BWIMの軸重同定を応用した橋梁の健全性評価

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Keywords：影響線，BWIM，変位

【研究背景】

供用橋梁の老朽化に伴い，効率的かつ定量的な橋梁の維持管理手法が求められており，従来の点検を補助できる技術として，センサによる構造ヘルスモニタリングの研究が注目されてきた．橋梁全体の性能変化を評価できる物理量として変位は有効であり，動画像解析や加速度応答から変位を同定し，構造物モニタリングへの活用も可能になりつつあるが，損傷検知を行うには外力の情報を必要とする．

【研究目標】

たわみ影響線によるBridge Weigh-In-Motion(BWIM)を応用し，本来は存在しない仮想の軸を軸重同定過程に導入することで，新たに仮想軸に割り当てられる重量から橋梁の異常の有無および損傷箇所の検知を行う．また，得られた仮想軸重の値が総重量に占める割合と推定曲げ剛性値を検討して，橋梁の健全性評価を行う．

【研究手法】

室内模型橋梁実験とシミュレーションモデルによる仮想軸の性能評価を用い，損傷箇所と測定点，仮想軸の配置箇所が示す傾向より，最適仮想軸配置を探索する．また，得られた仮想軸重値を応用して，損傷個所の推定を行う．また，変化の形状に即した仮想的な影響線を軸重同定過程に導入し，高精度な過大推定重量の抽出を行う．

【発表予定】

・令和5年度 国際ジャーナル

【結果概要】
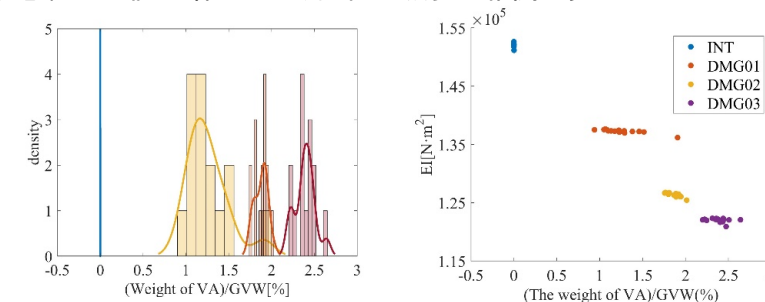
各損傷箇所で正の値として仮想軸重を同定することが出来た．さらに，仮想軸重の値の増加と曲げ剛性の減少に相関が見られた．
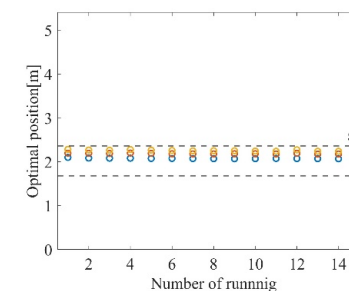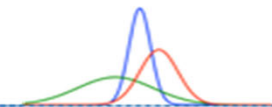

Fig.1 仮想軸重割合の結果と曲げ剛性との相関図

Fig.2 仮想影響線の損傷個所推定結果（点線は実際の損傷個所）

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The soundness evaluation of bridge applying the axle weight identification with BWIM

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Keywords : Influence line, BWIM, deflection

【Background】

With the aging of bridges, efficient and quantitative bridge maintenance methods are required, and research about sensor-based structural health monitoring has been attracted instead of conventional inspection. Displacement is an effective physical quantity that can be used to evaluate changes in the overall performance of bridges, and it is becoming possible to identify displacement from moving image analysis and acceleration response and apply in structural monitoring, but external force information is required.

【Objective】

Applying Bridge Weigh-In-Motion (BWIM) with displacement and introducing a virtual axle that does not originally exist into the gross vehicle weight identification process, the presence of damages and damaged areas of bridges can be detected from the weight assigned to the virtual axle. The proportion of the obtained value of virtual axle in the total weight and the estimated bending stiffness value are examined to evaluate the soundness of the bridge.

【Approach】

Using laboratory experiments with model bridge and a simulation model to evaluate the performance of the virtual axle, an optimal position of virtual axle is searched for based on the trends shown by the damage locations and measurement points. Comparing the obtained value of virtual axle in each measurement point are applied to estimate the damage locations. In addition, a virtual influence line in accordance with the shape of the change is introduced into the axle weight identification process to extract the over-estimated weight with high accuracy.

【Publication plan】

・R5 Intenationl Journal

【Results】

The virtual axle could be identified as a positive value at each damaged location. Furthermore, a correlation was found between the increase in the value of the virtual axle and the decrease in bending stiffness.
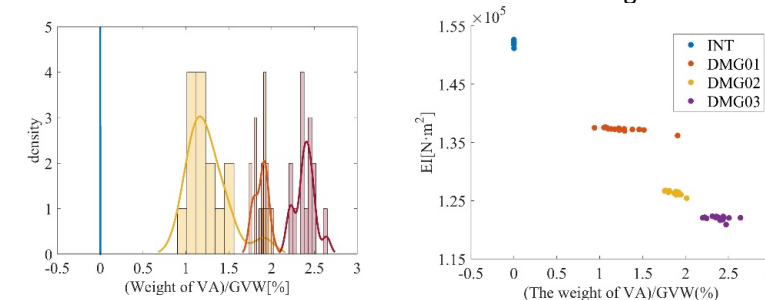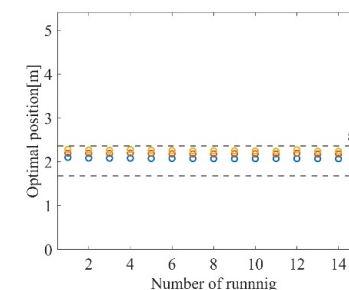

Fig.1 The results and correlation chart

Fig.2 The results of damage location estimation