

DISTRIBUTED SENSING EMPLOYING STIMULATED BRILLOUIN SCATTERING IN OPTICAL FIBERS (BIRAD)

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The Problem

Optical fibers serve as excellent sensing platform. In distributed analysis protocols, a parameter of interest is mapped along a fiber under test, and each fiber segment serves as an independent sensing node. Both temperature and mechanical strain can be mapped based on the physical principle of stimulated Brillouin scattering, or SBS. In this mechanism, two optical waves that counter-propagate in a fiber are coupled through the stimulation of a hyper-sonic acoustic wave. Their interaction is the most efficient when the difference between their optical frequencies precisely matches a parameter of the fiber known as the Brillouin frequency shift (BFS). The value of the BFS varies with both temperature and strain. Brillouin sensors can cover tens of km. However, the spatial resolution of most realizations is restricted to meter-scale. The modest spatial resolutions of most existing sensor protocols are insufficient for structural health monitoring of critical structures that require high spatial detail, such as bridges, railways, dams, reservoirs, vehicles, airplanes, ships.

The Solution

The cutting-edge solution presents a method to confine SBS interactions to cm-scale and even mm-scale lengths, thereby providing spatial resolution that is two orders of magnitude higher than those of existing methods. The principle relies on the judicious coding of the two optical waves of the SBS process by high-rate phase sequences. Measurements were demonstrated over 10 km of fiber with 2 cm resolution, corresponding to half-million independent sensors.

The Commercial Benefit

High-resolution, long-range fiber-optic monitoring can serve for preventive maintenance, save lives and costs associated with potential catastrophes, and reduce the cost of ownership and operation.

Market Potential

The overall structural health monitoring market was valued at USD 1.24 billion in 2017 and is estimated to reach USD 3.38 billion by 2023, at a CAGR of 17.93% between 2018 and 2023. Major factors driving the growth of the structural health monitoring market include high capital investments for structural health monitoring across various countries, stringent environmental regulations pertaining to the sustainability of structures, and a decrease in the cost of sensors those results in reducing the cost of the structural health monitoring system, among others.

Target Markets/Industries

The growing civil infrastructure would increase the demand for structural health monitoring systems. Civil infrastructures include numerous critical structures such as bridges, dams, tunnels, highways, and buildings. At present, major countries in different regions such as the US, the UK, Germany, Japan, China, India, Qatar, and Saudi Arabia are heavily investing in building infrastructural facilities, thereby ultimately growing the economy of the country.

Intellectual Property

Patent Granted in EP and USA

Team: Primary Inventor

Prof. Avi Zadok

Avi Zadok received the B.Sc. degree in Physics and Mathematics from the Hebrew University, Jerusalem in 1994 (cum laude), the M.Sc. degree in Electrical Engineering from Tel-Aviv University in 1999 (cum laude), and his Ph.D. in Electrical Engineering from Tel-Aviv University, in 2008 (with distinction).

Prof. Zadok was a post-doctoral research fellow with the Department of Applied Physics, California Institute of Technology (Caltech).

He joined the Faculty of Engineering and the Institute of Nano-Technology of Bar-Ilan University in 2009, was appointed an Associate Professor in 2013, and Full Professor in 2017.

Prof. Zadok is a coauthor of more than 140 papers in scientific journals and proceedings of international conferences.

Future Research

Development of an instrument prototype, field trials

The Opportunity

We are looking for investors that are willing to support the research and commercialize this novel invention.

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