

Coherent All-Fiber and Polarization Maintaining Source for CO₂ Range-Resolved Differential Absorption Lidar

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Abstract : The need for CO₂ monitoring technologies grows simultaneously with the worldwide concerns regarding environmental challenges. To that purpose, we developed a compact coherent all-fiber ranged-resolved Differential Absorption Lidar (RR-DIAL). It has been designed along a tunable 2x1 fiber optic switch set to a frequency of 1 Hz between two Distributed FeedBack (DFB) lasers emitting in the continuous-wave mode at 1571.41 nm (absorption line of CO₂) and 1571.25 nm (CO₂ absorption-free line), with linewidth and tuning range of respectively 1 MHz and 3 nm over operating wavelength. A three stages amplification through Erbium and Erbium-Ytterbium doped fibers coupled to a Radio Frequency (RF) driven Acousto-Optic Modulator (AOM) generates 100 ns pulses at a repetition rate from 10 to 30 kHz with a peak power up to 2.5 kW and a spatial resolution of 15 m, allowing fast and highly resolved CO₂ profiles. The same afocal collection system is used for the output of the laser source and the backscattered light which is then directed to a circulator before being mixed with the local oscillator for heterodyne detection. Packaged in an easily transportable box which also includes a server and a Field Programmable Gate Array (FPGA) card for on-line data processing and storing, our setup allows an effective and quick deployment for versatile in-situ analysis, whether it be vertical atmospheric monitoring, large field mapping or sequestration site continuous oversight. Setup operation and results from initial field measurements will be discussed.

Keywords : CO₂ profiles, coherent DIAL, in-situ atmospheric sensing, near infrared fiber source

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