PS T3.6

ICPR2021
www.icpr2020.it

Visual Prediction of Driver Behavior in Shared Road Areas

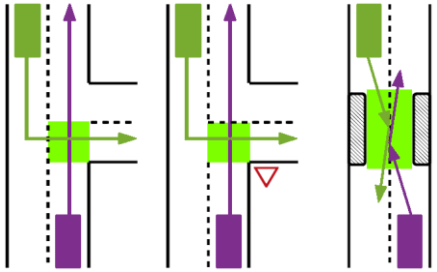
Peter Gawronski[1], Darius Burschka[1]
[1] Technical University Munich, Germany
{peter.gawronski, burschka}@tum.de

1. Introduction

- Urban traffic scenarios still pose a challenge for autonomous vehicles
- Mainly due to far more shared spaces as intersections and narrow passages

2. Motivation and Background

- Interactions happen at shared road segments – *interaction regions*

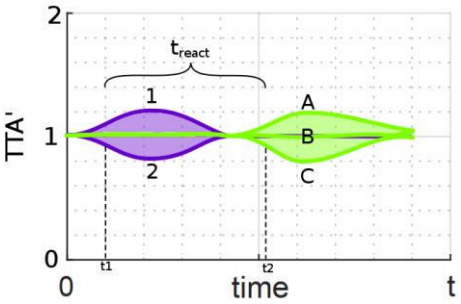


- Vehicles compete over usage, rights of way define most situations but may be tweaked by behavior
- Search for interactions by estimation of Time to Arrival (TTA) and occupation time of road segments
- Use Time to Arrival (TTA') to cancel out natural passage of time

$$TTA = \frac{d}{v_0} \quad TTA' = \begin{cases} < 1, & \text{vehicle slows down} \\ = 1, & \text{expected velocity} \\ > 1, & \text{vehicle accelerates} \end{cases}$$

3. Major Contributions

- Classification of behavior *B* of the other vehicle in terms of activeness and collaboration in a given scenario



$$B_{veh} = \begin{cases} passive, active \\ collaborative, neutral, disruptive \end{cases}$$

$$B_{veh} = \begin{cases} collab., & s(TTA'_2 - 1) \neq s(TTA'_1 - 1) \\ neutral, & (TTA'_2) \approx 1 \\ disruptive, & s(TTA'_2 - 1) = s(TTA'_1 - 1) \end{cases}$$

4. Methodology

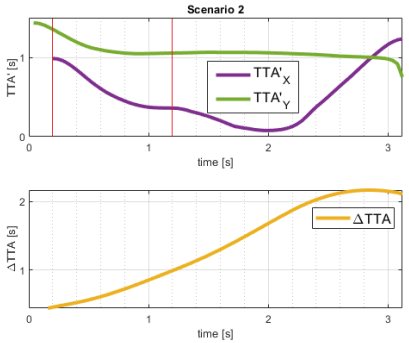
- 1. Identifying possible interactions from topology and create a logical map of outcomes in a scenario
- 2. Initiate an *stimulus* (behavior change) by one vehicle (purple)
- 3. Wait and classify the *reaction* of the opponent driver after a reaction time (green)

5. Experimental Design

- Intersection Drone Dataset (inD)[1]
- Candidates picked by ΔTTA<2s
- Setup reflects some typical situations:
  1. turning left with oncoming traffic
  2. merging at an intersection
- Filter raw input for Analyze activeness and collaboration of the opponent

6. Results

- Example: Y yields to X, X accelerates (TTA'>1) and collaborates by clearing the intersection earlier.



- Other scenarios show passive/unaware or disruptive behavior (slowing down while having Right-of-Way, sharp acceleration to merge/cutting off other drivers)

7. Conclusions

- Vehicles act and react to other's behavior in three main categories
- Approach identifies typical and unexpected behavior in urban traffic scenarios quickly
- TTA' is a meaningful property for behavior analysis

- Autonomous vehicles could use the situation awareness to collaborate with a given stimulus if possible

8. Future Work

- Approach can be generalized for other traffic participants as VRUs
- Current approach uses top-down view of a flying drone
  → use on-board systems of vehicles
- Use output for better collaboration and more natural behavior of autonomous vehicles in urban road scenarios

9. Sources

- [1] Bock et al., "The inD Dataset: A Drone Dataset of Naturalistic Road User Trajectories at German Intersections", 2019