Pulsed-Coherent Electronic Front End for Detection and Ranging

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SUMMARY

Researchers in the UCLA Department of Electrical and Computer Engineering have developed a Light Detection and Ranging (LiDAR) device capable of high resolution, high acquisition measurements with minimized walk error and adjustable detection quality.

BACKGROUND

Demand for ranging systems with high depth resolution and fast acquisition is increasing due to the rise of 3D scanning and remote biometric devices. LiDAR and radar are common elements that measure the time-of-flight (ToF) of coherent light radio-waves for distance ranging determination. Coherent detection can achieve high resolution but suffers from slow acquisition. An alternative to coherent detection includes frequency-modulated continuous wave detection which can perform fast acquisition and long-distant measurements but has low resolution limited by timing offsets (“walk error”). Pulsed detection has also been proposed as an alternative, with moderate resolution and acquisition, but suffers from a narrow dynamic range. To date, the gold standard has been to combine pulsed based detection and ranging (commonly used in long distance LiDARs) with coherent detection for very high measurement accuracy over short distances. This standard, however, still suffers from measurement limitations due to walk error. An alternative is needed that is capable of high resolution, high acquisition measurements with minimized walk error and adjustable detection quality.

INNOVATION

UCLA researchers have developed a method to dynamically tradeoff the resolution and sampling rate of a LiDAR measurement. This novel pulsed-coherent architecture significantly reduces walk error by the use of post-edge detection, improves noise-performance by multiple pulsing and allows for modulation of resolution and speed of detection even for long ranges. Benefitting from the multiple measurement and improved noise of coherent detection (for fine measurement) and the speed of the pulsed detection (for coarse measurement), this ToF receiver can theoretical achieve 40μm resolution with 1 MHz sampling rate.

APPLICATIONS

- Biometric devices

ADVANTAGES

- High resolution
- High speed acquisition
- Low “walk error”
- Adjustable detection quality

STATE OF DEVELOPMENT

Prototype device has been assembled with a 19GHz carrier frequency, up to 40μm depth precision and 1 MHz sampling rate.

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Published Application	20220252702	08/11/2022	2020-109

CONTACT

UCLA Technology Development Group
ncd@tdg.ucla.edu
tel: 310.794.0558.

INVENTORS

- Yang, Chih Kong K.

OTHER INFORMATION

KEYWORDS

pulsed-coherent receiver, biometric measurement, precision, lasers, ranging systems, 3D scanning, devices, time-of-flight (ToF), Lidars, radars, light radar

CATEGORIZED AS

- **Computer**
  - Hardware
- **Engineering**
  - Engineering
- **Sensors & Instrumentation**
  - Physical Measurement

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UCLA Technology Development Group

10889 Wilshire Blvd., Suite 920,Los Angeles,CA 90095

tdg.ucla.edu

Tel: 310.794.0558 | Fax: 310.794.0638 | ncd@tdg.ucla.edu