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## Multi-Tone Continuous Wave LIDAR

Tech ID: 30048 / UC Case 2018-836-0

### BRIEF DESCRIPTION

Object detection and ranging is a fundamental task for several applications such as autonomous vehicles, atmospheric observations, 3D imaging, topography and mapping. UCI researchers have developed a light detection and ranging (LIDAR) system which makes use of frequency modulated continuous waves (FMCW) with several simultaneous radiofrequency tones for improved speed of measurement while maintaining robust spatial information.

### SUGGESTED USES

- » Geographical mapping and remote sensing
- » Autonomous driving vehicles
- » Satellite LIDARs

### FEATURES/BENEFITS

- » Speed: The simultaneous modulation via several radiofrequency tones makes the system faster compared to conventional FMCW LIDARs, as there is no longer a need for successive measurements.
- » Simplicity: This system utilizes a continuous wave, rather than pulsed, laser, and so requires less complicated optical components.
- » Robustness: Usage of several radiofrequency tones makes system more robust, allowing for simultaneous measurement of object distance and velocity.
- » Sensitive, high dynamic range: The system is highly sensitive, capable of centimeter-scale resolution, and has high dynamic range due to coherent detection

### FULL DESCRIPTION

Remote sensing of objects up to thousands of feet away can be accomplished using LIDAR, a technology similar to RADAR using laser light instead of radio waves. Due to its reliable object detecting capabilities, LIDAR has found applications in technologies ranging from self-driving vehicles to atmospheric and topographical mapping. Pulsed lasers are necessary to allow for high temporal and spatial resolution. Though conventional LIDAR is highly accurate, it is time consuming and requires consecutive measurements to minimize error in timing. This limits the application of LIDAR to systems such as satellite monitoring. Standard LIDAR also is not capable of detecting velocity information from objects it encounters.

Researchers at UCI have proposed the multi-tone continuous wave (MTCW) detection system, based on frequency modulated continuous wave (FMCW) LIDAR. FMCW LIDAR utilizes a continuous wave, rather than pulsed, laser, and relies on interference techniques to generate highly sensitive measurements. The MTCW technology is an FMCW LIDAR system in which the continuous wave lasers are modulated by multiple radiofrequency tones simultaneously via a Mach-Zehnder modulator (MZM). MTCW LIDAR is less susceptible to interference effects and eliminates the time-consuming frequency scan of standard LIDAR. This technology has all the benefits of FMCW LIDARs bundled in a faster and simpler system, extending both the

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### OTHER INFORMATION

#### CATEGORIZED AS

- » **Optics and Photonics**
  - » All Optics and Photonics
- » **Communications**
  - » Optical
- » **Environment**
  - » Sensing
- » **Imaging**
  - » Remote Sensing
- » **Sensors & Instrumentation**
  - » Position sensors

#### RELATED CASES

2018-836-0

applicability and efficacy of LIDAR.

## PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	11,630,189	04/18/2023	2018-836

## STATE OF DEVELOPMENT

A theoretical study to prove the concept has been completed, and computer simulations were built to support the idea. Additionally, preliminary experimental results were obtained on an ideal target (e.g., mirror).

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