Comfort Determination in Autonomous Driving Style

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Abstract
A fully autonomous car is predicted to have a one dimensional driving style which is based on algorithms which inputs are from the sensors. Conversely, human drivers have multidimensional driving styles which inputs are based on motivations and emotions. Hence, there would be a mismatch between preferred driving style that would lead to physical and mental discomfort. In this position paper, we try to set up an experiment to investigate the relationships between two human driving styles (assertive and defensive) and three autonomous car driving styles (light rail transit, assertive and defensive) by focusing on thrill or sensation dimension. The experiment will be conducted at three different locations which are at the junction, speed hump and roundabout. In addition, we would like to find the correlations between the preferred accelerations (in longitudinal, lateral and vertical direction) in autonomous car and human driving styles.

Author Keywords
Autonomous driving; defensive and assertive driving style; comfort

ACM Classification Keywords
H.1.2 User/Machine Systems - Human factors; I.2.9 Robotics - Autonomous vehicles

Introduction

The autonomous cars are expected to behave in optimized manners which promote safe, reliable and comfort experience to the users. However, the experience of comfort may vary depending on users perception and can be very subjective due to many factors especially driving styles [1] which can be categorized into defensive and assertive driving styles [2].

Since autonomous or self-driving cars are basically robots and the means they drive and decide are strictly based on optimized logic while human drivers are driving based on their own personality traits and "targeted feeling" [3], [4] which leads to different driving styles, there will be mismatched in the driving style preference. The way an autonomous car accelerates, decelerates and takes the roundabout will be experienced differently for different human drivers. Furthermore, since human drivers are no longer in command (no hands on the wheel, no feet on the pedals), in order to compensate for safety and comfort, the autonomous car will probably accelerate and decelerate in the style which could induce mental discomfort to the human drivers both inside and outside of the car.

Hypotheses

The hypotheses to be tested are:

a) Assertive driving style is hypothesized to have higher sensation seeking personality while defensive driving style has the opposite relationship.

b) Autonomous car driving styles at three different scenarios (junction, speed hump and roundabout) are expected to induce discomfort to the human driver because of different type of preferred driving styles.

c) Assertive type of human driver will likely be uncomfortable with the autonomous car defensive driving style and vice-versa as summarized in Figure 1.

Autonomous DS \ Human Driver DS	Defensive	Assertive
Defensive	Comfortable	Uncomfortable
Assertive	Uncomfortable	Comfortable
LRT	Uncomfortable	Uncomfortable

Figure 1: Predicted autonomous and human driving styles

Aims and Objectives

The objective in this experiment is to study the preferred driving style for autonomous car users in three different urban scenarios (junction, speed hump and roundabout) based on their driving styles.

a) To determine the type driving style based on sensation/thrill dimension.

b) To find the range of preferred acceleration in the longitudinal, lateral and vertical directions for different types of drivers at four point of interests.

c) To find the correlation between the preferred acceleration and human driving styles (from sensation/thrill point of view) determination.

Proposed Method

In this experiment, there will be two phases which are:

a) The first phase is to determine what type of participants driving style, either defensive or assertive, by using questionnaires based on thrill and sensation dimension.

b) The second phase is field experiment where the participants will be seated in the car, which will be driven by a designated driver (who is going to imitate the autonomous driving experience). In this phase, three different driving styles will be conducted - LRT, defensive and assertive autonomous driving style.

Selected Range for Autonomous Driving Styles

In this experiment, the ranges [5]–[8] to be implemented for the LRT, defensive and assertive autonomous car driving styles are shown in Figure 2 and Figure 3.

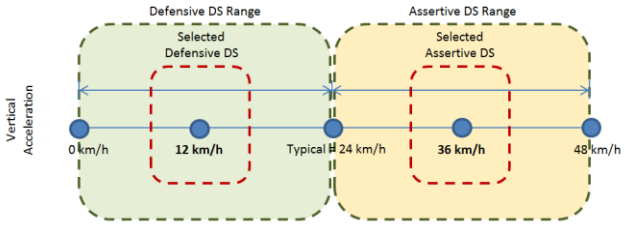

Figure 2: Range of selection of velocity approaching the speed hump to generate vertical acceleration

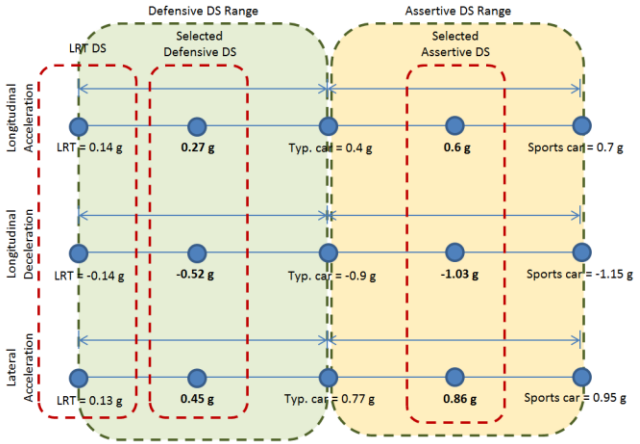

Figure 3: Range for autonomous driving styles in longitudinal and lateral directions

Conclusion

In conclusion, the proposed experiment will investigate the correlation between driving styles (assertive and defensive) and sensation seeking. In addition, the preferred acceleration in lateral, longitudinal and vertical directions will be determined using the comfort rating and later will be associated with the dynamics data collected from the accelerometers. Finally, we would like to find the relationship between driving styles (in term of sensation seeking) and comfort (in term of preferred accelerations).

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