

Advanced Research

June 2024

Project Title: Integration of Thermal Infrared (IR) Imaging into the Caltrans Inspection Program for Pavements and Bridge Decks

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Task Manager:

William Owen

Chief, Geophysics and Geology
Branch, Geotechnical Services

bill.owen@dot.ca.gov

Integration of Thermal Infrared (IR) Imaging into the Caltrans Inspection Program for Pavements and Bridge Decks

This research continued integration of thermal IR technology within Caltrans inspection practices through identification of commercial software solutions, development of processes and procedures for acquisition of georeferenced thermal IR data, processing of data to enhance, isolate, and visualize thermal anomalies, and interpretation and presentation of results.

WHAT WAS THE NEED?

The California Department of Transportation (Caltrans) must inspect pavement and bridge decks to support proactive infrastructure maintenance. By leveraging non-destructive evaluation technologies for sensing and data processing, early detection of defects allows repair and rehabilitation before significant degradation, saving time and money. Caltrans can improve the speed and efficiency of this critical duty by incorporating thermal infrared technology as part of the inspection routine. The Strategic Highway Research Program recognized the utility of Thermal IR for this purpose, and Caltrans has installed a thermal IR system on its 3D Ground-Penetrating Radar (GPR) vehicle, allowing georeferenced visual black and white and thermal IR imaging of pavement and deck surfaces concurrent with 3D GPR imaging of the subsurface. This deployment allows data acquisition without closing lanes, increasing efficiency of data collection with minimal impact to traffic and improved safety to both operators and the traveling public.

WHAT WAS OUR GOAL?

The goal was to onboard Thermal IR technology for Caltrans and incorporate it onto our existing GPR testing platform for deployment throughout the state for pavement and bridge deck inspection support

WHAT DID WE DO?

This research continued technology integration within Caltrans inspection practices through acquisition of commercial software and development of processes and procedures for:



DRISI provides solutions and knowledge that improves California's transportation system.

- Acquisition of georeferenced thermal IR data
- Processing of data to enhance, isolate, and visualize thermal anomalies
- Interpretation and presentation of results
- Development of software for georeferencing B/W camera imagery for pavement.

WHAT WAS THE OUTCOME?

This project enabled Caltrans to start using thermal IR cameras for early identification of shallow-seated deterioration in pavements and bridge decks. As a result of this research project, Caltrans is ready to start conducting pilot projects using the IR camera in conjunction with 3D-GPR. Further research will allow technology roll-out via multiple pilot projects. That will allow Caltrans personnel to gain the needed experience in data collection and analysis. Extensive real project experience is essential for developing a sound Standard Operating Procedure and recommendations for IR anomaly identification.

WHAT IS THE BENEFIT?

The results enable Caltrans to start using thermal IR camera for early identification of shallow-seated deterioration in pavements and bridge decks. Concurrent B/W imagery helps users to screen false anomalies in the 3D-GPR and IR data. This research directly aligns with Caltrans' Strategic Goal of Stewardship and Efficiency as it supports consistent application of thermal IR data collection and processing for improved infrastructure inspection and maintenance. Furthermore, this research allows thermal IR data collection from a moving vehicle, keeping workers off the pavement to improve safety. Currently no other DOT possesses the unique combined capability of mobile 3D GPR and thermal IR imaging. Thus, this research contributes to Caltrans' Organizational Excellence strategic goal by continuing and enhancing Caltrans' national leadership in the application of NDE methods for highway infrastructure.

LEARN MORE

To view the report:

<https://dot.ca.gov/programs/research-innovation-system-information/research-final-reports>

IMAGES



Image 1: The Caltrans NDE vehicle (rear view, showing GPR antenna and trailer). The IR and B/W camera housings are mounted at the NDE vehicle rear on top of the roof.

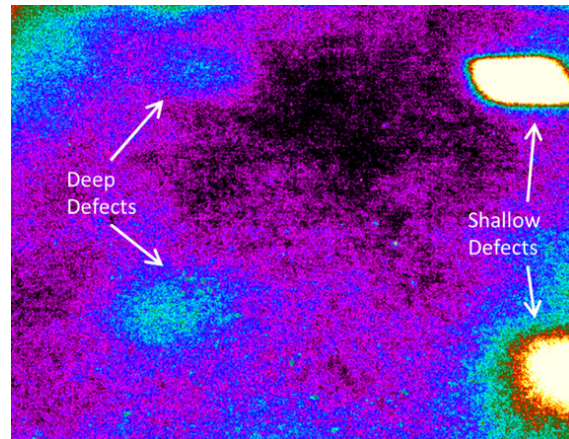


Image 2: Example Thermal IR imagery from a calibration test slab showing thermal anomalies from known construction defects below the concrete surface.

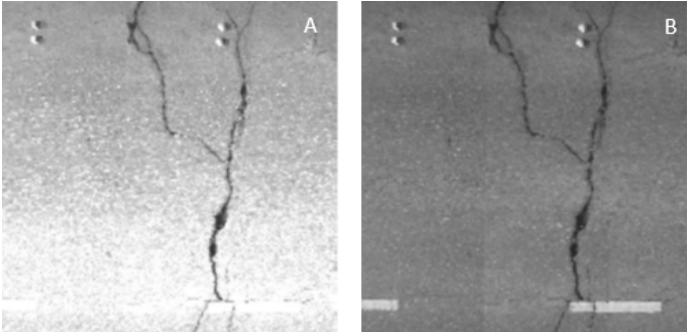


Image 3: Example B/W camera images showing original sample image acquired with fixed polarization (A) and with glare reduction process applied (B).