分散チューニング波長掃引ファイバレーザを用いた非機械的走査 AMCW レーザ距離計

Non-Mechanical Scanning AMCW Laser Rangefinder Using Wavelength-Swept Dispersion-Tuned Fiber Laser

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We for the first time proposed a non-mechanical AMCW rangefinder using dispersion-tuned wavelength-swept laser source. Continuous high-speed scanning of 10 kHz and centimeter-level depth resolution had been achieved with a single-pixel detector.

Dispersion-tuned fiber laser is an actively wavelength-tunable mode-locking fiber laser without any mechanical optical filter that may limit the tuning speed [1]. Dispersion-tuned laser provides a wavelength-swept Quasi-CW laser source that is inherent amplitude-modulated with a known frequency, which saves the trouble of external intensity modulation. At the same time, the wavelength-adjustability enables dispersion-tuned laser to realize non-mechanical beam steering with diffractive element [2].

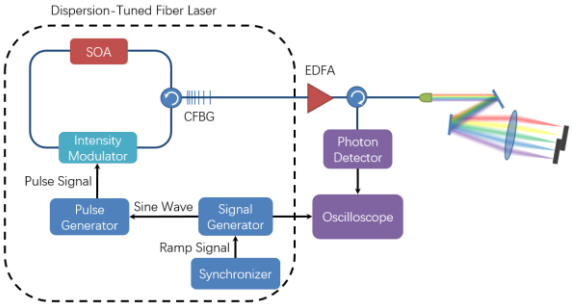

Fig.1. Setup of dispersion-tuned fiber laser and non-mechanical scanning system

The whole picture of proposed system is shown as Fig.1. The 1530-1580 nm mode-locked pulse output with power of 6 dBm from dispersion-tuned laser is amplified to 16 dBm by an Erbium doped fiber amplifier (EDFA), and then collimated to free-space with a 2 mm collimator. Two ruled reflective diffraction gratings are used to deflect light of different wavelengths to different directions, each provides 0.04°/nm dispersion and 60~80% diffraction efficiency. We used an achromatic doublet with good off-axis performance to focused the steered beam and minimize its spot size on sample, realizing scanning range of 1 cm. The collected light then goes back to collimator through the same path and then converted to electric signal by the photon detector. With synchronization from dispersion-tuned laser source, the oscilloscope collects the data for further data processing.

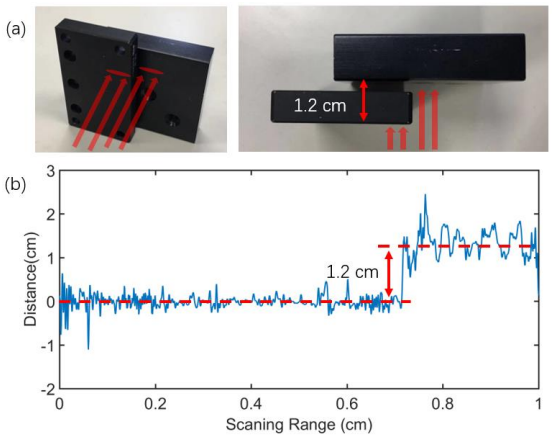

Fig.2. (a) Tested sample: two spacing plate, (b) Result of AMCW data processing.

As the Fig.2. (a) shows, we used two stepped placed metal spacing plate as sample to test the proposed detecting system. The distance between the surfaces of the two plates is set as 1.2 cm. According to the principle of AMCW, the phase shift between signal and reference channels can be obtained, which can then be converted to corresponding distance information. The Fig.2. (b) shows the result of scanning, from which we can see the obvious distance change on its surface, which has a good agreement with the 1.2 cm distance.

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References

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