

## 論文内容の要旨 Abstract of Dissertation

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While modern roundabout has been proven superior to signalized intersection in safety, delay, and capacity under homogeneous traffic, its merits in heterogeneous traffic are neither proven nor analyzed. Both unique characteristics and models to reproduce behaviors in simulation have not been discussed comprehensively, especially in the high proportion of motorcycle condition. In this background, the study aims to answer for the question that what are the unveiled characteristics of motorcycles at roundabout and how to reproduce them in simulation. In order to achieve the answer, the study has gone through the following procedures step by step.

Firstly, the literature review section determined the two constitutions of mixed traffic that are the performance rule and the appearance of small-sized vehicle. Ho Chi Minh city, Vietnam, satisfies both two conditions and has uniqueness that only one type of small-size as well as non-lane-based vehicle, motorcycle, also named as two-wheelers, and its dominance in traffic proportion. Thus, roundabouts in the city are selected as case studies. Moreover, this section also goes through the concepts and techniques related to model development, collective behavior, two-player game theory, agent-based modeling.

Secondly, the surveyed videos are recorded by UAV and the trajectory data is extracted by using semi-automated software. The accuracy of extracted data is examined with under 4.1% error. From extracted data, the macroscopic and microscopic characteristics of motorcycles are analyzed. Chapter 3 highlights three points, that are the exponential relationship between turning angle rate and speed, the small critical gap of motorcycle, 1.25 seconds, and the oval shape of following space.

Chapter 4 presents the model development in detail and its components. Based on the collective behavior and game theory, the motorcycle's interaction model is built at the microscopic level. The implementation of model in traffic simulator is detailed in chapter 5. The simulator is built based on the multi-agent programmable modeling environment, Netlogo. The parameters are calibrated with half of the collected data.

Chapter 6 validated the simulated result based on the remaining data. The innovative microscopic indicators are employed for validation. They are travel time, turning angle rate, delay, conflict rate, following space, and time-to-collision. The results show that the simulator could be considered as good in representing the traffic condition.

Finally, chapter 7 concluded the study's achievements, contributions, and limitations. Concerning research interest, the study proposed the novel motorcycle's interaction model at the individual level. The model potentially applies and expands in the future to improve the accuracy of the future microscopic simulations. In addition, the developed agent-based simulator also has practical contributions. It could be an useful tool for policy test as well as new geometric design test.