Development of a Safe Ground to Space Laser Propagation System for the Optical Communications Telescope Laboratory

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Abstract

Furthering pursuits in high bandwidth communications to future NASA deep space probes, the Jet Propulsion Laboratory (JPL) is building the optical communications telescope laboratory (OCTL) atop Table Mountain in southern California to serve as a research and development optical antenna. The OCTL will house the first telescope built for daytime and nighttime operations that is dedicated to optical communications. Not only will this first ground station be utilized as a test bed for optical communication strategies, but will also serve as a model for future ground stations to ultimately create a network of remote stations. Among some of the early experiments planned, operations will include propagating high-powered, Q-switched laser beams to uplink commands to deep space probes and provide a pointing and tracking beacon for downlink communications. However, laser beam propagation from the ground to space is under the cognizance of various government agencies, namely: the Occupational Safety and Health Administration (OSHA) that is responsible for protecting workforce personnel; the Federal Aviation Administration (FAA) responsible for protecting pilots and aircraft; and the Laser Clearinghouse of Space Command responsible for protecting space assets. To ensure that laser beam propagation from the OCTL complies with the guidelines of these organizations for current operations and future deployment of autonomously operated ground stations, JPL is developing a safety system that implements a multi-tiered air and space system that will coordinate the reporting and monitoring functions required by the various government agencies. At Tier 0, laser operators will meet OSHA safety standards for protection and access to the high power laser area will be restricted and interlocked. Tier 1, which extends from the telescope dome out to a range of 3.4-km, will use LWIR camera sensors to alert operators of at risk aircraft in the FAA controlled airspace. Tier 2, defined to extend from 3.4-km out to the aircraft service ceiling in FAA airspace, will detect at risk aircraft by radar. Lastly, beam propagation into space, defined as Tier 3, will require coordination with the Laser Clearinghouse. In this paper a detailed description of the roles of the four tiers is presented along with the results of the integrated monitoring and beam transmission control system.