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Editorial

Sensor Networks for Structural Health Monitoring

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Billions of dollars are spent globally every year on public infrastructure, automotive, and aerospace structures to keep up with the world's population growth. Managing those assets is of high significance, and to do that efficiently is an exhausting task that requires the need for continuous monitoring, maintenance, and rehabilitation. For instance, considering the bridge network in Europe, a recent survey showed that around 31% age between 50 and 100 years [1]. In-service and aging steel bridges entail a great attention to ensure a high level of safety, to maintain them in a good shape, and to extend their lifespan. The increase in the traffic flow and the size of the vehicles, environmental pollution, poor quality of construction, and inadequate maintenance necessitate the development of robust methods of inspection, in particular when dealing with complex and extremely large structures. Another example is the steel pipeline systems that are very crucial in transporting dangerous substances, such as crude oil and petroleum products, due to their practicality, efficiency, and cost-effectiveness. With many kilometres of the pipeline, carrying large volumes of hazardous substances, there are many reasons that may engender the pipeline's failure (mechanical, operational, corrosion, and natural failure or intrusion from a third party), rupture, leaks, and spillages. According to Concawe's report [2] having data collected on European cross-country oil pipelines from 1971 till 2016, 135 mechanical failures occurred from which 49 were due to construction faults and 86 due to design or material faults. As such, structural integrity monitoring and management are very crucial to maintain the high level of safety and prevent failure-related incidents and consequences.

Continuous structural health monitoring (SHM) systems would form a major establishment in the field of damage detection, assessment, and failure prediction. Knowing the integrity of in-service structures, on a continuous real-time basis, is crucial for manufacturers, maintenance teams, and operators. SHM is an area of growing interest and worthy of new and innovative approaches. A typical SHM system requires the constant collection of data from sensors that are embedded within the structure. The data can then be analyzed to detect the presence of any possible flaws; moreover, the remaining life of the monitored system can be estimated. The advancement in sensor technology, in its various forms, as well as hardware, leads to major developments of smart systems in many fields including manufacturing, automotive, aerospace, and civil engineering. The presence of a wide range of sensors, at a reduced cost, resulted in significant work in real-time monitoring of components and structures, in the last two decades, aiming at extending their lifetime, reducing the associated maintenance costs, and ensuring the public safety [3].

When designing a sensor network, many considerations must be taken into account that may impact every component of the SHM system, starting with the type of measurements (sensor selection or development), number and location of sensors, communication and data transmission, and finally data storage [4].

In this special issue, we aimed to shed some light on a very important component of an SHM system, which is related to sensing technologies and sensor networks. With no doubt, sensors' development and design of sensor networks are a fundamental step for an efficient and robust SHM system.

Although there have been a lot of focuses on sensor technologies and design of sensor networks, the implementation is not very smooth in particular when dealing with sensitive or critical components in automotive and aerospace structures. Retrofitting sensors on structures is not always plausible, and therefore, novel approaches for sensor installation or sensor embedment during manufacturing are of a high demand. Researchers and engineering scientists, in the future, should focus more on development of smart sensing systems that are effective for practical applications such as smart skins, smart paint, or miniature advanced sensing nodes.

Conflicts of Interest

The editors declare that they have no conflicts of interest regarding the publication of this special issue.

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