CPS: Synergy: Semi-Automated Emergency Response System

Tam Chantem, Pamela Murray-Tuite, Ryan Gerdes, and Kevin Heaslip

VirginiaTech
College of Engineering

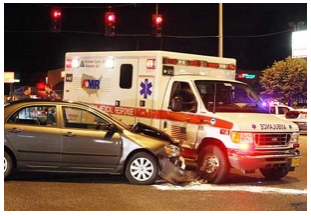
Purpose

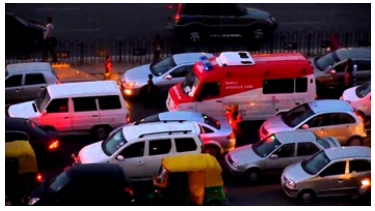
This project involves the use of the Connected Vehicle technologies to reduce the time it takes an Emergency Vehicle (EV) to reach its destination while increasing the overall safety and reducing the impacts on the non-emergency vehicles.

- Dynamic EV route selection
- Optimization of EV movement along arterials
- Faciliation of EV intersection crossing

Challenges

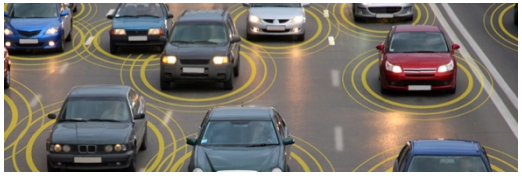
- Dealing with uncertainties in the traffic network
- Handling vulnerabilities that could threaten the system's security
- Coordinating the movement of multiple EV response in a network

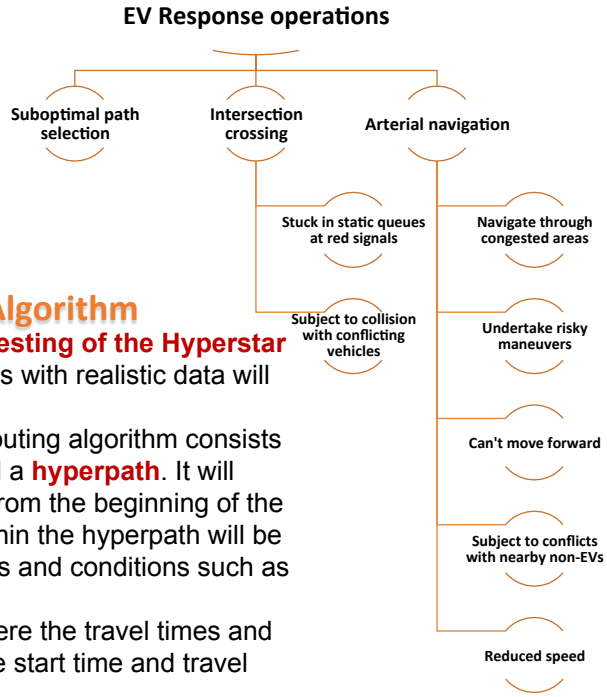




The **Connected Vehicles Technologies** based on Vehicle-to-Vehicle(V2V) and Vehicle-to-Infrastructure (V2I) communications constitute a new environment with the potential to enhance the response operations of an EV from origin to destination.

The proposed system is semi-automated where the vehicles are driven by humans who will receive assistance through V2V and V2I communications.





Hyperstar: The Dynamic Routing Algorithm

- In this project, the **implementation and testing of the Hyperstar routing algorithm** on case study locations with realistic data will be performed.
- Developed by Bell (2012), this dynamic routing algorithm consists of generating a set of optimal paths called a **hyperpath**. It will provide the EV with multiple alternatives from the beginning of the trip and the choice of a particular path within the hyperpath will be based on preferences and en-route events and conditions such as congestion and road incidents.
- This is a **dynamic routing algorithm** where the travel times and the delays on the links are functions of the start time and travel conditions.

Optimizing EV Movement through Transportation Link

A **mathematical program** aiming to facilitate the EV movement by **maximizing its speed** while travelling on a pre-specified route is being developed.
It relies on **data exchange** between vehicles. In fact, the EV will receive a set of instructions that will delineate its intra-link path. In addition, an instruction will be sent to each non-EV to assign it to a downstream location while considering its minimum stopping distance. Thus, the path of the EV will be cleared so it can travel safely and at the maximum speed possible

The optimization approach involves dividing the transportation link into identical cells. It will generate the following variables:

- EV assignment variables
- EV speed variables
- EV instruction variables
- Non-EVs assignment variables

This current approach assumes that no additional vehicles are entering or leaving the section during the EV movement and that no passing between vehicles is allowed.