DRISI

Caltrans Division of Research, Innovation and System Information

Research Results

Precision Mapping of the California Connected Vehicle (CV) Test-Bed Corridor

Processing of raw point cloud data collected from LIDAR scanning to extract Geometric Intersection Description (GID) features using off-line computer processing.

Advanced Research

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Project Title:
PATH Deployment Support

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WHAT WAS THE NEED?

Researchers have developed both hardware and software tools to precisely map features on the roadway down to decimeter-level accuracy. This precise mapping of roadway features are necessary components of any Intelligent Transportation System (ITS) application that relies on lane-level positioning of vehicles.

Over the last several years, there were a number of research programs that have used the California Connected Vehicle Test-bed Corridor, including:

1. The Multi-Modal Intelligent Traffic Signal System (MMITTS) project being carried out by the UC Berkeley PATH program
2. The Advanced Signalization Phase II project (part of a Federal Highway Administration (FHWA) Exploratory Advanced Research (EAR) program) being carried out by University of California Riverside and University of California Berkeley.

The projects have required that a precise map be available for the different applications. Vehicles will not only need to know which lane they are in, but they will also need to know their precise distance away from the intersection. As part of the mapping process, various roadway features will be used, including lane markings, stop-bars, intersection features, etc.

WHAT WAS OUR GOAL?

The goal of the project was to develop a system that could generate survey quality maps and outputs for SAE J2735 format data communication needs for connected vehicle technology.

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WHAT DID WE DO?

The California Department of Transportation (Caltrans) contracted the University of California Riverside - Center for Environmental Research and Technology (CE-CERT), to collect precise map information from a mobile sensor platform and to develop a Mobile Positioning & Mapping System (MPMS) mobile test-bed platform.

The platform collected positioning and mapping data from a variety of sensors and combined them to provide accurate, available and continuous intelligence on the state of the MPMS moving vehicle and on the surrounding areas. The MPMS yielded location detail and associated feature maps through a combination of global positioning satellite (GPS) technology, feature-based aiding sensors (vision, RADAR, LIDAR) and high-rate kinematic sensors. The platform captured and processed multiple location and feature-based signals and bridge data gaps whenever sensor reception was interrupted.

The vehicle with the system was driven repeatedly over the test site at different times of the day, with varying levels of congestion. At the end of each data run, the raw data was examined to determine the data validity which guided the data collection process for the remaining days. Image processing algorithms were applied to reliably extract stop bars on the intensity image generated from previous steps.

WHAT WAS THE OUTCOME?

This project was successful in showing that it is possible to collect precise map information from a mobile sensor platform. The key next steps are to formalize the process and to extend the work with more elaborate feature extraction algorithms.

WHAT IS THE BENEFIT?

The hardware, software and algorithm that were designed within this contract will make it easy to collect the features from an intersection by first scanning the intersections using LIDAR and then extracting features like stop bars using the developed hardware. This will help the owner/ operators of the intersections to utilize the features for connected vehicle applications with least amount of time and resources.

LEARN MORE

View the Final Report
https://dot.ca.gov/-/media/dot-media/programs/research-innovation-system-information/documents/final-reports/ca16-2777-finalreport-a11y.pdf

IMAGE

Image 1: Mapping Unit with GPS and LIDAR unit