Automated Driving Maneuvers of Vehicle under Passing Motorcycle Scenarios
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Overview

- Background
- Methodology
Background

Deployment of Autonomous Vehicle

Autonomous vehicles (AV) will be the major portion of all vehicles on road in some decades later from now on. Many traditional carmakers and new technology companies including BMW, Volvo, Waymo, Uber, etc. are carrying out extensive tests on AV driving under real situations. This means AV has to share the same road with other manually driven vehicles.

Driving in city is very challenging compared to driving in rural areas. Various kinds of vehicle including motorcycles (MC), pedestrians, complex environments and situations will be encountered. MC plays an important role in transport in many Asia countries. Car is mainly used in North America, Europe, and Japan, while MC are uncommon. So, encountering with MC by AV is inevitable when AV is implemented in those countries where MC is popular.
Motorcyclists ride normally on the most outer lane, but also anywhere across the street. In midstream of traffic, MC speed is usually less than car. This results in car always passing slower MC. Passing is one of the most common driving maneuver. AV has to possess this ability in order to determine when and how to perform this task.


Background

Research Problem

The AV passing maneuver has been mentioned in some literatures. However, how AV performing this maneuver is still needed more explanation especially passing MC. Czarnecki (2018) described AV maneuvers responding to MC in some scenarios such as motorcycle performing lane splitting and motorcycle riding in adjacent lanes except passing MC. Thorn et al. (2018) defined AV responses to a slower leading MC by lane changing lane and passing. However, those maneuvers are only described as shifting into an adjacent lane with constant speed or acceleration.

In order to perform the passing maneuver, AV has to gather and process information from various onboard sensors and then generate a continuous path through the surroundings according to the selected maneuver. A collision-free path or trajectory for automated passing maneuver can be constructed by many approaches. Those are statistical methods, traditional methods, optimization methods and machine learning which can be combined together. According to few numbers of study on the automated maneuver for passing MC, it might have some special characteristics, parameters or situations that differ from other maneuvers.
Purpose of Research

The purpose of this research is to develop the motion planning and motion control of AV maneuver for passing MC under various driving situations. To achieve the aim, the objectives of research study are followings;

1. To study the naturalistic driving behavior for passing MC in various situations,
2. To develop the motion planning algorithm and tracking controller of the passing MC maneuver,
3. To evaluate the proposed concept with various MC conflicts.

Research Questions

1. How do drivers perform the passing maneuver on MC?
2. How should AV perform the passing maneuver on MC?

Hypothesis

The naturalistic driving behavior for passing MC can be used as the outline of the automated maneuver for passing MC
Methodology

• Analysis of the naturalistic driving behaviors of the passing on MC
  - Study driver’s behaviors
  - Study conflicts with MC situations
  - Identify outline of the passing trajectory and conflicts

• Develop the motion planning algorithm and tracking controller of the passing MC maneuver
  - Review the related research of motion planning and tracking controller, i.e., approaches and related parameters
  - Develop the motion planning algorithm
  - Develop the tracking controller

• Evaluation effectiveness of the automated passing maneuvers on each sample MC conflict
Q&A