

An Integrated Environment For Control and Data Acquisition In Quantum Cascade Laser Experiments

Reuven Huntley¹, Paul Corrigan¹, Maung Lwin¹, Alexandra Tsekeri¹, and Amandeep Chhabra¹

¹ MIRTHE Foundation, City College of New York, New York, NY 10031, U.S.A.

email: rhuntle00@ccny.cuny.edu

Due to its wavelength tailorability and high power output, Quantum Cascade Lasers (QCLs) have shown tremendous potential in monitoring the concentrations of important environmental trace gases such as ammonia and ozone [1]. One popular technique involves intra-pulse tuning (chirping) the laser wave number across a 2-3 cm^{-1} window with 100-500 ns current pulses. However, this places strong demands on data acquisition (DAQ) systems in order to obtain the high resolution spectral information needed for precision experiments. To accurately determine concentrations at the parts per billion (ppb) levels in real time, efficient software for operation of the laser and retrieval of the experimental data is needed.

National Instruments' LabView software was used to create a robust DAQ environment. Virtual instrument (VIs) drivers were designed to control a laser and acquire data from trace gas detection experiments involving a pulsed, chirped, external cavity QCL system from Daylight Solutions. The QCL controller VIs were structured in layers to add modularity to the program (figure 1). These layers provide levels of abstraction between the hardware and user interfaces, allowing the application programmer to create flexible VIs with seamless error handling for a given project.

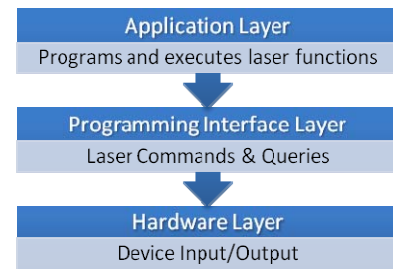


Figure 1. The layers that form the structure of the QCL VIs.

The core QCL VIs were used to create an application VI that would allow the user to set laser options such as pulse width, frequency, and relative temperature, and use those options to pulse the laser at given wavelengths/wave numbers. Additionally, it displays updates regarding the state of the laser such as temperature and activity. Once enabled, the VI auto-configures the laser, sets the wavelength, pulses the laser when ready, and shuts down appropriately (figure 2). The QCL VIs that form the application's foundation greatly simplify the error handling and programming required for such an operation.

The application will be further developed for recording of trigger-acquired sample and reference spectrums for measuring trace gas concentrations in cell and open-path environments. The integration of Matlab calculations into the VI, as well as the high temporal and spectral resolutions will enable accurate and real-time display of concentrations for interchangeable QCL systems.

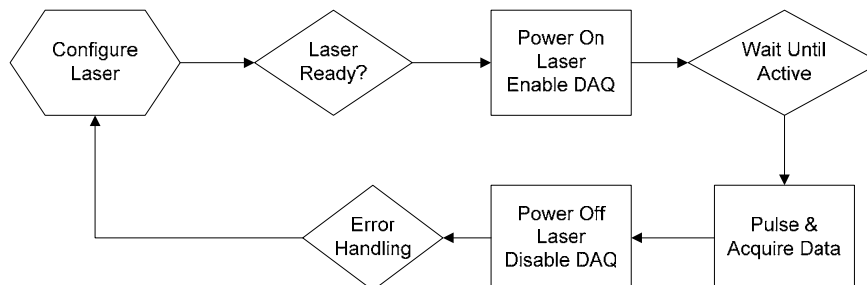


Figure 2. Sample flow chart for a QCL application VI.

- [1] Taslakov, et.al., "Open-path ozone detection by quantum-cascade laser", *Appl. Phys. B*, **82**, p.501, (2006).
- [2] Daylight Solutions, "Tunable Mid-IR External Cavity System", Revision 4.0, (2007).