Denoising of structural health monitoring data: method and coding

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Abstract

Numerous denoising approaches have already been presented to handle the noise in measured data of structural health monitoring systems. However, the performances and features of these existing methods applied in real data-set are not clear enough yet, where the noise is not known in advance. Therefore, based on the measured structural response data from a tied-arch bridge in China, six common data denoising methods are selected for a comparative study. The denoising effects are evaluated based on spectrums. Conclusions on the applicable situations and robustness of involved methods are given. A corresponding program is also developed. This study can provide references for applying the denoising methods in real structural health monitoring system data-set.

Keywords: denoising; noise; data polishing; spectrum analysis; structural health monitoring(SHM)

1 Introduction

Structural health monitoring (SHM) technique has been widely applied in bridges worldwide nowadays. The main object of SHM is to access the structural condition and identify damages, which significantly depends on the real-time monitoring data of structural responses [1,2,3,4]. However, the measured data from SHM systems always contain different levels of noise. The data noise can affect the accuracy of data analysis and sometimes even lead to wrong interpretation. As Teng [5] presented, data noise can be handled by three ways, that is, just leaving the noise in, data filter, or data polishing. As numerous methods were presented for data denoising, especially in data polishing, comparative studies involving several data polishing methods were also be conducted based on data generated artificially, just like Moosavi et al. [6]. However, to the author's knowledge, comparative studies of these various existing denoising methods on real-world data-set, which means the data noise is not artificially added and cannot be quantified, are yet to be done. Therefore, the features and applicable situations of various methods in practical application are not clear enough.

This paper aims to compare several common denoising methods on real SHM data from a tied-arch bridge in China. Totally six data polishing methods are adopted to denoise three different kinds of response data: accelerate, strain, and temperature data, respectively. The denoising

https://doi.org/10.2749/ghent.2021.0504
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