Summary

The optical remote sensing lab at the city college of New York is part of the CREST Lidar network. The purpose of the ORS lab is to monitor and investigate the optical properties of complex coastal areas as well as clear open ocean waters. This is accomplished with remotely-sensed data, received from operational and research satellites, observing platforms and in situ data. On a snowy Tuesday March 3rd 2015 our class of remote sensing from the New York city college of technology took a trip to visit the ORS Lab. During our trip, we had a chance to take a closer look at the City College LIDAR network. Moreover, during our visit we had the opportunity to listen to a presentation given by Abdul, a PhD student at the City College, about a project he is working on as his final thesis.

This report describes the various components of city college’s lidar system as well how it operates. It will also touch up a little bit on the presentation that was given by Abdul about the Quantum Cascade Laser (QCL) Lidar project that he is working on.

Introduction

LIDAR (Light Detection and Ranging) is the optical analog of radar, using pulses of laser radiation to measure ranges from a distant target. LIDAR uses waves ten to one hundred thousand times shorter than radar waves, which means that it is able to collect much more data. LIDAR uses ultraviolet, visible, or near infrared light to image objects and can be used with a wide range of targets, including non-metallic objects, rocks, rain, chemical compounds, aerosols, clouds and even single molecules. A narrow laser beam can be used to map physical features with very high resolution. LIDAR has been used extensively for atmospheric research and meteorology.

Moreover, LIDAR systems allow scientists and mapping professionals to examine both natural and manmade environments with accuracy, precision, and flexibility. NOAA scientists are using LIDAR to produce more accurate shoreline map, make digital elevation models for use in geographic information systems, to assist in emergency response operations, and in many other applications.

Main components of a LIDAR or system

Laser and steering mirrors

City College's LIDAR system uses the ND:YAG laser. The term YAG laser is usually used for solid-state lasers based on neodymium-doped YAG (Nd:YAG, more precisely Nd3+:YAG), although there are other rare-earth-doped YAG crystals, e.g. with ytterbium, erbium, thulium or holmium doping (see below). YAG is the acronym for yttrium aluminum garnet (Y3Al5O12), a synthetic crystal material which became popular in the form of laser crystals in the 1960s. Yttrium ions in YAG can be replaced with laser-active rare earth ions without strongly affecting the lattice structure, because these ions have a similar size.

YAG is a host medium with favorable properties, particularly for high-power lasers and Q-switched lasers emitting at 1064 nm. At City College's LIDAR system, the Nd:YAG emission wavelength is 1064 nm. Starting with that wavelength, outputs at 532, 355 and 266 nm can be generated by frequency doubling, frequency tripling and frequency quadrupling, respectively.

Optical receiver

Optic choices affect the angular resolution and range that can be detected. A beam splitter is also used to collect the return signal.

Signal detection

Silicon avalanche photodiodes are the main photo detectors used in the LIDAR. The sensitivity of the

**The Quantum Cascade Laser (QCL) LIDAR project.**

Contrary to City College’s LIDAR system, the LIDAR that Abdul is working on is smaller and more compact. It is mounted on a cart which makes it easier to move to other locations. Moreover, the transmitter used is a Quantum Cascade Laser (QCL) with a wavelength between 2µm and 8µm as opposed to the diode used in CCNY’s LIDAR. The receiver is an f/5 Newtonian telescope with a 10 inch primary mirror. The data is collected is collected using a detector with a spectral range of 2.5 µm to 5µm response. Once the data is collected, it is digitized using a 12 bit gage digitizer and then analyzed using LabView and MatLab.

**Conclusion**

The trip to City College was very informative, we were able to actually see a LIDAR system and have closer look at its various components. Also, we were able to learn a little bit about Quantum-Cascade Laser. I hope in our next trip (if there will be one) we will be able to turn the LIDAR on and take some measurements.

*References:*

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*Innovateus.net/science*

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