SHM of a railway truss bridge using low- and high-frequency methods

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A railway bridge has been the object of investigation since mid 2007 as a response to increasing interest in SHM by Polish Railways. It is a typical 40 m long, steel truss structure spanning a channel in Nieporet near Warsaw. The final objective of the investigation is to design, test and implement an SHM system dedicated to railway infrastructure. The patent-pending monitoring system [1] consists of two integrated parts. The first part is responsible for weighing of trains in motion, which aims at dynamic load identification. The second part is the actual SHM system applied to the railway truss bridge. The source of excitation for the bridge are passing trains only, which can be regarded as ambient excitation in terms of type. However the integrated system includes the weighing of trains in motion, which will determine the character of excitation unlike in operational modal analysis. There are many aspects of the whole system to be examined and tested e.g. measurement methods, design of customized hardware, development of monitoring software. Some of them have already been reported [2] - [4]. This paper is concentrated on measurement methods applied to monitor the structural health of the selected railway truss bridge. Dynamic strain is the measured physical quantity. Three methods of strain-in-time acquisition taking advantage of dynamic excitation of the bridge by passing trains are tested and compared. Low-frequency direct registration of strains with piezoelectric patch sensors and standard strain gauges is confronted with a high-frequency method using the time of flight difference for elastic waves between two closely-mounted ultrasonic probeheads. The paper will present experimental results obtained with the three methods and describe matching numerical model of the bridge to these results.

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