

## **EFFECTIVE IMPLEMENTATION OF GROUND PENETRATING RADAR (GPR) FOR CONDITION ASSESSMENT AND MONITORING PHASE 2**

### **PROBLEM**

The Maryland Department of Transportation State Highway Administration (SHA) is currently using Ground Penetrating Radar (GPR) for assessing the condition of bridge decks (such as surface condition, rebar cover depth and location, and deck thickness). In the last year SHA initiated a task to survey eighty (80) bridge decks using 3D GPR. The equipment for the task included the 3DRadar DX 1821 and DXG1820 antenna array, and a MkIV Geoscope. Maryland Environmental Service (MES) provided the data collection and initial analysis.

### **OBJECTIVE**

This University of Maryland (UMD) project, in cooperation with Starodub Inc, had the following objectives:

- 1) Provide data analysis support for 40 bridge decks;
- 2) Develop the analysis pipeline for producing structural reports according to the SHA template;
- 3) Identify potential improvements to the current SHA template;
- 4) Identify potential improvements in data processing methods for enhancing thematic analysis.

### **METHODOLOGY**

The university team provided overall project management and kept continuous interaction with SHA throughout the duration of the project to meet the project objectives and to obtain administrative and technical feedback. The technical reports reflecting the GPR data analysis for the 40 bridge decks completed by the team, included the following 3D-Radar analysis support activities:

- Perform data reduction of the 3dra files for the first bridge deck using Starodub's APE-2 software and analysis tools;
- Prepare structural reports in accordance to the SHA report template;
- Develop an analysis pipeline for the remaining 39 bridge decks;
- Identify improvements to the SHA template for potential adoption into a Maryland Standard Method of Test (MSMT).

## **RESULTS**

The following improvements to the GPR analysis were developed:

- Standard Operating Procedures – A sequence of tasks established as part of the Quality Assurance/Quality Control (QA/QC) process to produce the reports. The analysis pipeline is comprised of approximately 10 modules for analysis, 10 for visualization, and a few batch processing utilities for controlling and managing the flow of production, including cross-checking at the end of each module.
- Error Analysis – A list of specific components related to the data collection and data analysis processes on which the project team encountered problem was developed, and specific recommendations to overcome these issues were provided.
- Status of Coding – For each project, it is recommended to validate the completeness of these algorithms: (a) bridge deck segmentation method, (b) data processing and quality control procedures, (c) the software module outputs of thematic maps, (d) project cover page and summary of results table;
- QA/QC Procedures – The QA/QC tasks span over the entire analysis pipeline were presented in tabular form with four sections: output, processing, modules, and controls.

## **RESEARCH VALUE**

GPR can be used to monitor changes in bridge deck condition immediately after construction for quality assurance and acceptance testing, and provide the base line for potential time series analyses. This will enable long term rigorous performance monitoring of bridge decks for planning, maintenance, and rehabilitation activities.

## **REPORT INFORMATION**

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## **LINK TO FINAL REPORT**

Phase 1: [http://www.roads.maryland.gov/OPR\\_Research/MD-15-SHA-UM-3-11\\_GPR-Phase1\\_Report.pdf](http://www.roads.maryland.gov/OPR_Research/MD-15-SHA-UM-3-11_GPR-Phase1_Report.pdf)

Phase 2: [http://www.roads.maryland.gov/OPR\\_Research/MD-16-SHA-UM-4-04\\_GPR-II\\_Report.pdf](http://www.roads.maryland.gov/OPR_Research/MD-16-SHA-UM-4-04_GPR-II_Report.pdf)