Coherence Length Gated Microwave Photonics Interferometric System for Faster Signaling Processing (2020-038)

Coherence Length Gated Microwave Photonics Interferometric (CMPI) based distributed sensing technique for accurately measuring static and dynamic changes of physical, chemical or biological properties

Market Overview

High sensitivity distributed sensing method for both dynamic and static measurement is needed for structural health monitoring, seismic wave detection, and in situ underground deformation monitoring for geophysical and geotechnical applications. These systems are immune to electromagnetic interferences, can operate longer, and perform better in harsh environments. Current methods include phase optical time domain reflectometry (phase-OTDR) and optical frequency domain reflectometry (OFDR). Both methods are complicated, time consuming, and have a limited measurement range of around 100m. The distributed acoustic sensing market is projected to reach $792 million by 2025, growing at a CAGR of 11.4% from 2020 to 2025. Clemson University researchers have developed a CMPI system and method that allows for faster signaling processing time and a higher measurement rate of more than 100 km. This method is expected to cost significantly less than other distributed acoustic sensing methods.

Technical Summary

This sensing system includes an optical fiber with a series of any two reflectors from a Fabry Perot Interferometer (FPI), which records the localized change in distance between the reflectors in the form of optical interference. The microwave photonics interrogation unit is configured to prepare a microwave modulated low coherence light wave. By scanning the microwave frequencies, the complex microwave spectrum is obtained and converted to a time domain signal at a known location by complex Fourier transform. The values of these time domain pulses are a function of the optical path differences of the distributed FPI's, which are used to read the displacement between pairs of measurement reflectors.

Application

Distributed Sensing, Static Measurement, Distributed Acoustic Sensing, Optical Interference, Frequency Domain

Development Stage

Proof of Concept

Advantages

- Lower cost than other strain sensing methods
- CMPI measures strain directly so it can measure sharper spatial resolution with clear, defined uncertainty
- Allows for a faster temporal resolution

App Type	Country	Serial No.	Patent No.	CURF Ref. No.	Inventors
N/A	United States	N/A	N/A	2020-038	Hai Xiao

About the Inventors

Dr. Hai Xiao

Professor of Electrical and Computer Engineering at Clemson University

Dr. Hai Xiao is the Samuel Lewis Bell Distinguished Professor in Electrical and Computer Engineering at Clemson University. Dr. Xiao received his Ph.D. from Virginia Polytechnic Institute and State University in 2002. Prior to coming to Clemson, he was an associate professor of electrical engineering at Missouri S&T. He is the recipient of the Office of Naval Research Young Investigator Program Award, R&D 100 Award, and the Virginia Tech Outstanding Achievement Award. His research interests focus on photonic and microwave sensors and instrumentation.

For more information on this technology contact:

curf@clemson.edu
Please put technology ID in subject line of email.