

A NON-CONTACT MEASURING SYSTEM FOR MONITORING THE DISPLACEMENTS OF LONG DECK SUSPENSION BRIDGES

ABSTRACT

The Structural Health Monitoring is an emergent powerful diagnostic tool to identify and prevent failures of the various components that comprise the infrastructure. Without an efficient monitoring system, a component failure may cause irreversible damages in the infrastructure and, worst, a possible loss of human lives.

Considering the restrictions usually found on large engineering structures, an enhanced solution comprises a non-contact measuring system with dynamic response, accuracy and amplitude range well-suited to the physical phenomenon to measure. In the National Laboratory for Civil Engineering (LNEC) we are developing a measurement system based on vision technology and image processing that fulfil these goals. Specifically, the vision system aims to measure displacements of larger amplitude, such as those observed on suspension bridges, with accuracy better than 10 mm, resolution better than 1 mm and a minimum sampling rate of 20 Hz. To achieve these goals it is indispensable to perform the vision system calibration. The calibration process aims to find a mathematical model and its parameters values that govern the relationship of the transformation between the 2D captured image coordinates and the 3D real world coordinates.

The paper describes a methodology to perform the vision system calibration, which can be performed with little effort and requires a minimum set of information. Specifically, only a set of active targets fixed to deck and the knowledge about the distance between neighbour targets is required. The method makes no other assumption about the scene (targets position) neither about the pose of the cameras and can be implemented *in-situ*, while the deck is continuously in motion.

Results related to the performance evaluation of the calibration methodology are reported showing that the required accuracy value is fulfilled, even in an environment severely affected by noise.

KEYWORDS: Suspension bridge; Non-contact measuring system; Vision Metrology; Long range photogrammetry; Structural Health Monitoring.