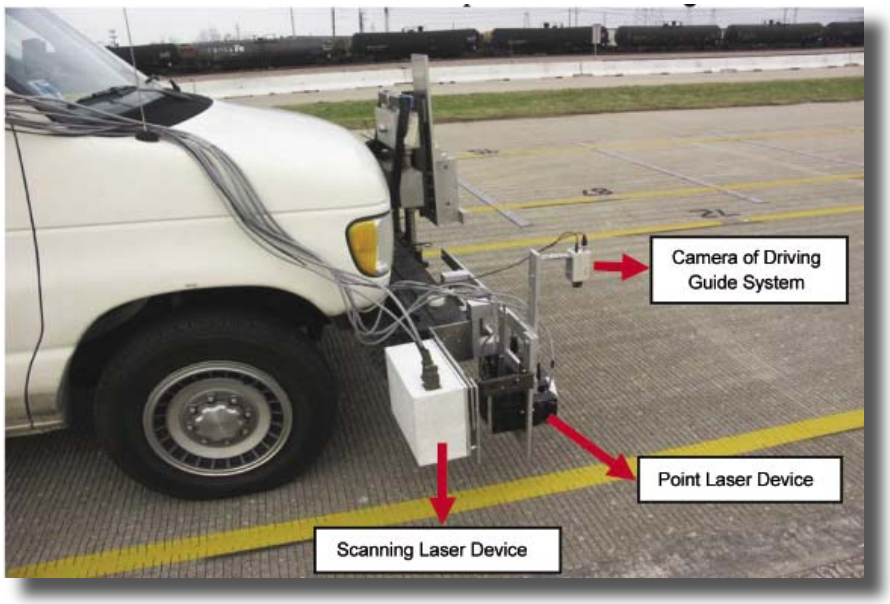
Project Summary

Texas Department of Transportation

0-5882: Development of a Vehicle Mounted Measuring Device Utilizing a Non-Contact Method to Determine the Thickness and Uniformity of Application of Thermoplastic Pavement Marking Material

Background

Previous research developed both pushcart and golf cart-mounted laser devices for measuring thermoplastic pavement marking material (TPMM) thickness. This project improved upon those devices so measurements could be taken at higher speeds.



New Laser Devices Mounted on a Van

What the Researchers Did

Under this project, two new versions of the vehicle-mounted laser thickness measurement devices were developed. The first new version, the *point laser device*, uses three synchronized point laser units instead of two (used in the golf cart version) to solve inaccuracy problems caused by the slope of the road. In the point laser device, there are three separate laser optical systems operating simultaneously to detect the position of the TPPM and the pavement. One laser is used to detect the position change of the pavement marking material, and the other two lasers are used to detect the position information of the pavement surface. Three laser signal processing units process the detected laser signals and transfer the position signals to different input channels of a data acquisition card. By subtracting and averaging the three position signals, a computer program displays and stores the TPMM thickness data.

The second new version, the *scanning laser device*, was developed based on the auto-synchronized laser scanning principle. This device can scan in the transverse direction and also measure the average thickness across a section of the TPMM. Since the scanning laser covers a large area, the driver is not strictly limited to following the thermoplastic tape. Accuracy is also increased on bumpy or sloping roads due to the large scanning area.

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A laser beam monitor system was developed to guide the driver in following the pavement markings. The system consists of a video camera and LCD unit. The video camera was installed over the measurement device to detect the laser beam, and the LCD unit was installed in the van to assist the driver in maintaining an alignment along the pavement markings.

The researchers also placed a laser bandpass filter behind the reflection receiver lens in both laser devices, an improvement from previous research. The bandpass filter, also called an interference filter, can transmit specific laser wavelengths and block other wavelengths by using light interference. With the bandpass filter, both devices can perform field tests without a cover box to block the sun.

What They Found

After finishing the lab tests, the researchers verified the system performance in the field. Seven thermoplastic tapes with different thicknesses were tested at the University of Houston test site. The white and yellow tape thicknesses varied from 40 mils to 100 mils. The measured average thickness of the 60-mil white TPMM was 63 mils. The test results of the other tapes were similar. The maximum difference between the marked thicknesses and the measured thicknesses for all the tapes was less than 5 mils.

Another set of tests was performed at TxDOT's Cedar Park test site. A 60-mil thermoplastic tape was measured by the scanning laser device. The average thickness of the thermoplastic tape measured by the device was 56 mils.

Field tests showed that the two laser measurement devices could be installed on either side of the vehicle without affecting their use or accuracy.

What This Means

The field test results show that the vehicle-mounted laser measurement devices for non-contact thickness and uniformity of TPMM are accurate up to plus or minus 5 mils at a constant speed of 30 miles per hour.

Despite the favorable results, there is still room for improvement in the system. The resolution can be significantly improved by using a focus lens with a longer focal length. Another issue concerns the accuracy and stability of the scanner. If the resonant scanner is replaced with a galvanometer scanner, the system may provide more accurate information about the deflected angle of the laser beam, thus increasing the accuracy of the TPMM measurements.

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