The Newly Refurbished San Fernando Laser Station

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The San Fernando laser station, a key asset in Spain's space observation network, has undergone significant modernization to enhance its satellite tracking and space debris monitoring capabilities. Central to these upgrades is the installation of an advanced alt-azimuth mount developed by the Spanish company AVS. This global SME, recognized for its role in major science and space projects, has developed a mount with state-of-the-art optical encoders and direct drive systems, achieving sub-arcsec nominal pointing accuracy. Its versatile design minimizes mechanical friction, reducing maintenance needs and extending system life.

The mount control system, designed in collaboration with AVS, integrates seamlessly into the station architecture, following a robust C++ modular approach that allows for easy upgrades. This flexibility is vital due to the rapid evolution of subsystems, enabling the station to adapt to new challenges without major refurbishments. The installation of the new mount involved developing a laborious geodetic task to calculate the new invariant point and carry out the local tie in the Observatory. The geodetic task conducted involved precise GNSS observations and classical survey methods, including network observation and adjustment, radiation, and intersections, achieving sub-millimeter precision in relative observations and millimeter-level accuracy in absolute terms.

Additional advanced devices have also been integrated. A new event timer has been added to the ToF measurement system, achieving time stamp accuracy of 1.5 picoseconds, enhancing the station's ability to provide reliable data for scientific research and practical applications, such as collision avoidance. A new finder telescope optimized for tracking space debris has been integrated, consisting of a Celestron RASA 8-inch telescope paired with a ZWO ASI 2600 CMOS camera. This system is able to detect faint, rapidly moving objects, improving tracking capabilities on low reflectivity targets or with uncertain ephemeris.

Although the mount is designed to accommodate a future telescope with an aperture of up to 800 mm, a major optical upgrade to the current Cassegrain reception telescope was carried out. This instrument consists of a 600 mm primary and a four-fold amplification factor secondary mirror giving a final focal length of 7200 mm (f/12). The secondary mirror has recently been

[a] Deceased.

optically refigured to greatly improve image quality, enhancing the visibility of distant and faint objects.

Also, a notable advancement is the concept of a new laser beam launcher telescope, intended for installation in late 2024. This system precisely adjusts laser beam steering and divergence, designed by station staff using ray tracing software, by using optomechanical COTS. Additionally, the Coudé path has been enhanced with high-reflectance mirrors, ensuring minimum losses of the laser beam at long distances.

A new weather station has been installed, providing essential data on atmospheric conditions, such as temperature, humidity, and pressure, for accurate laser beam measurements. Upgrades to the electrical system and control station, including new large capacities uninterruptible power supplies (UPS), ensure safety measures and continuous operation during power outages. A latest generation control computer now handles the increased data flow and manages the station's control system, including interfaces for all these different subsystems.

Alongside these upgrades, the station is planning several future developments, pending financial support, to further enhance its capabilities. Plans include installing a high-performance dome to match the fast motions of the new mount and a larger reception telescope, increasing the aperture from 600 to 800 mm to improve tracking of faint or distant objects. Additionally, the station aims to implement a high-frequency (KHz) laser designed for use simultaneously with cooperative objects under the ILRS and with space debris for EU SST, ESA, and other agencies. This advanced laser will broaden the station's participation in international space monitoring projects, reinforcing its role in global space safety. Finally, plans are in place to establish a new integrated control center to unify the Observatory's sensors into a single operation hub, streamlining operations and enhancing the station's ability to respond to space-related challenges.

These upgrades and planned developments showcase the SFEL station’s efforts to enhance its contribution to satellite tracking networks and space debris management. With its enhanced capabilities, the station is poised to play a more prominent role in global collaborations, contributing to the safety and sustainability of space activities worldwide.

In memory of Dr. Manuel Catalán Morollón, who from the beginning led this project with great dedication, future vision and team spirit.