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Data Quality for Structural Health Monitoring of Bridges

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ABSTRACT

The use of digitalization and reliance on relying on Structural Health Monitoring (SHM) in bridge engineering is increasing, especially for long-span bridges where the condition assessment becomes more challenging. Effectively, it ensures greater accuracy in damage identification and enhanced maintenance of existing bridges by collecting information on the bridge's actual condition (i.e., likely damage, its severity, etc.). This increased reliance on data and information raises the question of the quality of the data and its effect on the management strategy and the decision-making process for bridge engineering. To solve this issue, in this article, data quality indicators for SHM are first selected, then metrics for data quality are reviewed, and some metrics are proposed to assess them. Then, a bridge management strategy considering the data quality is suggested to improve bridge management and decision-making processes. This strategy considers several steps to account for the data quality of SHM in the life cycle assessment management, including mainly the value of information on SHM data quality and some life cycle system performance indicators, which now account for the SHM data quality.

Keywords: Data quality; SHM; Decision making; Bridges; Management strategy.

1 INTRODUCTION

Contemporary bridges are aging all over the world and necessitate maintenance. Extending their lifetime is challenging due to increased natural risks, climate change, and population growth.

Transportation is crucial for the economy and modern society's functionality and welfare (Schroten et al., 2019). Therefore, the European Union (EU) aimed to preserve the functionality of transport infrastructures and decided to spend €38 billion on its maintenance (Schroten et al., 2019). Nevertheless, the resources for maintenance are still scarce, and it is essential to develop a strategy to optimize bridge integrity management.

Lately, great research endeavors have been devoted to shifting from condition-based methods to risk-based methods for more efficient bridge integrity management, as shown in EU research projects such as COST TU1406 (Casas & Matos, 2021). Though, risk-based approaches do not suggest how to reduce the indirect consequences in the aftermath of the event and disruptions. Thus, some resilience-based methods were developed to ensure an effective recovery ((Bruneau et al., 2003), (Cimellaro et al., 2009), (Linkov et al., 2014), (Sharma et al., 2018)). Yet, networks and domain interconnections are still complex and largely neglected. This perspective is not representative of reality as the world is progressively more interconnected technologically, economically, sociologically, and ecologically ((Havlin et al., 2012), (Linkov et al., 2014)).

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