Detection and Analysis of Critical Interactions in Illegal U-turns at an Urban Intersection

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1. Contributions

- Detection of rare critical situations by a long-term analysis of naturalistic trajectory data

- A descriptive model of traffic behavior in U-turn scenarios

2. Dataset

- Recorded at AIM Research Intersection in Braunschweig, Germany

- DLR-internal dataset from 01-09/2019

- 4500+ hours (180+ days) of video recordings

- 9M+ trajectories of traffic participants

- 4000+ trajectories of illegal U-turns (see below)

- 15 VRU encounters triggered by absolute Post Encroachment Time (PET) < 2s

- 4 events were assessed as critical by watching the corresponding video recordings

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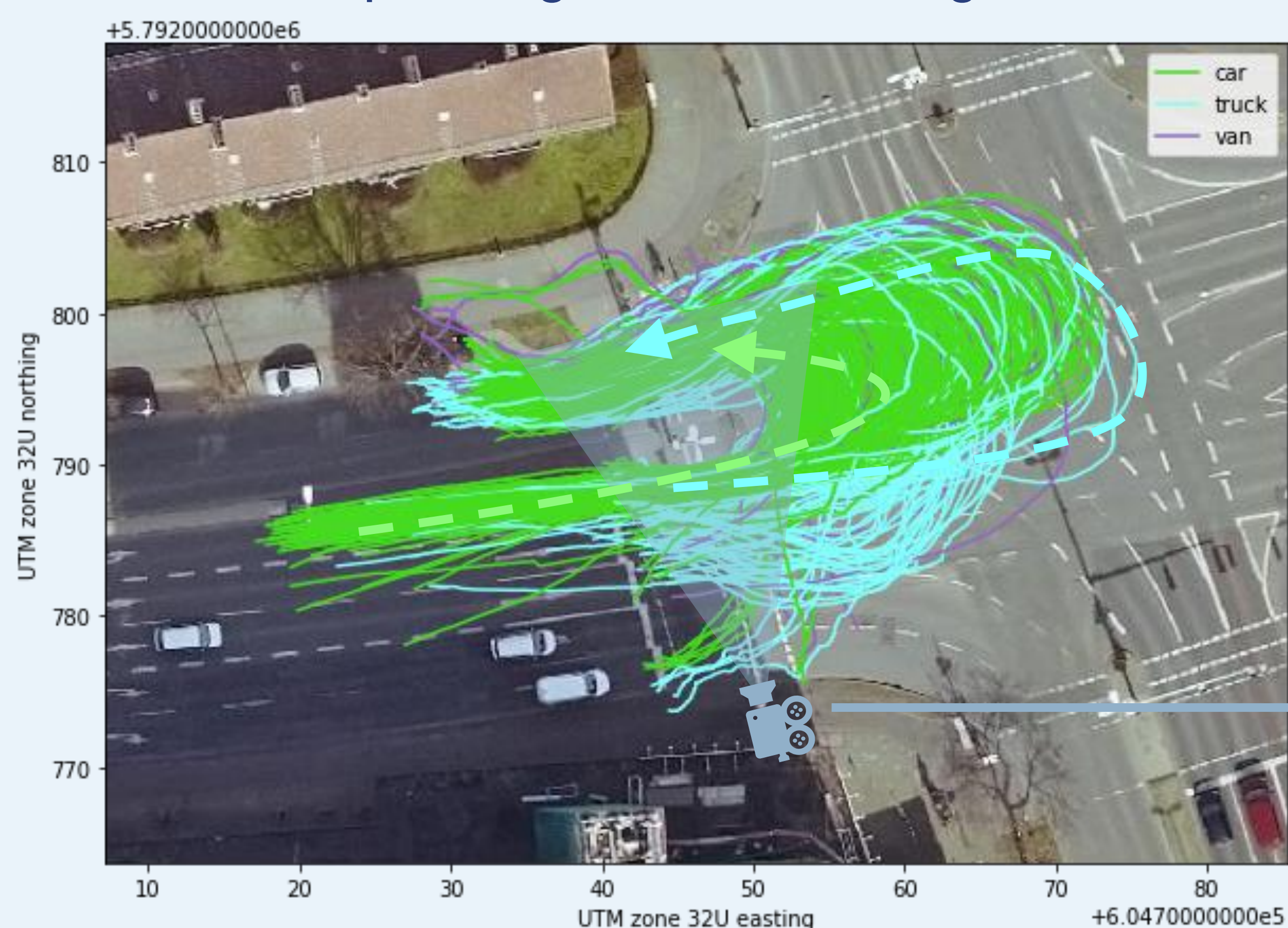
3. Results

- All triggered situations occur because the U-turning motorized road user has to leave the intersection waiting a long time for the oncoming traffic to pass.

