The Tap-Scan Damage Detection Method for Bridge Structures

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Summary

In this talk, we are going to introduce a new method that can detect the damage in bridge structures through the acceleration of a passing vehicle mounted with a tapping device. This method was inspired by the hunting behavior of woodpeckers and the idea of obtaining natural frequencies of bridge structures through the dynamic response of a passing vehicle [1].

Based on a simple vehicle-bridge interaction model, we analytically found out that the vehicle acceleration contains the damage information, which can be represented by the instantaneous stiffness Z as follows: (1)
where y_B is the deflection of bridge, F is the tapping force; v is the vehicle speed; M is the mass of vehicle and the third term is the constant acceleration due to dead load. From equation (1), it was easy to carry out the sensitivity analysis. From the above analyses, the tap-scan damage detection method was proposed under the framework of statistical pattern recognition. Numerical and experimental examples demonstrated that this method has the potential of successfully detecting the damage without the requirement of the finger-print of the intact structure, the pre-installing of sensors on structures, nor the traffic blocking.   keywordTap-scan method; Damage detection; Vehicle-bridge interaction

References
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2. Xiang ZH, Dai XW, Zhang Y, Lu QH. The tap-scan method for damage detection of bridge structures. Interaction and Multiscale Mechanics 3; 2010:173-191.