The Ohio Department of Transportation
Office of Research & Development
Executive Summary Report

Airborne LiDAR: A New Source of Traffic Flow Data

Start Date: October 2003

Duration: 12 + 9 months (extension)

Completion Date: June 2005

Report Date: October 2005

State Job Number: 134145

Report Number:
FHWA/OH-2005/14

Funding:
$50,245

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Problem

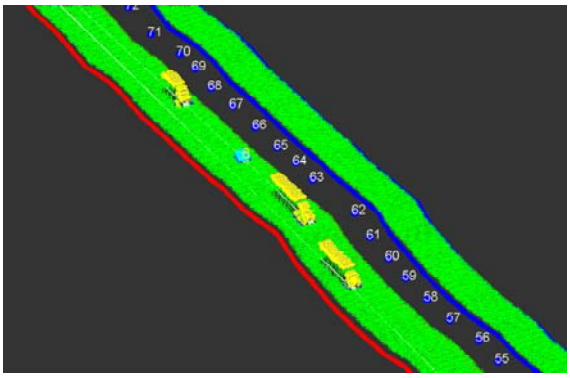
LiDAR (or airborne laser scanning) systems became a dominant player in high-precision spatial data acquisition in the late 90's. This new technology quickly established itself as the main source of surface information in commercial mapping, delivering surface data at decimeter-level vertical accuracy in an almost totally automated way. With increasing point density, new systems are able to support object extraction, such as extracting building and roads from LiDAR data.

Acquiring flow data in a timely manner is essential for many transportation processes, especially for traffic monitoring and management. Ground-based systems typically use loop detectors and video cameras. These systems provide excellent data at a local scale, but consequently are less appropriate for monitoring flow patterns over longer road segments. Remote sensing sensors, especially airborne systems, however, show somewhat complimentary characteristics; namely the acquired data can effectively support flow information extraction in a dynamic manner. Not only can vehicle counts and velocities be estimated but also complex flow patterns such as slowdowns and intersection/ramp turning movements can be identified and quantified.

Using LiDAR data for traffic flow estimates is a novel concept. In a sense, extracting vehicles over transportation corridors represents the next step in complexity by adding the temporal component to the LiDAR data feature extraction process. Vehicles are moving at highway speeds and the scanning acquisition mode of the LiDAR poses a serious challenge for the data extraction process.

Objectives

- To investigate the feasibility of extracting vehicles from LiDAR data to derive valuable traffic flow information for supporting traffic monitoring and management,
- To develop an operational system that could extract vehicles from LiDAR data and then group them into major categories to derive flow data,
- Using data from regular LiDAR missions to show how vehicles can be extracted and then parameterized in a way that a robust classification of the vehicles is possible.
- To study the potential for determining vehicle speed estimates from LiDAR data,
- To get an initial assessment on fusing LiDAR with optical imagery to improve the quality of the traffic flow estimates.



Description

The I_FLOW program developed by OSU is capable of automatically extracting vehicles from normal LiDAR data and grouping them into vehicle classes. With the time and location info added, valuable flow data can be derived from the vehicle records. I_FLOW has shown excellent performance on recently acquired LiDAR datasets and is ready for production.

Conclusions & Recommendations

A great amount of LiDAR data is collected over transportation corridors and in urban areas with a dense road network. In these datasets, vehicles on the road represent obstructions to the LiDAR pulses as they are reflected back from the vehicles instead of the pavement. Therefore, a substantial amount of processing must be devoted to the "removal of the vehicle". Rather than removing and discarding the signals from vehicles, they can be turned into traffic flow information.

Somewhat connected to the previous fact is that LiDAR systems can be turned on to collect data during transit, which accounts for substantial flying time. At almost no cost, a significant amount of data rich in traffic flow information can be acquired. There are indicators that transportation and other agencies will be deploying LiDAR systems over transportation corridors at an increasing rate in the future.

Implementation Potential

The I_FLOW program is ready for installation in the OAE.