**Digital Twins to Increase Mobility in Rural South Carolina**

# Technology Transfer Activities


by

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# TECHNOLOGY TRANSFER ACTIVITIES

## 1 Outputs

In this project, a load determination method using an artificial neural network was developed to examine the AE data collected from the AE sensors to determine the vehicle loads in the bridges. In addition, a Digital Twin (DT) approach is proposed to define the load-carrying capacity of an existing bridge, which includes one potential step to the development of an autonomous load rating procedure for precast reinforced flat slab concrete bridges. The research work funded by this project resulted in one technical report and two conference papers.

### 1.1 Output #1

One report has been submitted to $C^2M^2$.

The project also resulted in the following conference papers:

1 Ai, L., Bayat, M., Comert, G. and Ziehl, P., (2021). An Autonomous Bridge Load Rating Framework Using Digital Twin. Structural Health Monitoring, 2021, Stanford, CA.

2 Bayat,M., Comert, G., Ai,L.,Ziehl,P,. (2021). ASNT 2021: The Annual Conference, Towards Intelligent Bridge Evaluation: An Autonomous Framework Using Digital Twin, 15-18 November 2021, Phoenix, AZ.

### 1.1 Output #2

In this project, two methods were developed. One is the improved load rating method using the digital twin technique, the other one is the vehicle weight identification method using an artificial neural network. UofSC is working closely with IBM, Verizon, and Luna Innovations to extend the results of this project and meets weekly with representatives of IBM. The Blossom Street Bridge in Columbia South Carolina has been utilized in partnership with IBM and Verizon, and Luna Innovations and the approach has been demonstrated to the SCDOT as an efficient and alternate means of asset management  One innovation disclosure has been filed by UofSC.

## 2 Outcomes

Bridges are an important hub of the transport system. This project improves the load rating process for bridges. This project also improves the weigh-in-motion system by adopting AE monitoring and an artificial neural network. These two improved technologies are deployment ready.

### 2.1 Outcome #1

This project developed two deployment-ready techniques. One is the improved load rating method using the digital twin technique, the other is the vehicle weight identification method using an artificial neural network.

### 2.2 Outcome #2

Bridges are an important hub of the transport system. This project improves the load rating process for bridges. It is expected to reduce the cost of load rating and does not require traffic closures. Additionally, this project improves the weigh-in-motion system by adopting AE monitoring and an artificial neural network.

## 3 Impacts

### 3.1 Impact #1

The impacts will be realized over the longer term, as an entirely new approach to transportation infrastructure assessment becomes realized through vehicle to infrastructure (V2I) communications. This will lead to fruitful datasets in terms of infrastructure response to well understood vehicular loading, with only minimal instrumentation of the transportation infrastructure itself.

### 3.2 Impact #2

The proposed approach is thought to be new for the assessment of bridge load carrying capacity and has the advantage that extensive instrumentation and specialized loading are not required. The approach has become feasible due to advances in data-driven assessment techniques (artificial intelligence/machine learning) combined with advances in connectivity (remote sensing) and will be complemented with a reliable decision-making analysis.