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

Authors : Erwan Negre, Ewan J. O'Connor, Juha Toivonen

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 2x1fiber 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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