

Ultra Stable QCL Driver for IrSens2

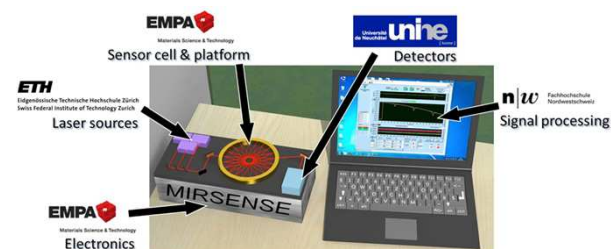


Materials Science & Technology

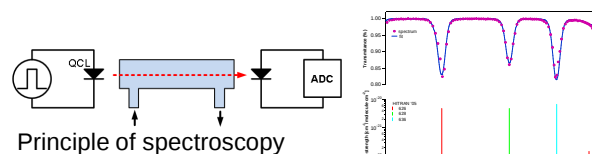
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Introduction

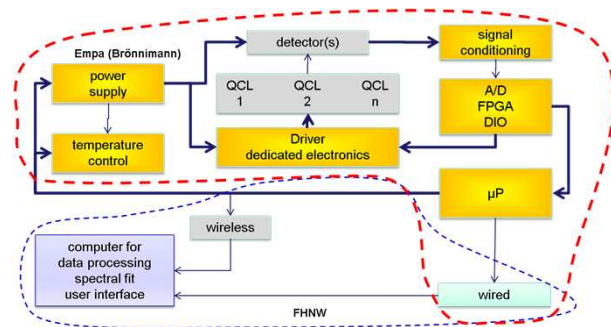


In the project IrSens2 a "multi-component sensor for air pollutants and greenhouse gases" will be developed. A device using several quantum cascade lasers (QCL) in conjunction with a sophisticated absorption cell, low noise electronics, low power requirements, and a small footprint results in a scientifically outstanding air monitoring system.



Control

The requirements result in a complex control system. To achieve low noise laser driver, signal conditioning and digitalization are critical. The complex timing, data acquisition and filtering is controlled by an FPGA in conjunction with a μP .



Reference:

M. Fischer et al., "Intermittent operation of QC-lasers for mid-IR spectroscopy with low heat dissipation: tuning characteristics and driving electronics", OPTICS EXPRESS 22 (6) p. 7014-7027 (2014)

Acknowledgment:

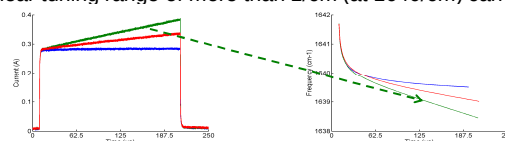
We acknowledge the close collaboration with Alpes Lasers SA and financial support from nanotera.ch (IRSENS II), as well as CTI (13453.1 PFFLI-NM)

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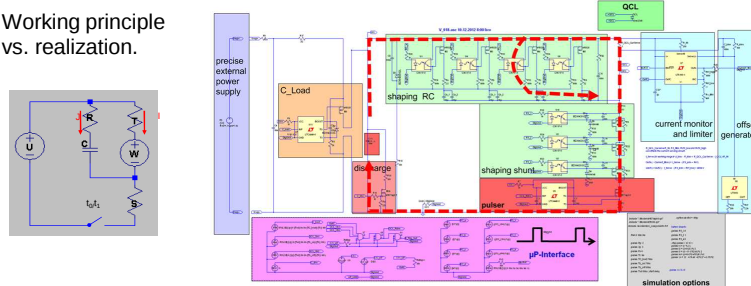
Laser driver

To perform high resolution absorption spectroscopy stable QCL drivers are required. Pulse shaping increases usable tuning range. With adequate pulses a linear tuning range of more than 1/cm (at 1640/cm) can be realized.



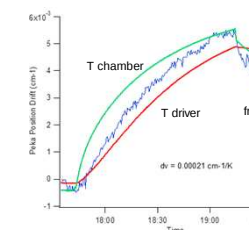
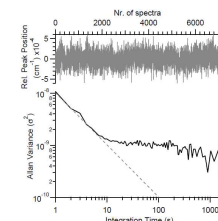
A passive pulse shaping method was developed to achieve low noise performance.

Working principle vs. realization.



The device was tested by measuring the apparent drift of an absorption line assuming the driver as only source of instabilities.

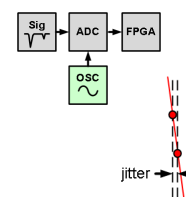
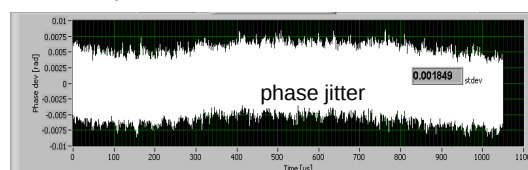
- stability(T_{driver} constant) : $s(k(t))/k(t) < 10^{-7}$
- thermal drift: $dk(T)/dT \sim 0.00021 \text{ cm}^{-1}/\text{K}$



Outlook

The development of the data acquisitions system is under development and preliminary results are available.

- Phase jitter of the digitizer clock is a mayor source of noise at high frequencies. A 400MHz oscillator with jitter less than 2 mrad (corresponding to 1ps) was successfully realized.



- VHDL code allows lossless averaging at high sampling rates.
- Averaged date is transferred to μP and available over network connections.

