Vision-Based Bridge Displacement Estimation

Joshua Irawan

Keywords: vision-based, bridge displacement estimation

【Background】

Bridge displacement is one parameter that important considering its ability to help describing bridge health state and condition. Nowadays, bridge displacement could be measured accurately with the use of displacement transducers. In the other hand, bridge displacement are identified by extracting and utilizing bridge response from accelerometers installed directly on the bridge. Although the approaches are studied successfully, the installation of such instruments in the practice cost so much time and efforts. Hence, a new approaches by utilizing vision-based to estimate bridge displacement is believed to be faster and easier than the methods mentioned above.

【Objective】

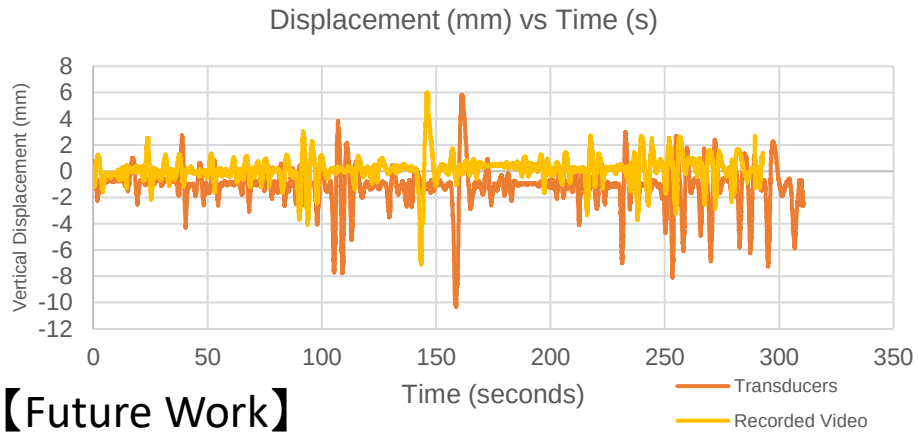
This study aims to estimate bridge displacement by using camera recording one target point attached on the real bridge experiment. Specifically, the research utilize OpenCV, an open-source computer vision and machine learning software library in the hope that the displacement identified could be highly accurate.

【Approach】

Target stickers is attached to a real bridge located at Hyogo Prefecture at several location on the bridge span and the movement are being recorded with camera. From the video, the study use OpenCV to run the algorithm. Phase-correlation method are being utilized in the study as the method to calculate the changes between frames of the video. Later, Laplacian Filtering is also being utilized to choose the most-unblurred frame as the reference frame. The result then being validated with the bridge displacement data obtained from displacement transducers which installed at the same location as the target stickers.

【Results】

Figure 1 and 2 are the bridge displacement obtained from transducers and video.



【Future Work】

For the approach : (1) Synchronize time frame, (2) Selecting reference frame method, (3) try another method (i.e point tracking method, etc.)

For the study : Integrate with another vibration-response damage detection study (i.e DBBI)

【Acknowledgment]

This study is a collaborated study with NEC, as part of the algorithm was created also by them.

Long-term Bridge Health Monitoring

Joshua Irawan

Keywords: long-term health monitoring, Mahalanobis Distance

【Background】

Damage detection study is an important task of bridge-health monitoring. Commonly, manual visual inspection method are still being used despite it is time consuming and costly. Vibration-based monitoring utilizing accelerometers to obtain bridge responses are growing in the academic research since it is easier and cheaper. Despite it shows promising and accurate results, installing sensors for every inspection would still cost high expenses and takes too much time. Therefore, this research aim to conduct the inspection method of identifying damage on the bridge by obtaining monitoring data remotely.

【Objective】

This study aims to detect the damage on the bridge by learning the change of bridge natural frequency by using statistical approach. The approach hopes to make the study through out 18 months of monitoring data easier by utilizing Mahalanobis Distance as the method.

【Approach】

18 months monitoring data of a PC bridge in Shiga were obtained from remote sensing system. Five bridge natural frequencies were identified from three (3) of tri-axial accelerometers. One first month of the monitoring data were chosen as the reference dataset, and the other are testing dataset. Mahalanobis-Taguchi Strategy (MTS), a pattern technology system, is being utilized to calculate the Mahalanobis Distance (MD) among the datasets. Obtained datasets later arranged within period of time (daily, weekly, monthly) to make the visualization and the observation of the changes easier.

【Results】

Figure below shows the distribution of Mahalanobis Distance (daily) across number of days of the entire 18 months monitoring data. The fluctuancy of the distribution shows that natural frequencies changes amongs days and months that believed due to the effects of environmental aspects (i.e temperature changes)