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A Method of Frequency-tracking in Direct Detection Doppler Wind LIDAR

The Direct Detection Doppler Wind LIDAR (DWL) is of great significance in the study of global wind measurements and climatology. The DWL adopting double-edge technique of Fabry-Perot etalon requires outgoing laser frequency to fall on the abrupt linear region of the transmittance curve of F-P etalon. Vibration and temperature variation would cause frequency shift, which will further induce laser frequency to fall outside the linear region. While the precision and sensitivity of DWL greatly lowered, a locking channel is hereby designed for shift detection. According to the shift, the position of transmittance curve can be modulated, which guarantees the frequency falling on the linear region.

An approach of detecting the frequency shift is to measure amplitude variation by Photomultiplier Tube (PMT). The output signal is periodic, with 50Hz in frequency, only 20ns-width and sharp edges. Consequently, it is difficult to measure amplitude of such a narrow pulse signal under relatively low sampling rate. To reduce the error caused by low sampling rate, the measurement of the pulse area is made to instead of pulse amplitude. Statistical methods are also applied for further accuracy and improving stability.

A data acquisition system including circuit and a specific software is designed. The system includes external trigger, data acquisition and processing. Controlling system sends trigger parameters and acquisition commands via software. Tests using splitters have been carried out. The ratio results indicate consistent between the data acquisition system and commercial oscilloscope. The results with relative error of 0.80% also meet the locking requirements.

Author: Mr YAO, Yuan (University of Science and Technology of China)

Co-authors: Mr LIANG, Futian (University of Science and Technology of China); JIN, Ge (Univ. of Science & Tech. of China (CN)); Ms GAO, Xin (University of Science and Technology of China); SANG, Ziru (University of Science and Technology of China)

Presenters: Mr LIANG, Futian (University of Science and Technology of China); JIN, Ge (Univ. of Science & Tech. of China (CN)); Ms GAO, Xin (University of Science and Technology of China); Mr YAO, Yuan (University of Science and Technology of China); SANG, Ziru (University of Science and Technology of China)

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