Rapid Multichannel Impact-Echo Scanning of Concrete Bridge Decks from a Continuously Moving Platform

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Impact-echo testing is a non-destructive evaluation technique for determining the presence of defects in reinforced concrete bridge decks based on the acoustic response of the bridge deck when struck by an impactor. Impact events excite Lamb-wave as well as flexural vibrations which, when properly measured and interpreted, can reveal the presence of defects, specifically delaminations, in the bridge deck.

Because of the utility of the impact-echo technique, a number of attempts have been made at improving the speed of data acquisition to especially reduce the required traffic control, which may exceed the cost of the testing itself or prohibit the testing altogether. In this vein, other researchers have developed air-coupled sensing for impact-echo measurements [1]. In our group, we have focused our efforts on developing repeatable excitation of flexural vibrations using disposable as well as mallet impactors. We have shown that the nature of the impact is very important for exciting the acoustic response associated with delaminations in concrete [2].

In this work, we build on our prior research with a single-channel impactor to demonstrate a seven-channel impact-echo scanning system with independent control of the impactors. This system is towed by a vehicle and integrated with distance measurement for registering the locations of the impacts along a bridge deck. The entire impact and recording system is computer-controlled. Because of a winch system and hinged frame construction of the apparatus, setup, measurement, and take-down of the apparatus can be achieved in a matter of minutes. Signal processing of the impact responses is performed on-site and can produce a map of delaminations immediately after data acquisition. This map can then be used to guide other testing and/or can be referenced with the results of other testing techniques to facilitate comprehensive condition assessments of concrete bridge decks. This work demonstrates how impact-echo testing can be performed in a manner that makes complete bridge deck scanning for delaminations rapid and practical.

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References: