Computer Vision-based Finite Element Model Updating Method Using Measured Static Data: An Experimental Study

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Abstract

Accurate FE models play an important role in structure health monitoring (SHM). In the traditional static finite element model updating (FEMU) process, loading tests interrupting the traffic are required for obtaining static data, which is inconvenient. This paper proposes a novel static FEMU method based on computer vision technology and WIM system, avoiding the mentioned defects. Firstly, the static response simulation under traffic load is carried out with the computer vision determining the load location and the BIW system deciding the load value. Secondly, signal processing technology extracts the measured static data from the monitoring data. Thirdly, the PSO method is utilized to perform the FEMU. An experiment is designed on a bridge model with an SHM system, and results verify the convenience and accuracy of the proposed method

Keywords: FEMU; computer vision; PSODE; parallel calculation.

1 Introduction

Detailed and accurate finite element (FE) models are vital for structural health condition assessment and damage detection [1]. The initial FE model established based on the documents inevitably differs from the existing structure due to parameter errors, signal processing errors, etc. [2]. Finite element model updating (FEMU) aims to decrease the variation by adjusting the structural parameters such as material elastic modulus and density [3].

According to the data type used in the FEMU process, the FEMU methods are divided into dynamic FEMU, static FEMU, and FEMU using dynamic and static data. In the existing studies of static FEMU methods, the static data are always procured from field tests, which interrupt the traffic and limit the loading scenarios. Up to now, several studies (Xiao et al. [4] and Wang et al. [5]) have carried out static FEMUs using the static data, including static influence lines, static displacements, and stresses. It's worth mentioning that the static data are all generated in the field test, interrupting the traffic and needing lots of preparations. To simpler the process, we can regard each vehicle passing over a bridge during the operational phase as a load test and transform designing vehicle loads in the field tests into

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