

Damage Detection of Railway Bridges

Automated Indirect Damage Detection System for Railway Bridges by Employing AI and Machine Learning

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There are over 30,000 railway underline bridges in the UK, with over 80% well-aged (>50 years) and often used past their life expectancy and carrying loads beyond their original design capacity. Therefore, there is an urgent need to develop efficient and reliable damage identification systems to feed into bridge safety and functionality assessments. The current practice of visual inspection of bridges is subjective, inconsistent, expensive and exposes the workforce to hazardous job sites. The alternative of direct instrumentation of the structure, whilst effective, can be prohibitively expensive to implement for the entire network.

In this project, we aim to produce an automated indirect damage identification system for railway bridges using an instrumented train while passing over the bridge at operational speed. In other words, the vehicle is acting as an actuator to excite the bridge and as a sensor to collect the response of the bridge. Given challenges with instrumenting a train and logistics of its operation on a network, there is currently no operational initiative for train-based bridge damage detection, hence the attempts have been limited to theoretical and lab-based experiments or bespoke systems for one bridge only.

Since 2003 Network Rail (the owner, operator, and developer of UK's railway infrastructure, encompassing 20,000 miles of track and 30,000 bridges) operates a high-speed state-of-the-art measurement train to inspect the condition of the tracks, covering 115,000 miles a year. Following an earlier feasibility study, Network Rail has provided the academic PI of the project access to five years' worth of data, covering 100 miles of track. Capitalising on this unprecedented source of data, we will develop a damage identification system for a strategically selected cohort of bridges on the rail network, with over 20% of the stock.

This project will be a fundamental step towards transforming indirect inspection systems and automating bridge damage identification, leading to early warnings, optimisation of maintenance regimes and reducing health and safety risks. The cost of monitoring bridges when the train is already inspecting the tracks will be marginal. In conclusion, this research will help in expanding knowledge in several of COWI's priority areas, such as the use of AI and Machine Learning in engineering, ensuring the resilience of critical infrastructure and digital asset management. The conclusions and tools could be easily expanded to other clients in other countries.