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"Development of New Structural Health Evaluation Method for Health Monitoring of Structural Components"

WP1. "Investigation of sensor measurements and signal processing methods "

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"Report on sensor measurements and data/signal processing methods for structural health monitoring of structural components"

Post-doctorate:

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Abstract

Modern civil, transport and aerospace engineering structures are becoming more complex and multifunctional and are expected to be fully functional under severe environmental conditions. Their failure can lead to tragic consequences and therefore structures have to undergo regular costly inspections. For example, The International Air Transport Association (IATA) indicates that civil aircraft Maintenance, Repair and Overhaul (MRO) costs represents 10-13% of airline costs. IATA estimates that a 1% reduction in maintenance costs could mean $800 million in savings for the industry [1]. The durability and service life of the reinforced concrete (RC) structures are one of the foremost problems faced by the civil engineering industry for the past few decades. It has been reported that corrosion associated maintenance and repair of RC structures cost 5 billion EUR annually in Western Europe alone [2]. Therefore structural health monitoring (SHM) has become one of the most important keys in maintaining the integrity and safety of modern engineering structures.

Traditional non-destructive evaluation (NDE) techniques such as ultrasonic inspection, acoustography, radiographic inspection, shearography, and thermography are effective for health evaluation of structural components, but usually are time-consuming, expensive and frequently it is difficult or impossible to use such NDE techniques in an operational structure due to the size and weight of the systems [3]. On the other hand, SHM technologies with an integrated self-diagnostic system that involve continuous monitoring of a structural component using integrated sensors offer a promising alternative. The basic idea of such SHM system is to provide a structure of interest, detection and analysis capabilities, and allow monitoring and evaluation to be performed periodically or continuously and autonomously. In general, a typical SHM system includes three major components: a sensor network, a data processing system (including data acquisition, transmission, and storage), and a structural health evaluation system (including diagnostic algorithms and information management) [4]. The structural responses are firstly measured by the sensor network spaced at regular intervals of time, then transmitted through the data processing system extracting damage-sensitive features, and finally analyzed by the health evaluation system. Therefore, the accuracy and reliability of structural health evaluation results are largely dependent on the quality of sensor measurements, which further depends substantially on signal processing. Hence, this report focuses sensor measurements and data/signal processing methods used in structural health monitoring. The main goal of this review is to present the findings of the latest studies in SHM and assist researchers in this field with a condensed source of references that are related to novel sensor measurements and data/signal processing methods in SHM applications. The peer-reviewed papers were selected from prominent databases, including Science Direct, Web of Science, ASCE, Engineering Village, Sage, and Wiley Online Library.