Application of close range photogrammetry in structural health monitoring by processing generated point cloud datasets

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Abstract

In bridge inspection, vertical displacement is a relevant parameter for both short and long-term health monitoring. Assessing change in deflections could also simplify the assessment work for inspectors. Recent developments in digital camera technology and photogrammetry software enables point cloud with colour information (RGB values) to be generated. Thus, close range photogrammetry offers the potential of monitoring big and small-scale damages by point clouds. The current paper aims to monitor geometrical deviations in Pahtajokk Bridge, Northern Sweden, using an optical data acquisition technique. The bridge in this study is scanned two times by almost one year a part. After point cloud generation the datasets were compared to detect geometrical deviations. First scanning was carried out by both close range photogrammetry (CRP) and terrestrial laser scanning (TLS), while second scanning was performed by CRP only. Analyzing the results has shown the potential of CRP in bridge inspection.

Keywords: bridge inspection; photogrammetry; 3D point-cloud generation; geometrical deviation.

1 Introduction

The process of implementing damage detection and performance analysis strategies for engineering structures are defined as Structural Health Monitoring (SHM) [1]. SHM deals with monitoring systems over time through collecting sampled static and dynamic response measurements. It can be performed by visual inspection, instrumentation or utilization of technological devices. Visual inspections are considered the industry standard but are subjective and often inaccurate. Thus, bridge inspectors have faced challenges related to inaccessibility, cost-inefficiency, and accuracy in some cases. For example, the inspectors are not able to get access to critical parts of a bridge without costly equipment, such as snooper trucks or scaffoldings. A study by Graybeal et al. [2] revealed that at most, 81% of visual inspections were assigned correctly. Furthermore, Phares et al. [3] tested the accuracy of visual inspections, revealing that at least 48% of individual condition ratings were incorrect. Thus, bridge managers all over the world are looking for simplified ways to monitor geometrical deviation for assessment. The role of geometrical deviations in assessment of existing concrete bridges was discussed in detail in [4]. Since, traditional methods for data revival are either time consuming, tedious or/and expensive, there is a need to develop simple, inexpensive, and yet practical methods to measure geometrical deviations in a bridge. Modern techniques are usually non-contact and able to collect a large

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