Autonomous TMA Truck (ATMA)
CDOT Evaluation and Performance Verification

Developed By

CDOT Vision

Project Vision

- Remove driver from TMA truck
- Decrease risk of operations
- Increase efficiency of operations
- Pursue cutting-edge technology to improve highway management

Project Goals

1. Installation of system on CDOT piece of equipment
2. Identification of limitations and anomalies in track setting
3. Log open highway miles in striping operation
4. Interchangeability of lead vehicle – sweeper or mower

How it Works

- ATMA will autonomously follow a leader vehicle
  - Leader transmits position, speed, heading
  - Follower matches leader’s movements using steering, throttle, brake actuators

Installation of System

- Retrofit leader vehicle with
  - Antennas
  - Navigation module
  - Communications module
- CDOT striping truck completed in ½ day
Installation of System

- ATMA Follower systems pre-installed
- Can be retrofitted to existing trucks
- CDOT purchased truck & technology
- E-Stop Button
- Lead/Follower Controls
- Steering Yoke
- Actuators under passenger seat

Detection Using Radar

- Front mounted radar on follower provides obstacle detection
- Only reacts to obstacles in the path between leader and follower
- Emergency stops upon obstacle detection

Performance Evaluation

- CDOT developed a set of scenarios to verify the capabilities
- First week of performance evaluation conducted at Christman Field a closed airfield at Colorado State University
- June 26-30, 2017

Performance Evaluation

- E-stop Buttons
  - Internal/ External
- Stopping Distance
- Follow Distance
- Lane Accuracy
  - Straight
  - Cornering

Performance Evaluation

- Team from Kratos and Royal Truck and Equipment were on site.
- Tests were downloaded with equipment and GPS data

Lane Accuracy
Gap Control

- Straight line following for 4000' with desired speed 7 mph (striping operation speed) and desired gap 60m
- Recorded gap is measured antenna to antenna: 60m bumper to bumper is 68.89m antenna to antenna

Driverless Run

Results

- Lane accuracy within +/- 4 in
- Gap distance much more consistent than human driver
- Accurate following in cornering and slalom setups
- Performed turns as tight as 45 ft radius
- Identified software and hardware changes to be made
  - CDOT’s production model will address issues found in evaluation of prototype
  - Further suggested modifications will be implemented in future

Future Modifications

- Full user interface with
  - Adjustable gap distance
  - Diagnostics monitoring
  - Video livestream with switchable camera views
  - Test mode to check radar system during pre-trip
- "Pause Mode" allowing ATMA to be stopped while leader continues
- "Tight turn mode" allowing vehicle to make tight U-turns
  - Making this a separate mode used only in turning around allows for the straight line driving to be much smoother

Operational – Fort Collins, CO Event

- Fort Collins – August 18th
- Self-Driving Work Zone Vehicle Showcase
  - https://www.youtube.com/watch?v=BGc8tVaQnY
  - https://www.youtube.com/watch?v=N-GkbFXq3Ts
- First time in painting operation on public road
- Face book Live Event
  - Internet — 421 online stories
  - TV/Radio — 41 stories
  - In total, that’s 945 hits for an estimated reach of 297,084,950 and publicity value of $2,378,632.
FHWA Peer Exchange – Greeley, CO

- FHWA Peer Exchange
  - September 19 & 20th 2017
  - 15 States
  - Live Operation
- Discussions
  - Policy
  - Operations
  - Project Development
- Future Steps – Pool Fund

Policy

- An Act

Policy and Operational Usage

- Task Force including CDOT & CSP & Revenue to Review
  - Risk, Public Relations, Operations & Policy
- Autonomous CSP & CDOT Process
  1. Operational Domain
  2. Certifications
     1. Safety Assessment
     2. Driver
     3. Vehicle
     4. Insurance
     5. Special Event
     6. Other

Policy and Operational Usage

- Autonomous Truck Mounted Attenuator
  - Operations Plan
  - Certification Process

Timeline Summary and Future Steps

- Goals
  - Log Highway Miles
  - Final Approvals – Pending
- FHWA – Pool Fund
  - Autonomous Maintenance Technology (AMT) Solicitation # 1460
  - Reached Funding Goal ($200k - $350K)
  - Work Together to get improvements
  - Document Successes

Questions?