HIGH-SPEED, HIGH-RESOLUTION, BROADBAND DUAL-COMB SPECTROMETER FROM 3-5 μm

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Dual Comb Spectroscopy (DCS) is an emerging technique for measuring infrared molecular absorption at higher speeds and spectral resolution than historically possible using Michelson interferometer-based Fourier Transform Spectroscopy. While Quantum Cascade Laser (QCL) DCS is capable of fast acquisition speeds and the ability to probe between 4-10 μm, these benefits also come at the cost of a low instantaneous bandwidth, spectral resolution, and coherence time over which measurements can be averaged.

Here we present the development of a GHz repetition rate intra-pulse DFG mid-IR DCS system. This system is based on mode-locked lasers simultaneously spanning 3-5 μm with 0.03 cm^{-1}comb tooth spacing, μs acquisition speeds, and single-cycle residual noise below 10^{-1}. Spectra and noise characteristics from a static spectroscopy cell containing various hydrocarbons are reported and discussed. The system shows promise for sensing in rapid transient systems given the high single shot signal to noise ratio and rapid interferogram acquisition time afforded by the GHz pulse repetition rates.