Connected Vehicle Identification System for Cooperative Control of Connected Automated Vehicles

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Project Overview

Researchers developed and field-tested a prototype preceding vehicle identification system for connected automated vehicles to enable cooperative platooning. The system combines GPS positioning data with time-of-flight sensor measurements through vehicle-to-vehicle (V2V) communication to accurately identify preceding connected vehicles. This technology addresses GPS positioning errors that could cause vehicles to incorrectly identify cooperation partners in mixed traffic environments.

Methodology

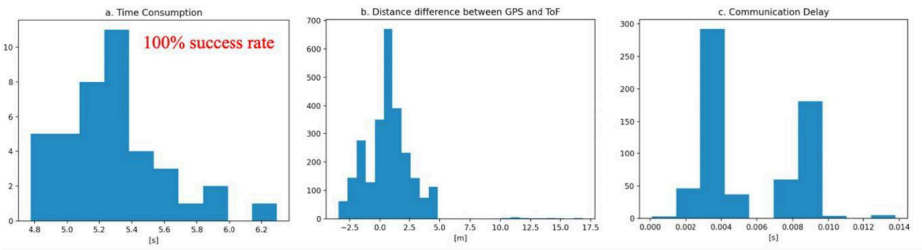
Researchers designed a prototype system integrating a Jetson Nano processing unit, Wi-Fi communication device, SparkFun GPS receiver, and Terabee time-of-flight sensor. Field testing involved two connected human-driven vehicles operating in a parking lot environment at speeds below 10 mph. The system iteratively matched GPS-measured distances with sensor-measured distances using optimized threshold parameters to achieve reliable vehicle identification.

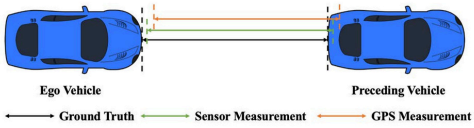
Key Findings

- **Identification Accuracy:** System achieved 100% success rate in identifying preceding connected vehicles across 43 field tests.
- **Processing Speed:** Average identification time of 5.3 seconds, optimized to 5.2 seconds with refined parameters.
- **Sensor Performance:** GPS and time-of-flight sensor showed mean distance difference of 0.8 meters with 2.1-meter standard deviation.
- **Communication Efficiency:** Vehicle-to-vehicle communication delay averaged 0.0055 seconds, proving negligible for system operation.
- **Hardware Limitations:** Time-of-flight sensor sensitivity to road surface variations caused invalid readings during uneven terrain traversal.

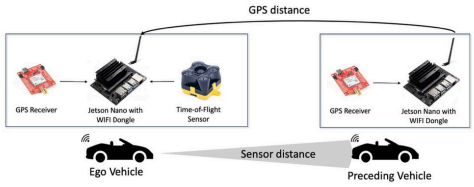
Key Figures

Test results indicate the effectiveness of the CVIS system: 100% identification success averaging 5.3 seconds , GPS-sensor distance measurement differences, and negligible V2V communication delays.

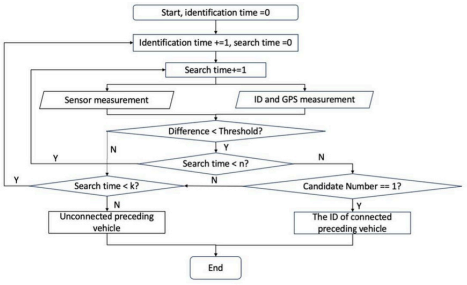




Measurement Systems Between Vehicles



Vehicle Identification Hardware



Flowchart of Identification Procedure

Notes for Policymakers

Policymakers can support CVIS deployment to enable cooperative automated driving in mixed traffic environments:

- **Develop communication infrastructure standards** for preceding vehicle identification in cooperative platooning.
- **Establish sensor integration requirements** for reliable distance measurement in diverse road conditions.