# Accepted Manuscript


Identification of Structural Dynamic Characteristics Based on Machine Vision Technology

C.Z. Dong, X.W. Ye, T. Jin

PII: S0263-2241(17)30615-2
DOI: https://doi.org/10.1016/j.measurement.2017.09.043
Reference: MEASUR 4993

To appear in: *Measurement*

Received Date: 27 May 2017
Revised Date: 7 September 2017
Accepted Date: 26 September 2017

Please cite this article as: C.Z. Dong, X.W. Ye, T. Jin, Identification of Structural Dynamic Characteristics Based on Machine Vision Technology, *Measurement* (2017), doi: https://doi.org/10.1016/j.measurement.2017.09.043

# Identification of Structural Dynamic Characteristics Based on Machine Vision Technology

C. Z. Dong[1], X. W. Ye[*1] and T. Jin[1]

[1]*Department of Civil Engineering, Zhejiang University, Hangzhou 310058, China*

**Abstract.** As a convenient and effective tool for monitoring of the structural behaviors of civil infrastructure, the machine vision-based sensing technology integrated with digital image processing algorithm has achieved great progress in the field of structural health monitoring (SHM). The prominent advantages of this kind of measurement technology mainly include non-contact, long-distance and high-resolution. Up to now, various types of vision-based systems have been developed and applied in structural performance monitoring of engineering structures, however, seldom investigations are relevant to monitoring of structural dynamic characteristics. In this paper, the method for multi-point synchronous measurement of structural dynamic displacement is proposed. The structural modal parameters are identified using measured multi-point dynamic displacements and fast Fourier transform. A simple-supported rectangle steel beam model is established for conducting experiments to investigate (i) comparison study on the measurement results obtained by the vision-based system and the accelerometer, (ii) the effect of the measurement distance on the accuracy of the vision-based system, and (iii) the feasibility of different types of targets (LED lamp and black spot). The experimental results show that the proposed vision-based method is effective, accurate and stable for structural dynamic response monitoring and modal parameter identification.

**Keywords:** structural health monitoring; vision-based technology; digital image processing algorithm; structural dynamic response; modal parameter identification

## 1. Introduction

Large-scale (long-span or high-rise) engineering structures are inclined to vibrate under external stochastic loadings such as wind, earthquake, traffic, etc. These vibrations will cause damage (e.g., fatigue and cracking) to the critical structural components. In general, the structural diagnosis paradigms are mainly based on the dynamic responses such as stresses, displacements, accelerations, etc. A key issue is to construct the congruent relationship between the structural dynamic properties and the damage of the target structure (Kim and Stubbs 2003, Yi *et al*. 2012). Thus, it is crucial to examine the vibration characteristics of structures under different external loading conditions. In the past three decades, vibration-based damage detection and modal parameter identification using the measurement data of structural dynamic response has been a critical task in structural health monitoring (SHM) (Fan and Qiao 2011). For instance, Oshima *et al.* (2014) developed an indirect approach for assessing the state of a bridge on the basis of mode

* Corresponding author, Associate Professor, E-mail: cexwye@zju.edu.cn