Research Recap

Mobility21
A USDOT NATIONAL UNIVERSITY TRANSPORTATION CENTER

Vehicle-based Panhandle Bridge Monitoring

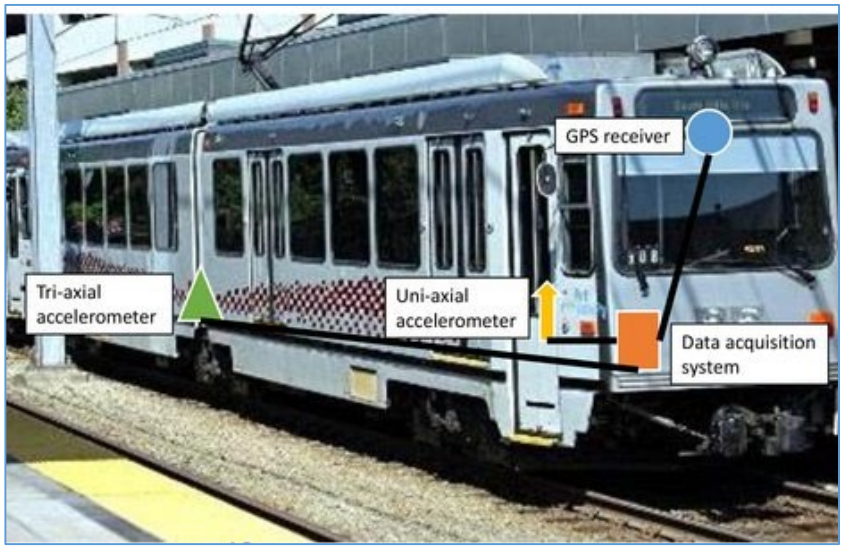
Purpose: The Federal Railroad Administration reported 1,096 derailments in 2017; additionally, the National Bridge Inventory found that 47,619 out of 615,002 bridges in the U.S. were in poor condition across the nation. These statistics justified the need for monitoring rail networks and bridge conditions, and this project aims to indirectly monitor railway bridges for structural damage diagnosis using sensors on instrumented operational trains. The goal is a low-cost and low-maintenance approach to detect infrastructure changes and damage.

Approach: The research group has been monitoring Pittsburgh's light rail network from sensors placed on passenger trains. The team used a combination of data-driven and physics-based approaches on acceleration signals to detect changes to the track condition relative to its historical baseline. The team has been conducting on-site experiments on the Panhandle bridge that carries two rail lines of the Port Authority "T" line across the Monongahela River in Pittsburgh. These are used to develop algorithms to analyze train response data to extract bridge states.

Key Findings:

Structural Track Damage Detection - The team was successful at uncovering internal structural damage using accelerometers and conducted lab-scale and field experiments to evidence better accuracy from indirect sensors than direct bridge sensors in certain cases. Additionally, it is possible to detect more gradual changes with the same methodology.

Damage Characterization – The team has developed algorithms to localize and quantify the detected damage and validated their accuracy using lab-scale experiments. The next phase will involve an on-site test to verify the influence of different types of damage scenarios, vehicle velocity, ongoing traffic, and environmental factors.



Conclusion: Vibration analysis on instrumented vehicles presents a low-cost and low-maintenance approach to structural health monitoring of bridges compared to direct sensor monitoring. This approach may potentially expand to an approach for indirectly monitoring and inspecting regular road and bridges using cars or trucks.

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Project Record:

- https://ppms.cit.cmu.edu/projects/detail/273

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