Implementation of the LASER Traffic Control System at Haleakalā Observatories

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INTRODUCTION

The University of Hawai'i Institute for Astronomy Haleakalā Observatories (HO) was for many years occupied by Mees Observatory and the LURE Laser Ranging Observatory. The LASER system at LURE could operate at night without disturbing other science operations because Mees is a solar observatory. Since 2002, several astronomical observatories have been built at HO, and more are being planned. Laser ranging operations ceased at LURE in 2004, but is now being carried out by the Transportable Laser Ranging Station (TLRS-4) since 2006.

In order to prevent scattered laser light from interfering with the science operations of the optical observatories, the Laser Traffic Control System (LTCS) was designed to control laser operations at HO. The LTCS has been fully implemented at the Mauna Kea Observatories (MKO) Hawaii, the Canary Islands (Spain), and in Chile.

The system currently supports laser guide star adaptive optics (AO) operations at Mauna Kea Observatories (MKO)-Hawaii, the Canary Islands (Spain), and in Chile.

The LTCS system is currently operating at HO in a simulation mode only. Full implementation is still several months away. The simulation has shown that a useful LTCS system that incorporates SLR is probably possible with only modifications to the configurations.

In order to overcome the differences noted above, the update rate for reading the TLRS-4 URL was set to the system maximum of one second and the declared FOV of the laser system was set to the maximum 1.667 degrees. The actual divergence of the laser beam at TLRS-4 is about 0.02 degrees. This added spatial and temporal buffer compensates for the fast tracking speed of the laser, and the fact that the Pan-STARRS telescopes have an extraordinary 3.0 degree field of view (full angle).

REFERENCES


SATELLITE LASER RANGING vs. ADAPTIVE OPTICS LASERS

The LTCS as implemented at the Mauna Kea Observatories was designed to solve the problem of how to keep the light from an AO laser (via Rayleigh scattering or from the fluorescence guide by star) from entering into the Field Of View of other telescopes on the mountain.

The LTCS web based, and is implemented as a client/server system. Each participating observatory is a client to the LTCS, and must provide access to a URL (Universal Resource Locator) file that describes that particular system for the LTCS.

The LTCS is a mature software system that has been installed at three astronomical sites that are operating SLR observatories. The basic design of the system has shown that it can be used by SLR sites that are also home to optical telescopes.

The above screen capture (Figure 2) shows the LTCS “Status and Alarms Summary” web GUI on the left, and a real-time 3-D plot of the simulation on the right. The 3-D plot is not part of the LTCS but runs independently of the host system. It was added as part of the simulation tests done at HO. It can be manipulated in real time (i.e., grabbed with the mouse and rotated about the origin, which is configured to be TLRS-4) and provided real time visualization during the installation tests.

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The above screen capture (Figure 3) shows the system indicating a collision has occurred. At the time of collision, a “SHUTTER” alert is sent to the LTCS log file. Because the LTCS was configured with the TLRS-4 laser being lowest priority, the TLRS-4 will receive the alert and block transmission of the laser.

As mentioned before, the “Shutter Event Duration” calculation will not be accurate when an SLR system is involved. The calculated duration shown is 2,664 seconds. The actual duration of this simulated event was about 60 seconds.

CONCLUSIONS

• The LTCS is a mature software system that has been installed at three astronomical sites that are operating similar guide stars in support of adaptive optics systems.

• The basic design of the system has shown that it can be used by SLR sites that are also home to optical telescopes only.

• In order to be used at sites that operate SLR and AO lasers along with optical telescopes, methods to handle combined Laser Guide Star and SLR targets will need to be developed. Interface changes to support non-sidereal target modeling would prove beneficial for astronomical and SLR use. This feature enhancement has been discussed and may be added to LTCS in a future update.

SIMULATED COLLISION

The following panels are screen shots of a simulated collision between the TLRS-4 laser and Pan-STARRS.

Figure 0

Figure 1

Figure 2

Figure 3