Vibration Sensing and Long-Distance Sounding with THz Waves

Tech ID: 31925 / UC Case 2019-608-0

SUMMARY

UCLA researchers in the Department of Electrical and Computer Engineering have developed a terahertz (THz) detector that utilizes the micro-Doppler effect to detect vibrations and long-distance sounds.

BACKGROUND

Terahertz (THz) detectors can play a key role in a diverse range of applications including measuring the speed of large moving objects and detecting and reconstructing sound over long distances. To be widely used in these areas, these detectors require additional hardware which decreases sensitivity. There is a need for improved THz detector technology to improve sensitivity and expand the potential applications for THz detectors.

INNOVATION

UCLA researchers have built a terahertz (THz) detector with improved sensitivity. The custom picosecond pulse radiator uses the micro-Doppler phenomenon in the Terahertz (THz) regime to improve the sensitivity of detection and accuracy of reconstruction of THz waves. The device was tested in the transmission and reconstruction through micro-Doppler of a ten-second music track and multiple frequency tones. The researchers used sound vibrations over a long frequency range (Hz to KHz) to modulate a carrier signal radiated from a digital-to-impulse silicon chip and the sound waves were recovered via frequency demodulation at the receiver.

APPLICATIONS

- THz detectors
- Radars
- Medical devices
- Materials identification/detection
- Imaging

ADVANTAGES

- Utilizes micro-Doppler effect
- Detects vibration signals in THz
- Detects sound waves in THz

STATE OF DEVELOPMENT

A prototype silicon-based picosecond pulse radiator was used to detect and reconstruct a ten-second music track. The device can detect and distinguish between sound tones from 100-400Hz and can use sound vibrations over the frequency ranges of 50 Hz to 1 KHz to modulate a 395.2 GHz carrier signal radiated from a digital-to-impulse (D2I) silicon chip.

RELATED MATERIALS

- S. Razavian, M. M. Assefzadeh, M. Hosseini and A. Babakhani, "THz Micro-Doppler Measurements Based On A Silicon-Based Picosecond Pulse Radiator," 2019 IEEE MTT-S International Microwave Symposium (IMS), Boston, MA, USA, 2019, pp. 309-311.

PATENT STATUS

Country	Type	Number	Dated	Case

CONTACT

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

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INVENTORS

- Babakhani, Aydin

OTHER INFORMATION

KEYWORDS

micro-Doppler effect, radars, terahertz, terahertz detectors, vibrational wave detection, long-distance sound detection

CATEGORIZED AS

- **Communications**
  - Other
- **Imaging**
  - Other
  - Security
- **Semiconductors**
  - Other
- **Sensors & Instrumentation**
  - Other
  - Position sensors
- **Transportation**
  - Aerospace

RELATED CASES

2019-608-0

United States Of America	Issued Patent	12,123,938	10/22/2024	2019-608
United States Of America	Issued Patent	11,442,159	09/13/2022	2019-608

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- Broadband Comb-Based Spectrum Sensing
- THz Impulse and Frequency Comb Generation Using Reverse Recovery of PIN Diode

UCLA Technology Development Group
10889 Wilshire Blvd., Suite 920,Los Angeles,CA 90095
https://tdg.ucla.edu
Tel: 310.794.0558 | Fax: 310.794.0638 | ncd@tdg.ucla.edu

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