3rd URSI AT-AP-RASC, Gran Canaria, 29 May – 3 June 2022

Displacement Measurement on a Railway Bridge using Video Surveillance Cameras

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In future smart cities[1], a video surveillance camera system could be capable of monitoring any relevant structures and assess their behavior, for example by finding response abnormalities or by analyzing its load cycles over time. This would allow a more knowledgeable maintenance of critical structures, such as bridges, [1]-[2], with minor intervention onto the infrastructure itself. This work brings a first step towards that vision where several video surveillance cameras were employed (in 2D and 3D arrangements) to monitor a civil engineering structure.

The displacement experienced by different areas of a railway bridge due to passing trains was evaluated using three camera systems through computations based on digital image correlation [3]. The installation included a single camera capturing an area of the bridge from its east side, a stereo system comprised of two cameras capturing an area of the bridge from below and another stereo system installed on the bridge's west side. The cameras were connected to an IP local network and set to acquire video frames synchronously using a method based on the Network Time Protocol (NTP). The video streams output by the cameras were continuously recorded for roughly two hours, capturing the passage of several trains during that period.

Even though all the examined surfaces were prepared with speckle patterns for the possibility of full-field analysis, this work is focused on the displacement of single points within those areas and the analysis of their displacement over time as each train exerts its dynamic load on the bridge. The displacement profiles were compared between the camera systems, as well as with measurements obtained through independent methods. For each type of train, there is a distinct evolution of displacement values and a different magnitude of the maximum displacement, which went up to 2.1 mm for the analyzed events.

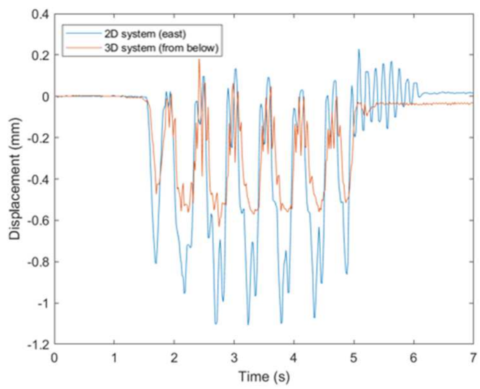

Figure 1. Railway bridge with a high-speed train passing and some of the installed cameras (left); evolution of displacement over time caused by an *Alfa Pendular* train on two camera systems (right).

References

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[3] Barros, F., Sousa, P. J., Tavares, P. J. & Moreira, P. M. G. P., 2018. Digital image correlation through image registration in the frequency domain. *The Journal of Strain Analysis for Engineering Design,* 53(8), p. 575–583.

1 The authors acknowledge the financial support received from P2020 project number POCI-01-0247-FEDER-041435, Safe Cities - Inovação para Construir Cidades Seguras, cofinanced by European Union (EU) through the FEDER (European Regional Development Fund) under of the COMPETE 2020 (Operational Program for Competitiveness and Internationalization).