CW Mid-Infrared LiDAR based on Pseudo Random Noise Modulation technique

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The growing demand for compact and cost-effective systems for remote sensing is motivated by a large number of applications, ranging from remote sensing for atmospheric species like pollutants, aerosol, or particulate matter, to range finding and target identification for safety and security [1]. Driven by the presence of strong absorption lines of several greenhouse/toxic gases (such as CO, CO2, N2O, O3, etc,) combined with low blackbody radiation emission from Sun and Earth, the 4-5 µm band represents an attractive region of the electromagnetic spectrum for addressing efficiently both of these important applications.

Among the pool of optical detection techniques, LIDAR is one of the most used and performing techniques. In LIDAR systems, a high peak power pulsed laser, or a modulated CW source, can be exploited to determine the distance of an object by measuring the time delay between the sent and back-received signals. Furthermore, if the laser is resonant with one absorption feature, it is also possible to perform absorption spectroscopy along the beam path, retrieving information about the specific targeted trace-gas concentration [2,3].

This work aims to combine the potential offered by the LIDAR technology and the advantages given by the mid-infrared transparency window. In our implementation, a PRN technique [4] is exploited to intensity-modulate a CW QCL laser emitting around 4.5 µm with a specific high-frequency digital pattern characterized by null autocorrelation for any non-null shift. The modulated light is guided to a distant target (a scattering obstacle or a reflector), and the back-reflected beam is collected via a detection unit. Thus, the correlation between the detected signal and the modulation pattern will result in a peak at the target distance and (possibly) will retrieve possible absorption features along the optical path. Here, the LIDAR principle and experimental implementation are discussed, together with the characterization measurements and the preliminary outdoor tests.

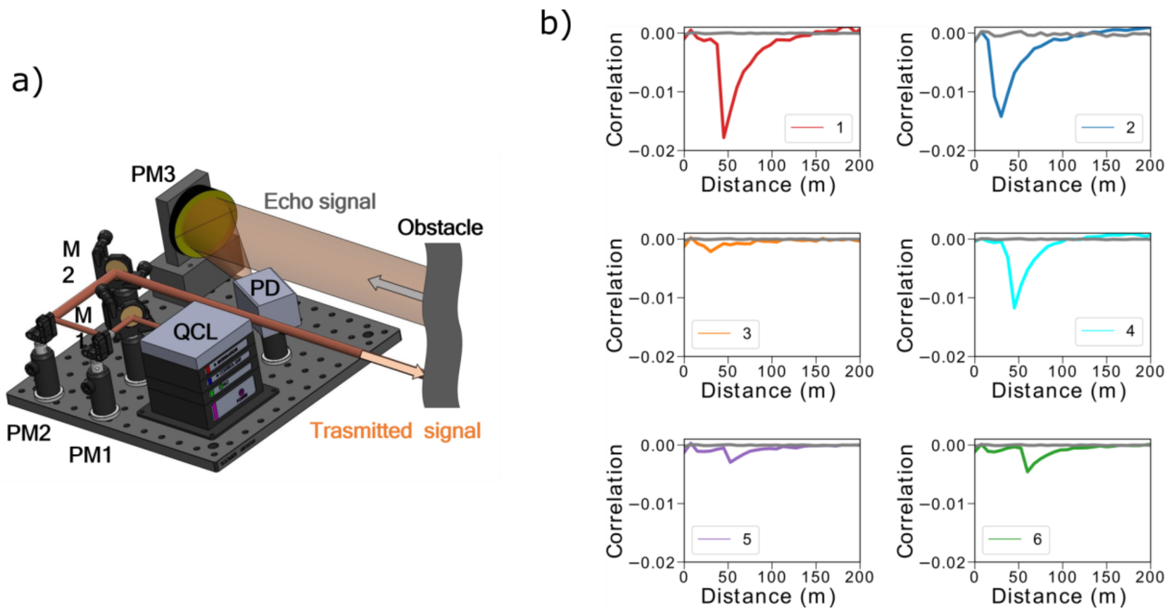

Fig. 1: *(a): Representation of our mind-IR CW LiDAR. (b): Correlation function obtained with different target obstacles.*

References

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