Road safety assessments use two main categories of data to evaluate the safety of a given location: accident data and other safety related events and behaviors directly observed in traffic. Typically, results are summarized for the specific location: total number of accidents or other events per intersection or road link. This provides a general picture of the location's safety; however, these do not pinpoint specific maneuvers that have a higher risk of collision. It is however possible to study safety at the more microscopic level of road user movements at the site. Few maneuver-specific studies have been carried out. The safety of through cyclists and turning vehicles was specifically evaluated in (1, 2), which is a step towards understanding risks of specific maneuvers. Our study aims to go further and evaluate the relative safety of all cyclist movements based on their interactions with other vehicles using surrogate measures of safety. To achieve this, a trajectory clustering algorithm is adopted to combine similar trajectories into sets of distinct movements (motion patterns) for cyclists and vehicles.

The Time-to-Collision (TTC) is a surrogate measure of safety that relies on the concept of collision course, defined as a situation in which two or more road users approach each other to an extent that a collision is imminent if their movements remain unchanged. However, the assumption that vehicles will continue straight does not accurately represent real-world behavior where users perform slight steering or major maneuver changes such as turning. Furthermore, this traffic conflict definition is inapplicable in situations where the road user does not have the option to continue along a straight path, for example at a T-intersection. Instead, one can learn motion patterns from observed user trajectories and use them to predict the road user’s future positions and compute more realistic and robust TTC. Our study makes use of this Probabilistic Surrogate Measures of Safety framework to measure the safety of the cyclist-vehicle interactions.

Past studies show that at cycling network discontinuities (interruptions in the cycling network such as changes of cycling facility type, end of the cycling facility, change in location of cycling facility on road, etc.), cyclists perform a higher number of movements compared to similar sites without a discontinuity (3). This provides an ideal condition for movement-based safety evaluation. Video data is collected at two intersections with discontinuities, one with a change in cycling facility type and one with a change in cycling facility location on the road, as well as two control sites. Road user trajectories are extracted using the automated traffic intelligence tool on a sample of 2 hours for each location. After automated tracking and classification, the trajectories are further verified and classified manually for safety analysis. Using a clustering algorithm, similar trajectories are combined based on the longest common subsequence providing their percentage of similarity to obtain the main movements, or motion patterns.

Our results summarize the surrogate measures of safety for each movement and compare the safety across movements at the discontinuity site and with movements at the control site. Results are expected to show large safety variations among cyclist movements at the discontinuity locations compared to the control sites.

References
