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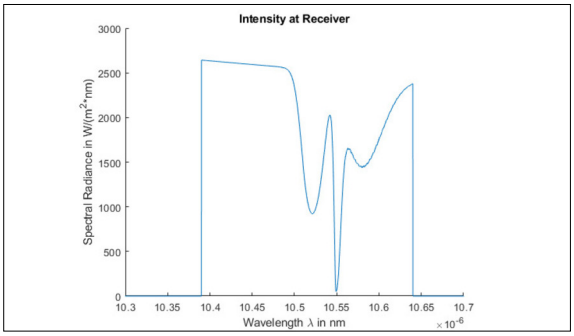
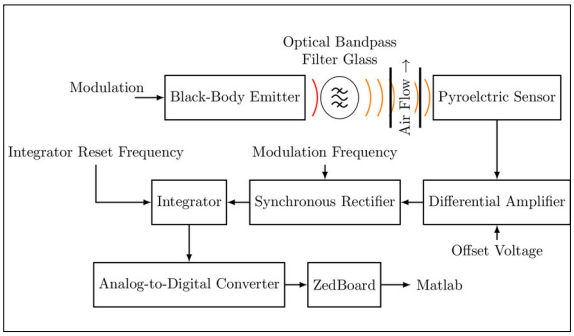
Subject Area	Sensorics

SF6-Sensing for Lung Function Tests



The blue graph represents the amount of spectral radiance received at the sensor with a SF6 gas concentration of 5%.
Own presentment

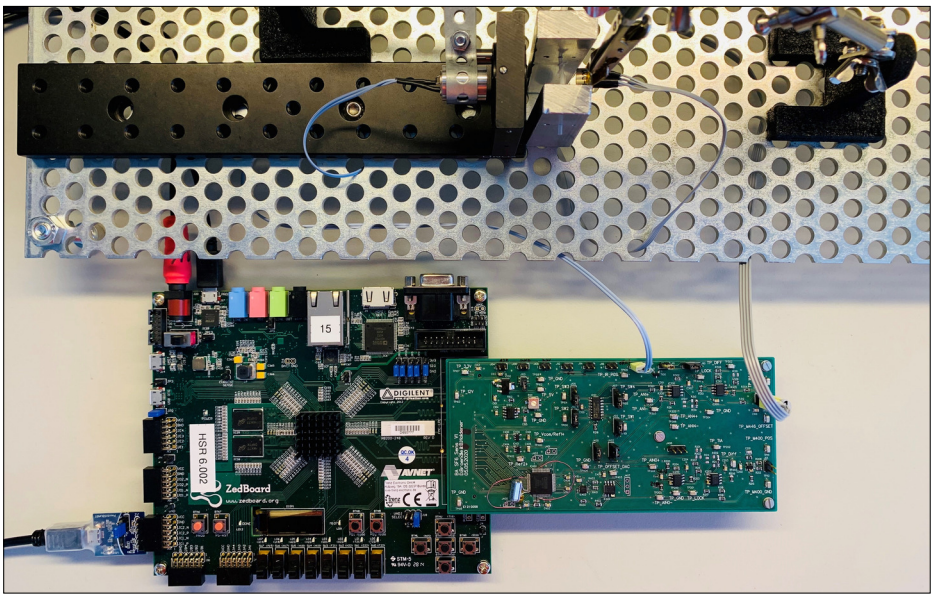


Block diagram of the system
Own presentment

Initial Situation: For a lung function test, the amount of sulfur hexafluoride (SF6) gas in the exhaled air is measured to investigate the function of the deeper lung spheres. At the moment, the concentration of SF6 is calculated with the molar mass and composition of the exhaled air. The goal of this thesis is to develop a way to determine the concentration of SF6 gas mixed with air. The applied technique is non-dispersive infrared spectroscopy. Light of the specific wavelength 10.55 um is emitted onto the gas sample and absorbed by the SF6 molecules. The power of the waves not being absorbed is then measured and the concentration of SF6 gas can be determined.

Approach: A black-body emitter in combination with a bandpass filter glass is used. The transmitted light is measured with the help of a pyroelectric sensor. The black-body emitter is pulsed so the output signal of the pyroelectric sensor can be processed with a lock-in amplifier. In the first step, the non-changing part of the output signal is subtracted with a differential amplifier. The remaining signal is then fed into the lock-in amplifier to suppress most of the noise and rectify the measurement signal. The integrator of the lock-in amplifier adds up the rectified sensor signal to amplify the difference, which then is measured by an analog-to-digital converter (ADC). The digital values are stored and transmitted over the FPGA on a ZedBoard to the computer.

Result: The functionality of the circuit board, including the lock-in amplifier, IR-Emitter, ADC, transimpedance amplifier and the differential amplifier is proven to be working based on multiple measurements. The IR-Emitter excitation and the DAC are successfully controlled by the FPGA. The FPGA of the ZedBoard converts the data of the ADC and sends it to the computer. The sensor signals are not consistent, because too many interferences are introduced. Further investigations of the signal path, starting from the sensors, are necessary.



Display of the measurement setup
Own presentment