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Long-term Bridge Deflection Monitoring using Indirect Estimation with Strain and Computer Vision-based Measurements

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ABSTRACT

Monitoring long-term behavior of a bridge from construction to in-service stages provide valuable information for structural safety and maintenance. Long-term deflection measurement under various loadings and harsh environment is a truly challenging task due to practical issues such as sensor reliability and movement. The existing methods for deflection sensing in field testing are mostly tailored to short-term campaign-type testing, including traditional contact sensing of the linear variable differential transformer and wire gauge, computer vision-based approaches, and indirect estimation. Although these methods have been well proven for full-scale field testing in the literature, their long-term performance is still doubtful as effects of the varying environment have not been fully considered. This study presents an approach for long-term bridge deflection measurement and prediction. Displacement measurement is enabled by an approach using combination of strain-based indirect estimation and computer vision. A physics-based machine learning approach is introduced for predicting structural displacement. The proposed measurement and prediction approach is validated using a railroad bridge under construction.

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