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Monitoring of the Great Belt Bridge hanger vibrations and expansion joint movements using Digital Image Correlation.

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Abstract

Civil infrastructure system owners are often faced with an increasingly impossible set of management challenges. Informed decisions on timely intervention for effective bridge maintenance activities rely on good quality, accurate and reliable asset condition data. Digital image correlation (DIC) is a noncontact photogrammetry technique that can be used for monitoring by imaging a bridge component periodically and computing strain and deformation from images without traffic disruption. This paper describes the use of DIC for the monitoring of the Great Belt Bridge wind-induced hanger vibrations and temperature-induced movements of the expansion joint. Both DIC measurements provided previously unavailable data and informed next steps with respect to the maintenance strategy. To the authors knowledge these are one of the first such vision-based structural health monitoring campaigns carried out on a suspension bridge.

Keywords: structural health monitoring, hangers, expansion joint, fatigue, asset management, digital image correlation, cost effectiveness, value of information, short & long term monitoring.

1 Operation & Maintenance of global transportation infrastructure – business need

Despite the growing gap in building new infrastructure the worldwide stock of existing infrastructure is worth about US$ 50 trillion, which is of the same order of magnitude as the global stock market capitalization (US$ 55 trillion) and comparable, to a certain extent, to the global GDP (US$ 72 trillion). This existing stock offers a great opportunity to narrow the infrastructure gap if governments are capable and willing to optimize the operations and maintenance (O&M) of their infrastructure assets [1]. The ongoing cost of maintaining the world's physical infrastructure is extremely high. Considering bridges alone, it's estimated that some US$ 70 billion is spent annually on repairing bridge structures that have deteriorated under loads and environmental conditions to the stage where expensive reactive maintenance is required.

The principal difficulty with adding several traditional monitoring systems is that they produce vast quantities of inconsistent data and are labor intensive. Asset managers or bridge operators typically do not know what to do with this data unless there are very clear trigger levels defined

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