波長 1.55μm 利得スイッチング LD を用いた高分解能 ToF ライダー
High resolution ToF LiDAR using 1.55μm gain switched-LD

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INTRODUCTION Recently, Light Detection and Ranging (LiDAR) technology for distance measurement have been widely used as autonomous vehicles, astronomy, atmospheric wind and so on. Time-of-flight (ToF) measurement in pulsed mode is the traditional sensing technique for distances longer than 100m and is routinely used for many civilian applications [1]. In order to measure the time delay between the peaks of emitted and reflected pulses when the distance shorter than tens of meters, accurate ToF measurements need to take into account the temporal pulse shape [1]. The range resolution of conventional ToF method is limited to several millimeters due to nanosecond pulse width. In this report, we use the picosecond optical pulses generated by a gain switching laser diode (GS-LD) for high precision short distance (<100m) measurement.

EXPERIMENT AND RESULTS Figure 1 shows the experimental configuration. In the experiment, we used 6.5ps optical pulses generated by gain-switching (GS) operation of a 1.55μm DFB-LD [2]. For the purpose of stable measurement, we employed a corner-cube reflector to efficiently detect the light returned from the object. The averaged optical power of the GS-LD pulse source was 320μW at 10MHz pulse repetition rate. Since this power was found to be not very sufficient for 20m measurement, we introduced an optical amplifier (EDFA: Er-doped fiber amplifier) to increase the averaged optical output power to 3mW and used a variable attenuator to control the optical pulse power. For the ToF measurement, we used an optical circulator to distinguish one way in which a light pulse is emitted to a target object, and another way in which reflected light is detected by a photo-diode (PD). Port 2 of the optical circulator was connected with the angled physical contact (APC) converter to avoid the detection of optical pulses reflected by the fiber edge. When the measurement distance was ~20m, the maximum detected optical power at port 3 was 1.8μW and the beam diameter was about 10mm. Figure 2 shows that the reflection optical pulse signals observed on the oscilloscope by each moving step of 0.3mm, and it is to be noted that each waveform is clearly distinguishable. The present results indicate that our GS-LD technology will be beneficial for high-resolution LiDAR systems.

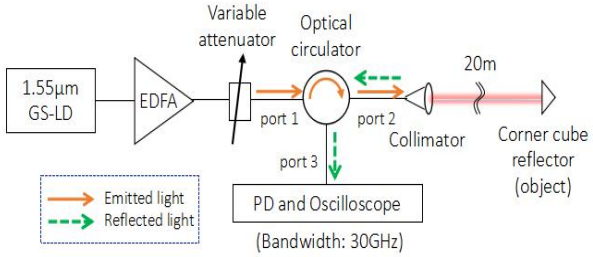

Fig. 1 Schematic diagram for the ToF LiDAR experiment using a GS-LD optical pulse source.

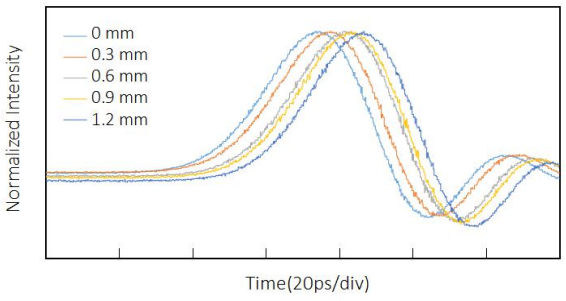

Fig. 2 Reflected signal when the object moving step of 0.3mm at 20m distance.

References:

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[2] H. Yokoyama, et al., Optics Express **14**(8), pp. 3467 - 3471 (2006).