

2019 UDOT RESEARCH PROBLEM STATEMENT

*** Problem statement deadline is Feb. 6, 2019. Submit statements to UTRAC@utah.gov. ***

Title: Infrared thermography for concrete bridge deck condition evaluation exploiting machine learning **No. (Office Use):** 19.04.03

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Select ONE Subject Area Materials/Pavements Maintenance Traffic Mgmt/Safety Structures/Geotech
 Planning Perf Mgmt/Data Analytics Public Transportation Other

1. Describe the problem to be addressed:

Infrared thermography has been utilized as an effective and efficient bridge deck condition evaluation tool. However, there are challenges on the interpretation of data for accurate delamination shape profiling, depth and severity estimation. And its performance is highly dependent on multiple factors, which can often lead to unreliable measurement and inconsistent results when compared to methods such as sounding.

2. Write the project objective (25 words or less):

The proposed study aims to develop an infrared thermography system reinforced by machine learning for improved concrete bridge deck condition evaluation.

3. Explain why this research is important:

(In response, consider addressing specific UDOT goals, applicability in Utah or other states, etc.)

Delamination, a horizontal crack embedded in the subsurface of a bridge deck, is a common problem in concrete bridge decks which can eventually affect structural integrity and performance. Infrared thermography provides a testing tool to estimate delamination location and size in a fast and non-invasive manner which requires little traffic disruption. For practical bridge deck delamination evaluation, it is highly desirable to accurately estimate the delamination location and severity. Recent advances in machine learning open a new avenue to extract in-depth information about delamination from infrared thermography data. A supervised learning framework based on deep neural network is proposed for accurate delamination detection and segmentation. Such a system would quantify the severity of delamination and could potentially provide rapid assessment over a large inspection area. If successful, the project will have a beneficial impact to practice, because accurate evaluation of bridge deck condition is needed for condition-based maintenance. To ensure reliability of the proposed method, a guideline for infrared thermography on bridge deck condition evaluation will also be developed.

4. List the major tasks:

1. Literature review on bridge deck evaluation using infrared thermography, with a focus on camera selection, testing configuration, and environmental variability
2. Identify the optimal data collection configurations and guidelines
3. Numerical simulation and experimental data collection
4. Supervised learning framework development and validation

5. List the expected deliverables (reports, manual, specification, design method, training, etc.):

1. Report on literature review, with a focus on data collection practice
2. Guidelines and recommendations for data collection
3. Supervised learning framework for improved accuracy on delamination detection

6. Describe how the research results will be implemented:

(In response, consider addressing UDOT leader support, process or standard improvement, etc.)

With successful implementation, it will enhance the accuracy and reliability of infrared thermography data for accelerated data collection and decision making.

**7. Requested from UDOT: \$50,000
(or UTA for Public Transportation)**

Other/Matching Funds: \$0

Total Cost: \$50,000

8. Outline the proposed schedule, including start and major event dates:

Project month 4: Report on literature review and guideline submission

Project month 8: Report on numerical modeling and testing submission

Project month 12: Final report submission