Automated & Connected Vehicle Applications Development for FDOT Systems

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About Southwest Research Institute®

Organizational Characteristics
- Independent and nonprofit [501(c)(3)]
- Revenue provided by R&D contracts
- Broad technological and scientific capabilities
- Decentralized organization
- Internal research encouraged
- Unique Client-Oriented intellectual property policy

10 Operating Technical Divisions
- Applied Physics
- Applied Power
- Intelligent Systems
- Mechanical Engineering
- Engines, Emissions, and Vehicle Research
- Fluids and Lubricants Research
- Signal Exploitation and Geo-location
- Space Science and Engineering
- Geosciences and Engineering
- Chemistry and Chemical Engineering

About SwRI
- ESTABLISHED: 1947
- STAFF: >2700
- GROSS REVENUE FY2014: >$548M
- FY15 Projects: >6,800
- CAMPUS: ~4.86 km² (1200 Acres) in San Antonio, TX
- LABS/OFFICES: > 204,400 m² (2.2M ft²)
- Over 1,100 Patents; 38 R&D 100 Awards
- FY15 IR&D: $7.2M, 73 projects
Overview

- Roadway Characteristic Inventory (RCI)
  - FDOT currently maintains
  - Currently manually collected
  - What characteristics can be collected from sensor equipped cars?

- Dynamic Message Sign (DMS)
  - Broadcast Message to Connected Vehicles
  - Standalone and Advanced Traffic Management System Integration (ATMS)
  - Abides by pre-existing Transportation Management Protocols
Roadway Characteristics Inventory
Intro to Roadway Characteristics Inventory

Straight Line Diagram (SDL)
Feature 221 – Horizontal Curve

- Compass Bearing
- Central Angle
- Degree of Curve
- Point of Intersection
- Point of Curvature
- Point of Tangency

Examples with and without Bearing:

**Curve to the right: with bearing**
- PC = 3.519
- PI = 3.577
- PT = 3.632
- \(D = 0^\circ05'00"\)
- \(\Delta = 0^\circ29'30"\)
- \(B = S89^\circ32'25'E\)

**Curve to the left: without bearing**
- \(\Delta = 0^\circ48'00"\)
- \(D = 0^\circ05'00"\)
- PC = 3.965
- PI = 4.056
- PT = 4.147
Automated Driving System (ADS) Reference Architecture

Draft from SAE ORAD – still under development
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<th>Feature#</th>
<th>Feature Name</th>
<th>Characteristics</th>
<th>Feasible</th>
<th>Vehicle Type</th>
<th>Primary Equipment</th>
<th>Secondary Equipment</th>
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Selected Feature – Thru Lanes 212

**Number of Roadway Lanes**
- Different count for each side of the road
- Auxiliary lanes are not included

**Pavement Surface Width**
- Total width
- 1 foot accuracy
- Outside edge to Outside edge
Technology Demonstrator

- Dual Cameras for Computer Stereo Vision
- Linux Computer with Independent GPU
- Power distribution
- Wi-Fi, USB, HDMI and Ethernet ports on back
- Inertial Navigation System (Not Shown)
Sample Results / Demonstration
Dynamic Message Sign
DSRC Integration
Dedicated Short Range Communications (DSRC)

Background

Source: USDOT

DSRC was developed with a primary goal of enabling technologies that support safety applications and communication between vehicle-based devices and infrastructure to reduce collisions. DSRC is the only short-range wireless alternative today that provides:

- **Designated licensed bandwidth**: For secure, reliable communications to take place. It is primarily allocated for vehicle safety applications by FCC Report and Order FCC 03-324.
- **Fast Network Acquisition**: Active safety applications require the immediate establishment of communication and frequent updates.
- **Low Latency**: Active safety applications must recognize each other and transmit messages to each other in milliseconds without delay.
- **High Reliability when Required**: Active safety applications require a high level of link reliability. DSRC works in high vehicle speed mobility conditions and delivers performance immune to extreme weather conditions (e.g., rain, fog, snow, etc.).
- **Priority for Safety Applications**: Safety applications on DSRC are given priority over non-safety applications.
- **Interoperability**: DSRC ensures interoperability, which is the key to successful deployment of active safety applications, using widely accepted standards. It supports both V2V and V2I communications.
- **Security and Privacy**: DSRC provides safety message authentication and privacy.
DSRC Roadside Equipment
OnBoard Unit (OBU)

- Installed in vehicles
- Communicates with other vehicles and roadside equipment
- Performs local processing to interface with the driver
Concept of Operations

**Standalone**

- Manually Inputted Controller

- Serial and Ethernet Connections

- Some with Cellular Capabilities
Concept of Operations

ATMS Controlled

- SUNGUIDE Integrated
- Hard Fiber or Cellular Connection
SunGuide Architecture
Thank You!

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