- The vehicles of critical U-turns leave the intersection at a time, when the traffic light of the Vulnerable Road Users (VRU) switches from red to green.

- Whereas the mean duration of all U-turns is 22s, the mean duration of U-turns with VRU encounter is 29s.

- In 4 cases the U-turn vehicle has to break for at least 1s with more than 1 m/s^2 to give way for VRU.
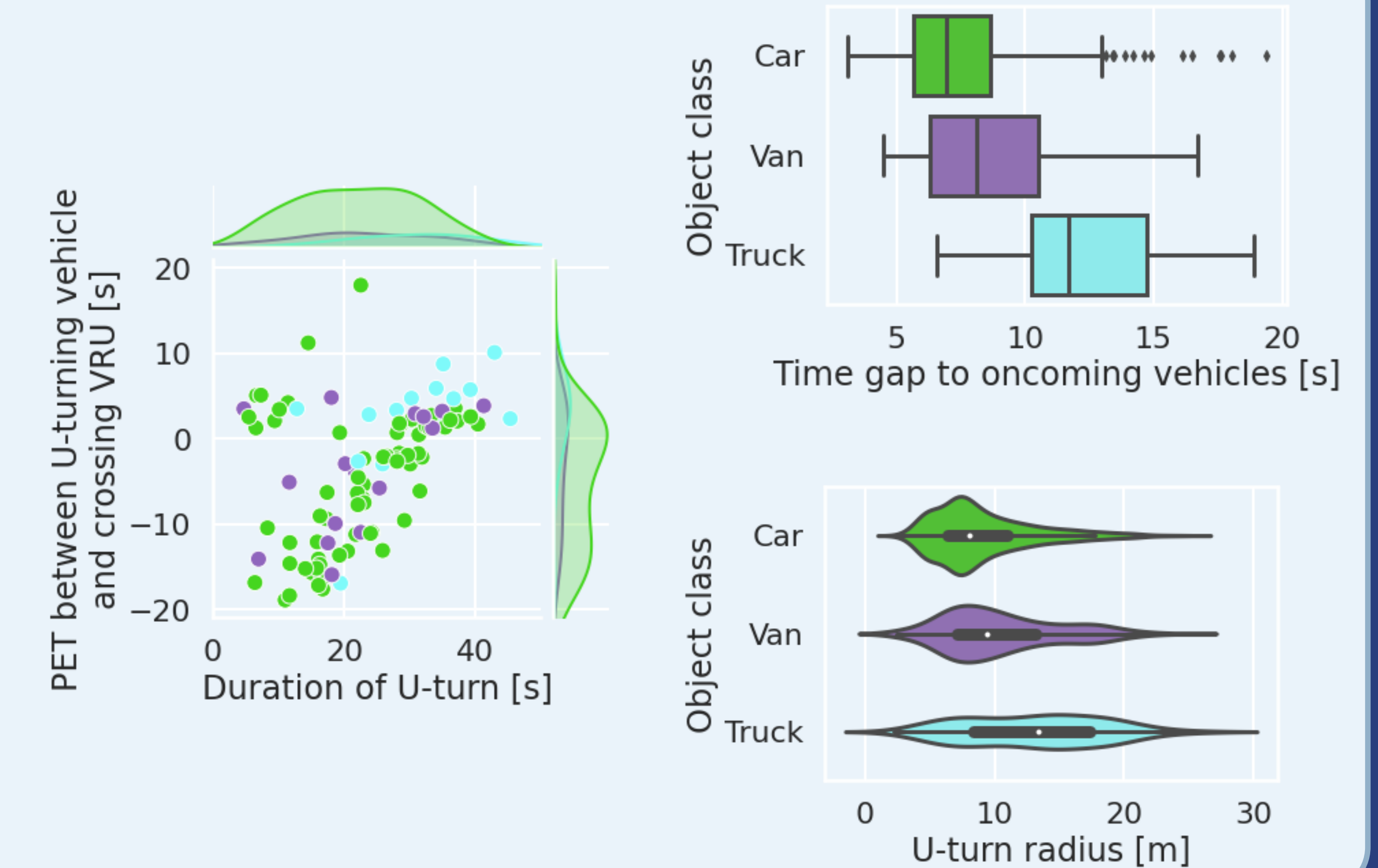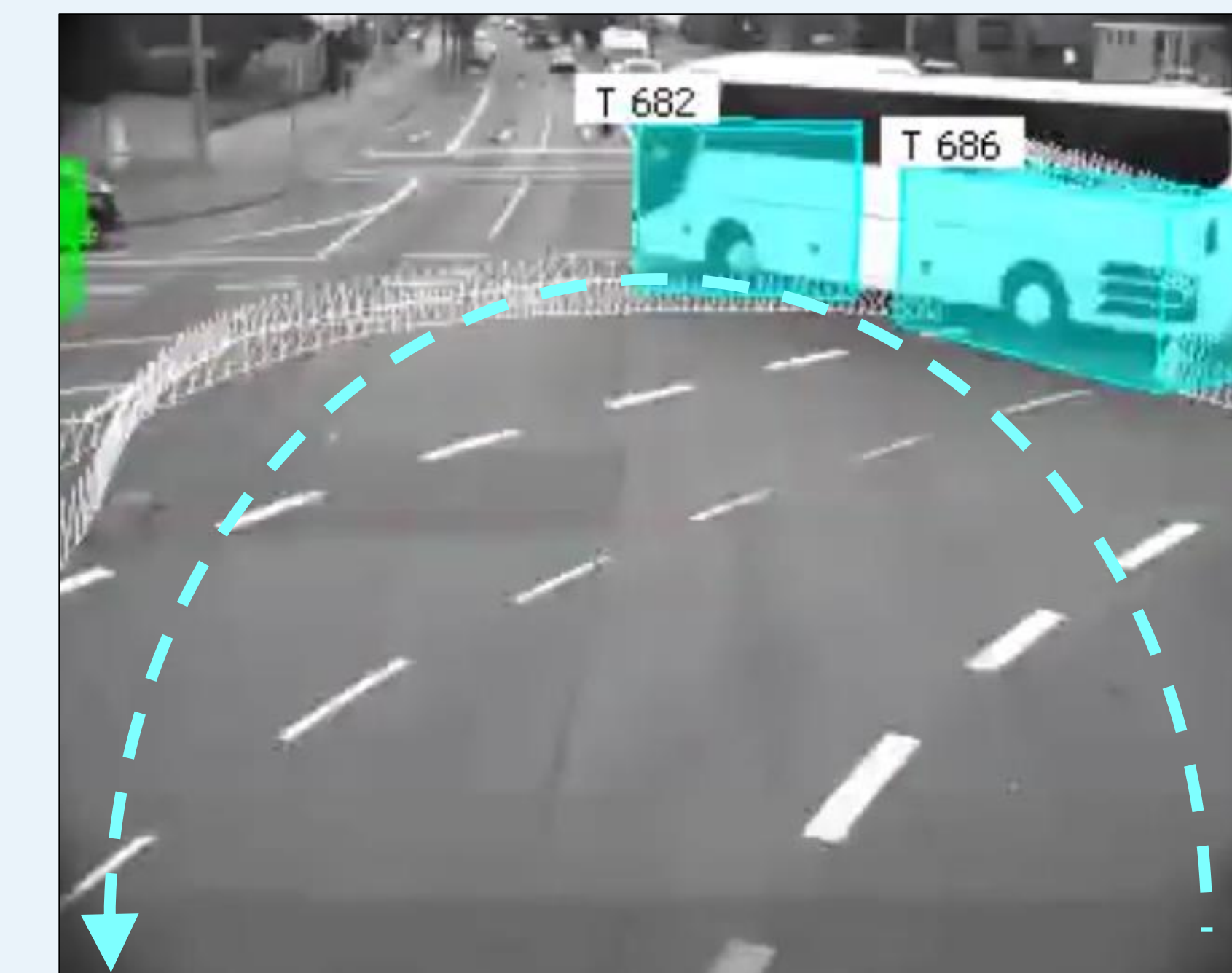

4. Screenshots of video recordings

Most critical interaction

- The PET between vehicle C108 and cyclist B521 is 0.44s.

- The vehicle has to brake with up to 3.2 m/s^2 to avoid a collision.

Atypical event

- The bus T682 has the maximum curve radius of 26.5 m and affects 4 other traffic participants.

5. Conclusion

Tailored preventive measures such as vehicle-to-infrastructure communication could reduce criticality in the shown U-turn situations because the vehicles would then be aware of the traffic light state.

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