Acceleration data quality assessment for bridge structural health monitoring via statistical and deep-learning approach

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Abstract

In recent years, the safety and comfort problems of bridges are not uncommon, and the operating conditions of in-service bridges have received widespread attention. Many large-span key bridges have installed structural health monitoring systems and collected massive amounts of data. Monitoring data is the basis of structural damage identification and performance evaluation, and it is of great significance to analyze and evaluate its quality. This paper takes the acceleration monitoring data of the main girder and arch rib of a long-span arch bridge as the research object, analyzes and summarizes the statistical characteristics of the data, summarizes 6 abnormal data conditions, and proposes a data quality evaluation method of convolutional neural network. This paper conducts frequency statistics on the acceleration vibration amplitude of the bridge in December 2018 in hours. In order to highlight the end effect of frequency statistics, the whole is amplified and used as network input for training and data quality evaluation. The results are good. It provides another new method for structural monitoring data quality evaluation and abnormal data elimination.

Keywords: Bridge structural health monitoring; frequency distribution; one-dimensional convolutional neural network; data quality assessment.

1 Introduction

Bridge structural health monitoring (BSHM) technology is likely to ensure the safety and durability of bridge structures, so it has been developed rapidly in the past decades [1]. The goal of BSHM is to continuously and quantitatively monitor the state of bridge through sensor network [2], and to realize the damage identification of bridge structure. In addition, the measured data can also be used for load identification [3], response reconstruction [4] and vibration control [5]. However, the increase of monitoring data brings great challenges to the data quality identifying.

In recent years, deep learning has attracted much attention because of its advantages in accuracy and robustness when applied to complex problems (especially those with huge data) [6-9]. Inspired by the deep learning trend, this study proposes a novel data classification method for bridge structural health monitoring, using the relative frequency distribution and the convolutional neural network.

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