CPS: Synergy: Semi-Automated Emergency Response System

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Facilitating Emergency Vehicle Movement at Intersections

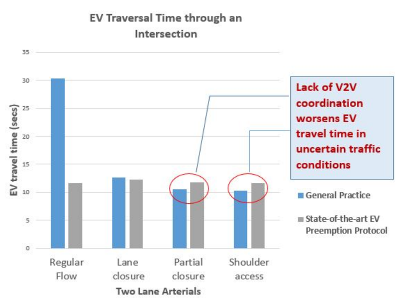
Objective

Efficient traversal of Emergency Vehicle (EV) through an intersection to ensure safety in uncertain traffic conditions using V2V coordination

Analysis

Comparison between general practice as base protocol and state-of-the-art EV preemption protocol

- Improvements in EV travel time in case of general regulated traffic flow
- Underperformance of preemption protocol in case of uncertain vehicle behaviors caused by roadblocks and lane closures ahead of the intersection



Approach

- Incorporate V2V coordination to alert and control the behavior of non-EVs at an intersection for safe traversal of EV
- Leverage accessible empty areas on shoulder and lanes while approaching an intersection for smooth traversal

Facilitating Emergency Vehicle Movement through a Transportation Network Link

Objective

Find an intra-link path that maximizes the EV speed and minimizes the presence of adjacent vehicles

Integer Linear Program

- Facilitates the passage of an EV through a transportation link
- Leverages V2V communications

Overview of Solution

- Set of cells that constitutes the EV path in the AR
- EV maneuvering instructions at every increment in the AR
- EV speed at every increment in the AR
- Non-EV positions in the AR

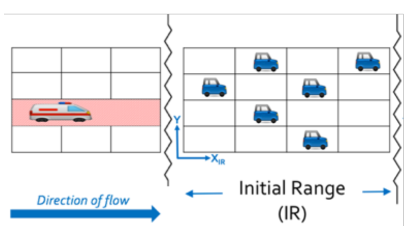
Constraints

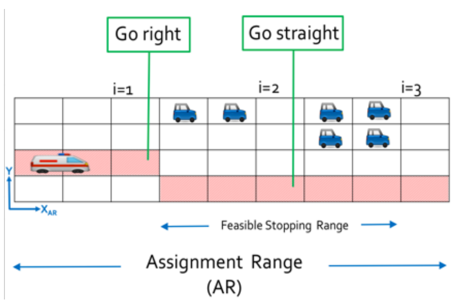
- Only one vehicle assigned to each cell
- Each non-EV assigned within its feasible stopping range
- No passing and no weaving between non-EVs
- Relationship between EV instructions and the EV's assignment to dictate its motion
- Relationship between the EV instructions and the non-EVs' assignments to clear the path for the EV
- Speed constraints to ensure that the speed varies between the minimum and maximum bounds based on the EV instructions and the EV's surroundings

Comparative Analysis

Formulation vs. "Go to the nearest edge" practice

- This formulation led to the same or better results (on narrower links) than the tested local practice
- This formulation could eliminate confusion and reduce conflicts



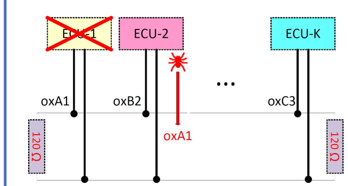


Physical Layer Identification of Electronic Control Units for Intrusion Detection Purposes

Objective

Detection and localization of an Electronic Control Units (ECUs) impersonating one another for intrusion detection purposes in vehicular networks

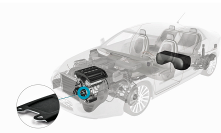
Attack Model



Masquerade attack on a CAN bus with 120 ohm load and K ECUs.

Solution: Physical Layer Identification using the fingerprints derived from voltage measurements

Method: *MVN (Multivariate Normal Distribution) identification*



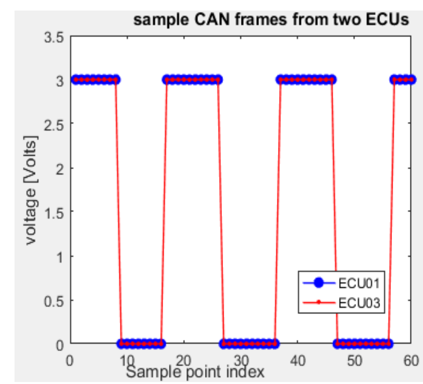
Resource Constraint Environment

- Low sampling rate: 1 Msps
- Low training data percentage: 2%
- Time and power constraints
- Low-cost data acquisition setups
- Detection only based on a single frame

Metric

Equal Error Rate (EER)

An accuracy metric for identification systems defined as the equality point of false acceptance rate and its false rejection rate, which is the best when zero



Representative results:

ECU	ECU01	ECU02	ECU03	ECU04	ECU05	ECU06	ECU07
Avg. EER	7.76%	0.023%	2.53%	5.32%	6.00%	6.62%	5.75%

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CPS-1544601