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Wireless Data Sensor Systems and Sensing Networks

Forbes Richard*

Department of Information Science, University of Pennsylvania, Philadelphia, PA 19104, USA

Description

Optical fibre sensors have several advantages over other types of sensors. These benefits are primarily due to the optical fiber's properties, which include being small, lightweight, resistant to high temperatures and pressure, and electromagnetically passive, among others. Exploring the properties of light to obtain measurements of parameters such as temperature, strain, or angular velocity is how sensing is accomplished. Furthermore, optical fibre sensors can be used to create an Optical Fiber Sensing Network (OFSN), which allows manufacturers to create versatile monitoring solutions with a variety of applications, such as periodic monitoring over long distances (kilometres), in extreme or hazardous environments, inside structures and engines, in clothing, and for health monitoring and assistance.

The majority of the literature on this subject focuses on a specific field of optical sensing applications and details their operating principles. This paper provides a more comprehensive overview, including a literature review that describes the fundamental principles of optical sensing and highlights the versatility, benefits, and various real-world applications of optical sensing. Moreover, it includes an overview and discussion of a less common architecture, where optical sensing and Wireless Sensor Networks (WSNs) are integrated to harness the benefits of both worlds. The advancement of optical fibre technology was a significant step forward in global communications technology. The advent of low-attenuation optical fibres in the 1970s enabled high-bandwidth long-distance communications. Since then, production volume has increased, and by 2000, optical fibres had already been rapidly installed around the world [1-3]. The advancement of optical fibre technology also allowed for the development of devices for optical processing entirely in fibre, reducing insertion losses and improving processing quality. One factor that contributed to the full migration of optical fibre technology was the identification of photosensitive optical fibres.

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Electromagnetically, optical fibre sensors are inactive. This property is critical because it enables the use of optical sensors in situations where other types of sensors cannot be used, such as in high and variable electric field environments where there is a risk of explosion [4,5]. Furthermore, the silica compound, which is the basic optical fibre transduction material, is resistant to most chemical and biological agents and can thus be used in this type of environment and materials. Another advantage of optical fibre sensors is that they can be small and lightweight. Because the fibre has low optical attenuation, it can transmit signals over long distances (kilometres) between monitoring stations. Low attenuation is also required for multiplexed measurements. It is possible to operate large arrays of distributed sensors without active optoelectronic components in the measurement area by using a single optical source and detection unit. As a result, electromagnetic passiveness and environmental resistance can be preserved. Optical fibre sensor systems are typically used in fixed locations. As a result, extensive lengths of fibre optic cable are required to connect all of the sensors and create an optical fibre network, which can be costly and impractical. Wireless Sensor Networks (WSNs) have received a lot of attention in recent years because of their ability to collect data on parameters like temperature, pressure, acceleration, and vibration. Nonetheless, most WSN systems do not incorporate optical fibre sensors and thus do not benefit from their unique properties and advantages. As a result, incorporating optical fibre sensors into WSNs provides advantages and new capabilities for the design of advanced hybrid-sensing systems.

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Conflict of Interest

Authors declare no conflict of interest.

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***Address for Correspondence:** Forbes Richard, Department of Information Science, University of Pennsylvania, Philadelphia, PA 19104, USA, E-mail: ForbesRichard4@gmail.com*

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