

Performance-based maintenance of high-speed railway bridges using on-board and on-site sensors

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Abstract

Efficient maintenance of a huge number of deteriorating railway structures is an important issue in many countries. This presentation introduces a railway bridge management method that uses data measured on-board and on-site, which has been developed at RTRI and is actually being introduced for a Japanese high-speed railway. The focus here is on the management of significant vibrations due to resonance, which is one of the well-known issues of high-speed railway bridges. So far, evaluation of bridge resonances has been a time-consuming and costly task that requires a huge number of on-site measurements.

The basic idea consists of drive-by evaluation (as screening) by sensors on-board and on-site detail measurement / data analysis of the detected bridge. Drive-by inspection by commercial train is rough estimation but enables high frequency and all bridge inspections. In addition, the selection of bridges that should be inspected in detail enables the application of advanced but labor-intensive on-site measurements. To realize this strategic maintenance, a drive-by resonant bridge detection method has been developed that uses the carbody accelerations or track irregularities measured at the first and last vehicle of a commercial train. In addition, on-site measurement and data analysis methods are developed for detail estimation of the bridge state.

Curriculum Vitae

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Education:

March 2013 : Doctor of Engineering, Osaka University in Japan
March 2010 : Master of Engineering, Osaka University in Japan

Expertise:

Dr. Matsuoka currently works as a senior researcher in the Railway Technical Research Institute (RTRI), Japan. His main research interests are railway bridge dynamics, train-bridge dynamic interaction, and drive-by bridge diagnosis.

During his Ph.D. program, he was awarded the Research Fellowship for Young Scientists from Japan Society for the Promotion of Science. His dissertation was focused on a unique modal identification method that describes the nonlinearity of structures using the Bayesian approach.

On concluding his Ph.D. program, he joined RTRI. In RTRI, Dr. Matsuoka continued to actively influence the realization of better high-speed railway bridge design and maintenance by pioneering the development of methodologies such as detailed or indirect bridge dynamics evaluation methods and nonlinear modal identification methods. From 2015 to 2016, he served as a visiting researcher at Politecnico di Milano, during which he participated in a speed-up project of the Milano–Torino high-speed railway under the supervision of Prof. Andrea Collina.

Dr. Matsuoka has been felicitated with many awards, including the Young Scholar Paper Award (JSCE, 2017), Paper Encouragement Award (Japan Concrete Institute, 2017 & 2019), Young Scientist Award Prize (European Structural Integrity Society TC12, 2019), Tanaka Award, which is the most prestigious award in the field of bridge engineering in Japan (JSCE in 2019), and EASD Junior Award of “Development of Methodologies for Structural Dynamics” (European Association for Structural Dynamics). In 2019, he gave a speech as an expert on “Drive-by Bridge Inspection for High-Speed Railway” at an organized session for on-board monitoring proposed by Prof. Diana in Politecnico di Milano at WCRR 2019, Tokyo, Japan.