status.