Continuous Real-Time Highway Bridge Joint Monitoring System

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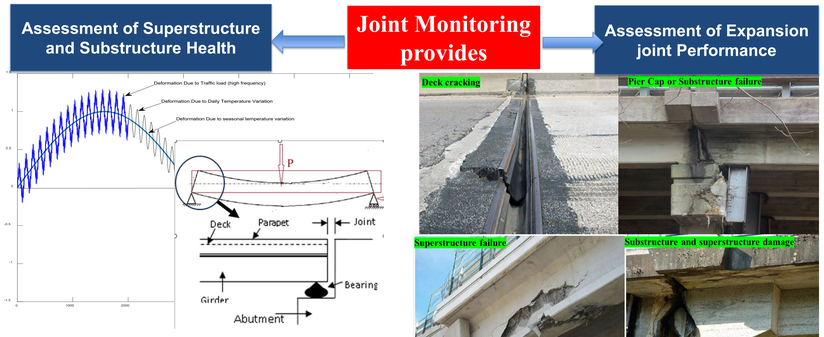
Background

- Although expansion joint is small element in bridges, its performance affect every element of bridge(Palu et. al, 2018)

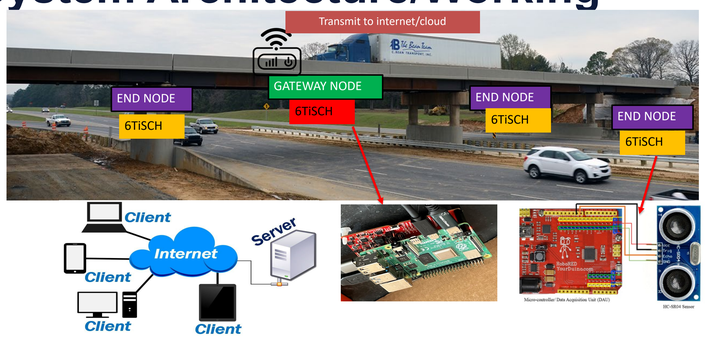


- Existing method are costly to implement on joint monitoring

Objectives

- To develop a low-cost bridge joint monitoring system
- To establish bridge health assessment methods based on system measurements

System Architecture/Working

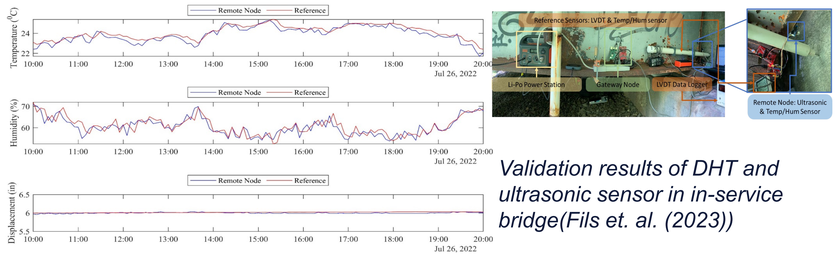


System Components and their working

Key Features			
Low Cost (230$)	Wireless	Real-time	Scalability
Low-Power (4-5W)		Long-Term Monitoring	

System Validation

- Sensing compared with LVDT
- Communication by Lag Measurement

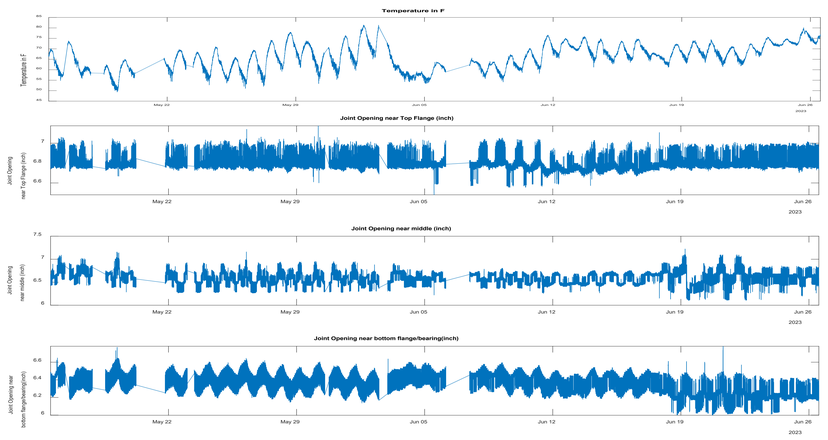


Validation results of DHT and ultrasonic sensor in in-service bridge(Fils et. al. (2023))

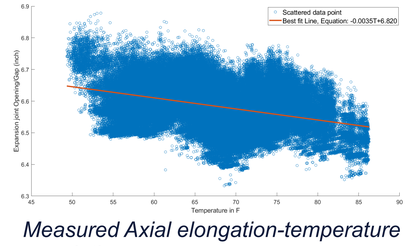
Deployment for Long-term Monitoring

- Deployed in an in-service concrete-steel composite bridge with asphaltic plug joint in Coventry Connecticut (Fig 4) from 15th of May 2023 to 6th July 2023.
- The positions of sensing components is shown below

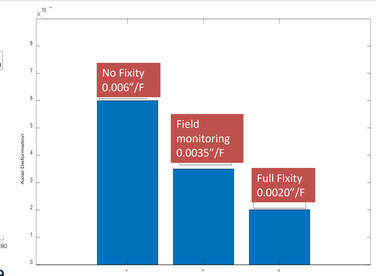
Testbed bridge with sensor location on the expansion gap and system



Field Monitoring results from 15th of May to 26th of June



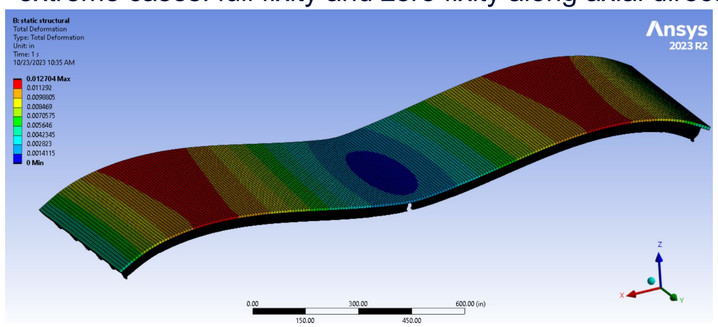
Measured Axial elongation-temperature correlation



Comparison of field measured vs FE results on axial deformation

Validation/Data Fusion

- A 3D FE model of testbed bridge in ANSYS mechanical
- Load Cases: 1F Temperature Rise
- Pinned elastomeric bearing fixity are modelled as two extreme cases: full fixity and zero fixity along axial direction



ANSYS Model results on Deformation due to 1F temperature change

Conclusion

- With this newly developed low-cost joint monitoring system, remote, long-term and real-time monitoring of expansion joint and other component (with small modification) is possible.
- Bridge superstructure responses due to temperature change, traffic and other movement can be measured through expansion joint.

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