Data Analysis and Measurements for GPR and Roadway Instrumentation Systems (Summary of Final Report)

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August, 2000

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Prepared for: Florida Department of Transportation
Contract # FM4037031B201, BC280

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Introduction

The following sections summarize the work completed by the Electronic Communications Laboratory (ECL) at the University of Florida for the Florida Department of Transportation (FDOT) project "Data Analysis and Measurements for GPR and Roadway Instrumentation System", Contract FM4037031B201. This summary of the final report describes the problem, approach, findings and conclusions.

Problem

Two major areas of work were addressed by this project; test methods and procedures; and software improvements for roadway GPR. The first part addressed the preparation, calibration, collection, and reporting of GPR data. The second part addressed improvements to the current Pulse Radar GPR software evaluation environment that were recommended by the FDOT SMO. These improvements were seen as necessary for completion of FDOT SMO GPR goals.

Findings

Test methods and procedures

The goal of this task was to improve the FDOT test methodology and procedures by documenting good practices and calibrations necessary for obtaining quality, accurate GPR data that can be processed by a computer. Data collection, storage, management, processing and reporting were all a part of this task. These procedures and guidelines will enhance the quality and usefulness of the GPR data as well as mitigate the operator induced errors.

The following areas were investigated and recommendations were presented in written and oral formats to the FDOT SMO:

- Metal Plate and End Reflection File (Pulse Radar) - Emphasized the necessity of taking a metal plate file prior to each new GPR data collection and encouraged the taking of an end reflection file each day when GPR data is collected.
- Antenna Height Calibration (Pulse Radar) - Discussed the results of the antenna height calibration for the Pulse Radar and found that a new antenna height calibration file was not necessary.
- GPR Filter Settings - Discussed important filtering concepts and provided formulas with examples for proper setting of filters for GPR data.
- FDOT GPR Test Pit Data (GSSI Radar) - Discussed the data corruption that resulted from improper gain settings and the FDOT SMO desire not to reprocess the data.
- Clipping and Gain Settings - Discussed how clipping occurs and gave suggestions for proper setting of gains for collection of GPR data.
- DMI Re-calibration and Setup (Pulse Radar) - Discussed the FDOT SMO re-calibration of the DMI and suggested the review of current methods of sampling the Pulse Radar as current methods do not match manufacturer instructions.
- Automated GPR calibration methods - Discussed the lack of progress in this area and made suggestions for further effort.
- DC offset (Pulse Radar) - Discussed the possible outcomes of changing the DC offset of the Pulse Radar and recommend not changing the DC offset settings.

Antenna Setup (Pulse Radar) - Discussed the importance of properly setting up the Pulse Radar antennas so that accuracy of the GPR data can be maintained.

GPR reports - Discussed the need of standardized reports and recommended sections to be included in a GPR report.

Software improvements for roadway GPR

Improvements to the Pulse Radar GPR software evaluation environment were identified during joint meetings with the ECL and FDOT SMO. The ECL implemented the following improvements to the software environment in order to facilitate FDOT GPR signal processing requirements:

Retaining edited tracks - Software enhancement to allow the use of edit tracks for additional processing to determine roadway layer interface depths.

Separate Processing Parameters - A method was provided to break up long data files into segments for use of different data analysis parameters. A method was provided to concatenate separated analyzed files.

Axis scaling and zooming - Software implementation to achieve zooming and scaling of plotted radar data axes.

Tagging GPR data for distance and geophysical locations - Recommendation for an alternate position location/data tagging method for the GPR data and possible software implementations (As per the proposal, no software was written).

Averaging depth data - Software enhancement to allow the averaging of depth data for a track.

Conclusions

This project provided methodologies and testing procedures for data collection and analysis for the FDOT SMO and provided requested additions to current GPR software for the Pulse Radar System. Future work in the areas of automated GPR calibration, GPR reporting methods, ECL data processing support, and enhanced GPR signal processing software was recommended.