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Virtual Axle Approach for Bridge Damage Detection

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【Background】

The standard algorithm of BWIM requires the system to be calibrated over time and thus, vehicle properties of the current measurement are always needed. The Virtual Axle (VA) approach was introduced as it does not need any information on the current vehicle properties. Previous studies of VA which are based on strain (SVA) and displacement (DVA) conclude that either the load effects are feasible for bridge damage detection. On the other hand, the rotation angle is believed to be one load effect that is more sensitive to damage and can easily be obtained directly from accelerometers.

【Objective】

This study aims to investigate the performance of the Virtual Axle approach based on rotation angle for bridge damage detection.

【Approach】

A virtual axle is introduced as an additional “weightless” axle to the two-axle vehicle passing on a bridge. The virtual axle is positioned in various locations ranging from [-L] to [+L] of the bridge span. One indicator of VA, named VAI, is chosen from the Root Mean Square (RMS) value of VA. After being studied with the numerical simulation, an experimental validation was conducted to verify the study. Three damage scenarios of different severities are introduced during the experiment.

【Publication plan】

・2023 JSCE Annual Conference

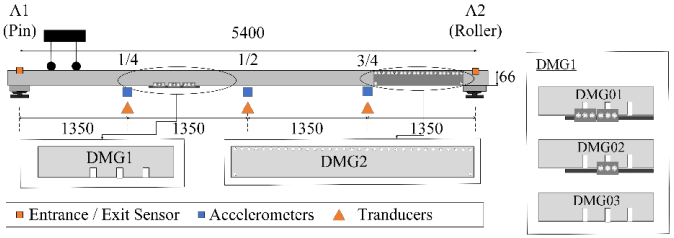

Fig. 1 Experimental Damage Scenarios

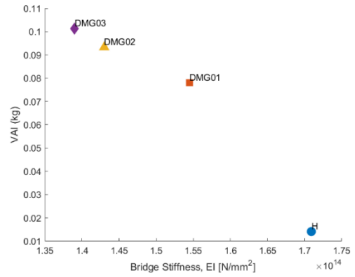

Fig. 2 VAI (kg) among Damage Scenarios

【Results】

The capability and feasibility of the Rotation-angle based Virtual Axle (RVA) is confirmed not only for simulation but also experimentally. Fig. 2 shows that VAI increases as the bridge stiffness decreases.