Laser Road Surface Sensor Camera Evaluation

project summary

Aurora

working to advance road weather information systems technology

RESEARCH PROJECT TITLE
Laser Road Surface Sensor Camera Evaluation Project–Aurora Project 2004-02

COMPLETION DATE
2005

PROJECT CHAMPION
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KEY WORDS
chemically-melted frost, frost formation

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ABOUT AURORA
Aurora is an international partnership of public agencies performing joint research, evaluation, and deployment initiatives related to road weather information systems (RWIS).

www.aurora-program.org

Objectives

This project was conducted to determine if the IceHawk® Laser Road Surface Sensor (LRSS) could be used in the winter maintenance environment to detect road frost and pavement conditions. The results presented in this report were collected from February and March 2004 and the winter of 2004–2005. It was originally intended that two versions of the IceHawk camera would be tested; however, only one version of the camera was tested due to production problems.

Problem Statement

Unlike in-pavement sensors which deduce the surface condition in a very small (approximately 25 square inches) portion of pavement, the LRSS can provide information regarding a lane-width of pavement. A larger area of information is preferable to smaller areas especially when the condition of the road is not spatially uniform.

LRSS sensor module and mounting bracket

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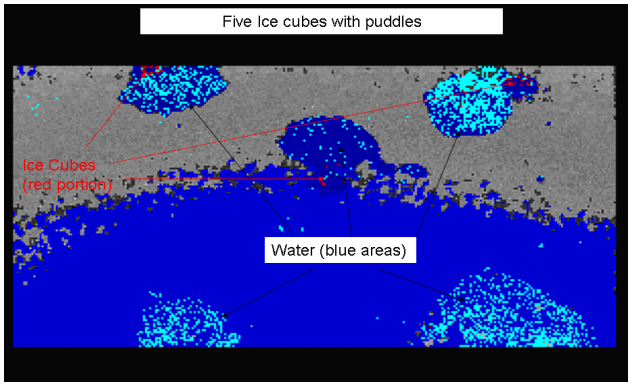
Technology Description

The LRSS was installed in two different locations during the test period. It was first installed on a rural concrete bridge crossing US Highway 30 during February and March 2004. The LRSS was mounted on a steel pole erected by the Iowa Department of Transportation (IaDOT). This pole was affixed to the bridge deck side rail. The camera was installed at the top of the pole to a slotted bracket that allowed adjustment of the sensor module. The electronics module was attached to the side of the pole. The camera was positioned to view an area in the middle of the bridge.

The camera was aimed so that the image covered the outside wheel track of the driving lane and the apron area of the bridge deck so one could compare the condition of the treated bridge deck to the condition of the untreated apron area. It was hoped that this comparison would allow determination of whether the camera could detect and differentiate frost formation on an untreated surface from chemically-melted frost on a treated surface.

A road weather station was located approximately 200 feet from the LRSS. This station provides pavement condition reports in the vicinity of the LRSS scanning area, precipitation identification, dew point readings, and other weather observations. Observations from this station were used for comparison with the LRSS images.

Colored portions of the LRSS images represent different water phases as shown below. A properly configured color-enhanced LRSS image would show ice in red, snow in dark blue, and water in light blue coloration. The LRSS was set in the automatic scanning mode so a scan was taken every 15 minutes.



A color-enhanced picture from the LRSS during its calibration phase

Key Findings

After the LRSS was properly mounted and configured, it was able to detect many different pavement conditions. The winter of 2004–2005 started late in the season, but produced many types of winter storms and created many different pavement conditions. When the camera was configured to scan in two-minute intervals, the evolution of the surface condition could be closely monitored. The images produced reasonably detailed images that could clearly show different pavement conditions. The LRSS camera was found to provide useful information about the condition of the road in its view.

Implementation Benefits

The images provided by the LRSS can be used by Winter Maintenance Supervisors as well as the public to monitor the spatial distribution and phases of water substance on the driving surface. The LRSS provides images as well as the percent of ice, snow, and water included in the images. Another benefit of the LRSS is that it can collect useful data in dark areas where traditional cameras may not produce useable images. Since the LRSS uses an infrared beam to illuminate the surfaces in the viewing area, it is not necessary to illuminate the test site or rely on ambient lighting during the evening hours.

Implementation Readiness

Although the camera performed very well, the IaDOT notes some significant downfalls of the LRSS system for widespread RWIS deployment. The scan information was processed into images using manufacturer's image software installed on the IaDOT's laptop computer. Unfortunately, the image software requirements also limited the operating system of the download computer to Windows 98®. Furthermore, this camera is extremely difficult to access remotely and required manual downloads of the scan information. This would prohibit the use of the LRSS in real-time pavement monitoring.

The cost of the LRSS was also found to be prohibitive for deployment by the IaDOT, limiting any installation to the most vital or troublesome roadway segments. The camera was purchased for a price of $25,500. Widespread deployment may become more appealing in the event that the unit price declines or if future versions of the LRSS offer additional capabilities beneficial to the Iowa DOT.