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16. Abstract

To further enhance the capabilities of the Pave-IR thermal segregation detection system developed at the Texas Transportation Institute, researchers incorporated global positioning system (GPS) data collection into the thermal profiles. This GPS capability enhances operation by allowing easier identification of the limits of the thermal profile and by more easily and precisely identifying the location of anomalous temperatures for long-term monitoring. Three existing Pave-IR test systems were retrofitted to include GPS capability.

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# IMPLEMENTING GPS INTO PAVE-IR

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# TABLE OF CONTENTS

**Page**

# LIST OF FIGURES

**Figure** **Page**

# CHAPTER 1

# GPS INTEGRATION INTO PAVE-IR

## SUMMARY

Through TxDOT Projects 0-4126, 0-4577, and 5-4577-01 (*1, 2, 3*), Texas Transportation Institute (TTI) researchers developed a paver-mounted thermal imaging system that collects thermal profiles of hot-mix-asphalt (HMA) construction. The system, called Pave-IR, collects a transverse scan of temperatures for every 2 inches of forward travel of the paver. Pave-IR displays the thermal profiles in real time; these profiles can further be reviewed and analyzed with post-processing functions.

To further the development of Pave-IR, TTI undertook the incorporation of global positioning system (GPS) capability into the system. The primary purpose of the GPS is to allow for easier documentation of thermal profile locations.

## OBJECTIVES OF GPS CAPABILITY

Prior versions of Pave-IR simply used a distance wheel measurement to locate thermal profile locations. This method of collection required accurately recording a "zero" point at the start of the profile, and then the locations of thermal scans were defined by the distance from the zero point. While this method worked reasonably well, slight discrepancies among distance wheels could occasionally result in sizeable discrepancies in measured distance when paving runs traversed several thousand feet. With the availability of relatively low-cost, accurate GPS systems, TTI researchers desired to incorporate GPS into the collected thermal profiles for the following reasons:

- to more easily identify the limits of the thermal profile, and
- to more easily and precisely identify the location of anomalous temperatures in the thermal profile for long-term monitoring.

## HARDWARE SELECTED FOR GPS

To enable accurate real-time GPS signal collection, TTI researchers selected the Trimble® DSM232 system, which provides sub-meter accuracy in real time. Figure 1 shows the GPS system. Currently, the Pave-IR system still requires the distance wheel to trigger data acquisition.


**Figure 1. Trimble DSM232 System.**

## EXAMPLE DATA COLLECTED WITH GPS

To collect the thermal profiles with GPS, TTI updated the Pave-IR collection software to include GPS functionality. Each time a scan of temperatures is recorded, the GPS coordinates are also recorded. On September 23, 2008, TTI researchers collected thermal data on a crack-attenuating mix (CAM) paving project in the San Antonio District. The project site was on US 90 just west of Uvalde. A Barber Green® BG-260C paver was used to place the mix, which was produced in Uvalde approximately 15 miles away. End-dump trucks transported the mix and off-loaded the CAM directly into the paver hopper as Figure 2 illustrates.

**Figure 2. Paving CAM on US 90.**

A Pave-IR system retrofitted with GPS collected thermal plots during construction. Figure 3 shows the Pave-IR system with GPS installed on the paver. An antenna mount simply slips into holders on the infrared-bar mounts to secure the GPS antenna in place.


**Figure 3. Pave-IR with GPS on Paver at US 90 Project.**

Figure 4 illustrates thermal data collected on the project. In post-processing, moving the cursor across the mat will result in the GPS window displaying the coordinates of the location where the cursor is pointing.

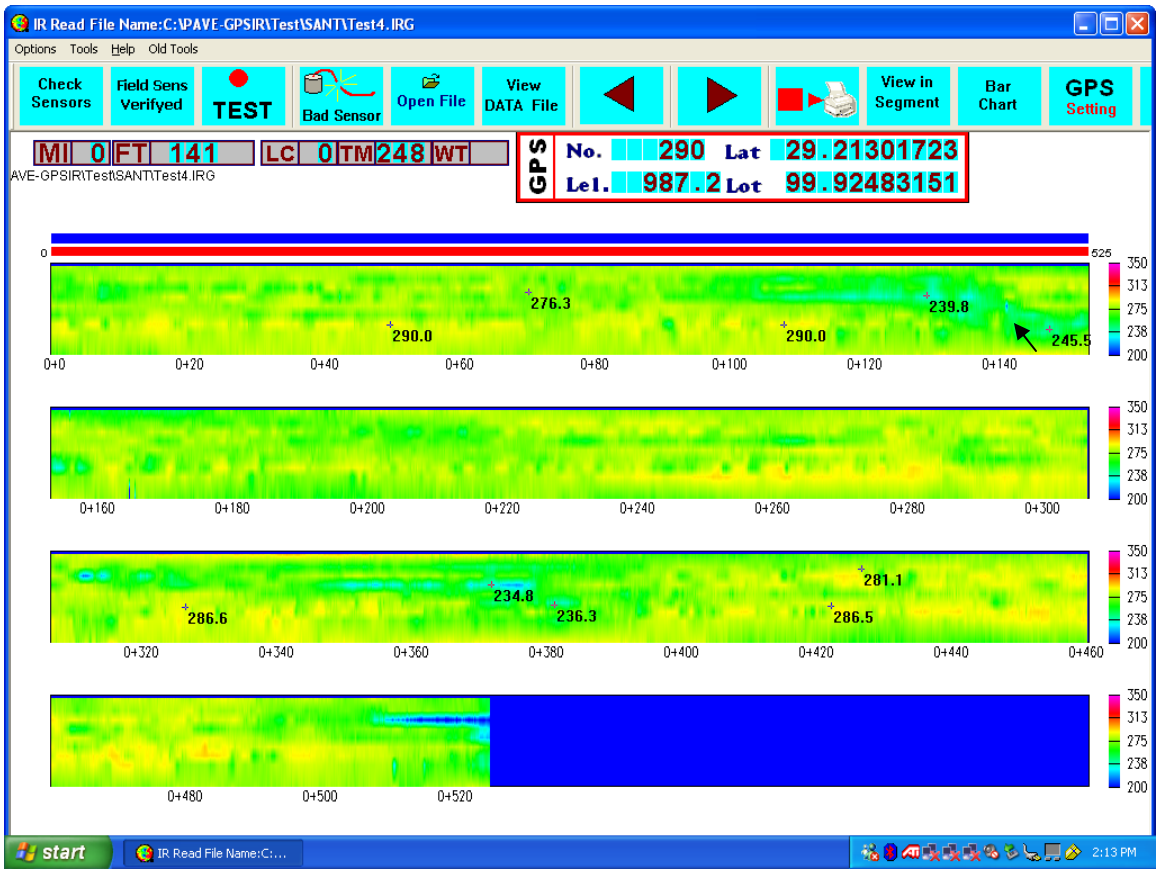


**Figure 4. Thermal Profile with GPS.**

*Note: GPS coordinates update according to location of cursor.*

# CHAPTER 2

# RECOMMENDATIONS

With GPS capabilities, Pave-IR now provides an even more powerful dataset for review and evaluation of HMA construction thermal profiles. GPS enables precise location of anomalous locations in the HMA mat so that these locations' long-term performance can be monitored. With GPS capabilities, the Pave-IR thermal profile is in an even better state of development to replace the manual thermal profiling required in Tex-244-F.

Currently, Pave-IR with GPS still requires the use of a distance wheel to trigger data acquisition. Work should be conducted to investigate if the distance wheel could be entirely eliminated.

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