Overview

Automated Electric Transportation (AET) is a concept proposing platoons of network-automated vehicles electrically powered by the roadway via in-motion wireless power transfer (WPT). As seen in pictures, AET functions similarly to railroads’ “third rails” and overhead wires, without the various connection, maintenance, and safety issues that they pose.

The primary focus of this research is to investigate the capacity (in vehicles per hour) of an AET system, comparing it with both current roadway lane-capacities and traditional roadways. See attached pictures. Automated Electric Transportation (AET) is a concept proposing platoons of network-automated vehicles electrically powered by the roadway via in-motion wireless power transfer (WPT). To parse that sentence:

A safe, effective, and efficient variation of “beamed” energy, IPT relies on magnetic induction to provide on-demand, in-motion power to vehicles. See attached pictures. The variable used include:

- \( L \): The number of vehicles in each platoon
- \( p \): The platoon spacing
- \( C \): The average capacity of a platoon
- \( T \): The average time of each vehicle change
- \( S \): The average speed of each vehicle
- \( V \): The average speed of the fleet
- \( T_a \): The acceleration time
- \( T_r \): The reaction time of the follower vehicle
- \( T_b \): The braking time
- \( T_s \): The stopping time
- \( T_i \): The intervehicle spacing
- \( T_c \): The control delay
- \( T_p \): The sensor delay
- \( T_l \): The link delay
- \( T_e \): The event delay

This is a simplified version of the PATH equations, chosen to present here. The variable used include:

\[
C = \frac{V}{T} \quad Z = \frac{S}{L} + (Z - 1)S_y + Z \cdot L
\]

The Danger Zone

Controlled Avoidance Distance (CAD), also known as the danger zone model, is illustrated first in [Fig. 9.11]. For AET in the current stationary state, the danger zone is the region of unsafe separations/headways (\( H \)), and it is defined as any headway where the following vehicle cannot brake with sufficient force to avoid a collision. The danger zone is defined as any headway where the following vehicle cannot brake with sufficient force to avoid a collision. The danger zone is the region of unsafe separations/headways (\( H \)).

\[
H = \frac{V^2}{2a} \quad a = \frac{V}{T}
\]

The braking distance is simply the area under the brake curve, and the distance traveled is the area under the danger zone curve. The difference between the two curves is the danger zone at zero separation (vehicles are fully stopped). The dynamics of each vehicle in the platoon are described as:

\[
\frac{d\phi}{dt} = \frac{L}{2} \cdot \frac{d}{dt} \cdot \tan(\phi)
\]

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\]

Typical braking distance at 30 m/s is 27 m. Stronger follower braking can be increased from 27 m to 29 m, while weaker braking decreases the danger zone to 21 m.

The Danger Zone for Automated Electric Vehicle Platooning:

- Scenario 1: Leader Brakes, Follower Stopped
  - Leader Brakes, Follower Has Not Reacted Yet
  - Leader Brakes, Follower Has Not Reacted Yet

- Scenario 2: Leader and Follower Both Braking
  - Leader Brakes, Follower Has Not Reacted Yet
  - Leader Brakes, Follower Has Not Reacted Yet

Implements

\[
\text{Implications:}
\]

- Minimum \( S_y \) can be plugged directly into the capacity equation
- Minimum \( S_y \) can be determined in an acceptable research
- Maximum \( S_y \) can be determined in a realistic laboratory conditions
- Vehicle braking AND vehicle electrification can reduce travel time
- \( 0.2 \) is optimal for both emergency scenarios and inter-idle conditions
- FIST in a vehicle exiting the platoon is necessary to enter the danger zone

\[
\text{Future Work:}
\]

- \( 0.2 \) is optimal for both emergency scenarios and inter-idle conditions
- FIST in a vehicle exiting the platoon is necessary to enter the danger zone
- Testing for various road conditions

More Information

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