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Description of state-of-the-art methods and algorithms of data processing techniques and MEMS sensing technologies applicable for the global SHM of building structures

2020

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1. Annotation

Structural health monitoring (SHM) – the method of evaluating and monitoring structural health is a vast topic. This report focuses on the review of SHM (structural health monitoring) vibration-based (VBM) state-of-the-art methods with potential application to building structures especially to the low or medium-rise buildings that characterize with small vibration amplitude region during normal operation. Reviewed SHM methods are associated with normal loading conditions (ambient vibrations) affected by operational, environmental factors and ageing of the structure. The focus maintained on low – cost sensors and sensor network, e.g. microelectromechanical system (MEMS) potential application to the object in the report.

Instead of giving the detailed mathematical description of numerous methodologies and algorithms, this report intended to summarise relevant information and attempting to structuralize important aspects of SHM applicable to the low or medium-rise buildings. It is addressed the key issues and covered following topics: topicality of the review, general scheme of SHM system, typical dynamic characteristics of low and medium-rise buildings and modelling issues, typical ambient vibration sources, identification techniques of operational modal analysis (OMA), data normalization and signal processing techniques including problems induced by operational and environmental factors, damage identification and localization techniques and relevant microelectromechanical systems for sensing.

As currently transferring research into practice is viewed as a critical milestone report summarises performed full-scale experimental research on medium-rise buildings between 2002 and 2019 in different countries. This highlight successfully used sensing technologies and OMA identification algorithms in practice. Additionally, attention paid to developments of practical guidelines in the field of SHM.

Based on the review, some challenges, suggestions, and future trends in SHM of low or medium-rise buildings utilizing VBM approach proposed.