능동안전(인공지능)

자율주행을 위한 이미지 시멘틱 세그멘테이션 기반 차선 및 정지선 검출 알고리즘

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Image Semantic Segmentation Based Side-Lane and Stop-line Detection Algorithm for Autonomous Driving

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Key Words : Autonomous driving(자율주행), Deep learning(딥러닝), Semantic segmentation(시멘틱 세그멘테이션)

ABSTRACT

This paper presents an image semantic segmentation based real-time side-lane and stop-line detection algorithm to achieve high segmentation accuracy while maintaining rapid inference speed. In autonomous driving, the results of side-lane and stop-line perception play a crucial role for any subsequent tasks such as localization, decision, and motion planning. Conventional techniques rely on hand-crafted features and typically require post-processing, resulting in increased time complexity and reduction in scalability. In order to overcome these drawbacks, a deep neural network-based algorithm has been proposed to classify the side-lane and stop-line at pixel level from given RGB images. The network parameters are trained and evaluated via a public dataset. The proposed algorithm has been verified via Robot Operating System(ROS) datasets obtained from actual driving on urban roads. Evaluation results show that the proposed algorithm was able to achieve enhanced inference speed without deterioration in segmentation performance.

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자율주행 자동차의 인지 알고리즘 성능 평가를 위한 시뮬레이션 기반 시나리오 개발 및 검증

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Scenarios Development and Validation in Simulation for Perception Algorithm Evaluation of Autonomous Vehicle

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Key Words : Autonomous driving(자율주행), Vehicle simulation(차량 시뮬레이션), Evaluation scenarios(평가 시나리오)

ABSTRACT

This paper presents a method of constructing an environment and implementing scenarios for autonomous vehicle perception module evaluation in simulation. Evaluation in simulation is essential because it is possible to simulate risky situation and compare the result with the target's ground-truth state and it can easily be done in the same scenario multiple times. In order to validate realistic scenarios in simulation, CARLA, a simulator that provides a surrounding environment, a vehicle, a pedestrian, and a sensor model, was used. To connect the simulator and Robot Operating System (ROS) based algorithms, the bridging structure is developed. In addition, a test track and predefined scenarios are implemented for a replicate experiment. Then, the perception algorithm based on ROS is evaluated in simulation with proposed scenarios. This evaluation result shows that the environment is well equipped and that the simulator can successfully represent reality.

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딥러닝 기반 차선 인식 시스템의 악천후로 인한 센서 시야방해 조건에서의 성능 평가

전현재* · 김예온** · 김태수* · 손성호*** · 이정기*** · 최경호****,† · 임용섭*****,†

Evaluation of Performance of Deep Learning Based Lane Detection System Under Sensor Blockage Caused by Adverse Weather Condition

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Key Words : Blockage (센서 시야방해 물질), Lane detection system (차선 인식 시스템), Lane keeping scenario (차로 유지 시나리오), Deep learning (딥러닝)

ABSTRACT

Autonomous driving technology recently targets to level 4 or level 5, but the researches have been faced some limitations for developing reliable driving algorithms in diverse challenges. To promote the autonomous vehicles to spread widely, it is important to properly deal with the safety issues on this technology. Among various safety concerns, the sensor blockage problem by severe weather condition can be one of the most frequent threats for lane detection algorithms during autonomous driving. To handle this problem, the importance of the generation of proper dataset is being more significant. In this paper, a synthetic lane dataset with sensor blockage is suggested in the format of lane detection evaluation. Rain streaks for each frame were made by experimentally established equation. Using this dataset, the degradation of the diverse lane detection methods has been verified. The tendency of the performance degradation of deep neural network-based lane detection methods has been analyzed in depth. Considering the autonomous vehicle system will require additional computing time for handling the blockage problem in such conditions, we have tested UFLD and LaneATT models that have extremely short inference time using anchor-based detection methods. Finally, the limitation and the future directions of the network-based methods were presented.

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도심 정체 상황 차선 변경을 위한 도달 가능성 기반 차선 변경 가능성 판단 알고리즘

서다빈* · 이경수**

Reachability-based Lane Change Possibility Decision-Making for Autonomous Driving in Urban Congested Traffic

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Key Words : Autonomous driving vehicle(자율주행차), Reachability Analysis(도달 가능성 분석), Intention inference (의도추론), Recurrent neural network(순환신경망), Interactive lane change(상호작용을 고려한 차선 변경), Urban congested traffic(도심 정체 상황)

ABSTRACT

This paper proposes a reachability-based lane change decision algorithm for congestion situations. In a congested scenario, the interaction with surrounding vehicles is one of the most important issues. Also, the autonomous driving decision algorithm should be able to operate robustly against errors in localization, perception, prediction, and control. In this study, lane change possibility decision algorithm is proposed, which is consider 1) yield intention of other vehicle by considering interaction over time 2) localization, perception, prediction, control errors. To infer yield intention, the RNN-LSTM network was constructed in consideration of the longitudinal and lateral interactions with surrounding vehicles. The network was trained through human driving data acquired in the urban environments of Seoul. Additionally, we proposed interactive lane change problem formulation, which can consider localization, perception, prediction, control errors. In that formulation, we developed the reachability analysis algorithm suitable for the purpose of autonomous driving in the process of estimating the convex reachable set. The performance of the developed algorithm has been evaluated through open-loop simulation based on actual vehicle data and monte-carlo simulation

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CARLA를 통한 강수량에 따른 실시간 객체 검출 모델 YOLO의 정량적 성능 평가

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Quantitative Performance Evaluation of Object Detection Model YOLO in Precipitation Situations by CARLA

Taesoo Kim*, Hyeonjae Jeon**, Yongseob Lim***,†

Key Words : Object detector (실시간 객체 검출 모델), Virtual simulation dataset (가상환경 데이터셋), Bad weather condition (악천후 상황)

ABSTRACT

Autonomous driving has made a lot of progress and is currently set to develop into levels 4 and 5. As for autonomous driving development with those higher level, object detection, path-planning, and control should be perfectly completed. Accordingly, object detection is the most basic task in autonomous driving and thus should be prioritized for safe driving. Therefore, not only object detection in clear weather, but also vehicles and pedestrians should be accurately detected even in bad weather situations such as rain, snow, and fog. Many studies have been conducted about this problem, but no research has been conducted on the performance degradation of the object detection performance due to a specific amount of precipitation. Therefore, we constructed precipitation situation dataset from real world using the virtual environment CARLA and used that dataset to study how much the performance of the YOLO, real-time object detection model, degrades with precipitation.

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안전한 첨단 운전자 보조 시스템을 위한 제어장벽함수와 심층강화학습을 활용한 기법 연구

유윤하* · 도우키 올리드** · 이덕진***,†

Research of Safe ADAS using Deep Reinforcement Learning with Control Barrier Function

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Key Words : Adaptive cruise control(적응형 순방향 제어), Control barrier fucntion(제어 장벽 함수), Deep reinforcement learning(심층강화학습), ADAS(첨단 운전 보조 시스템), Safe-critical(안전-중요), Machine learning(기계학습), Safe control(안전 제어), Non linear environment(비선형환경)

ABSTRACT

Recently, there has been great interest in combining ADAS and artistic intelligence. Efforts to combine ADAS with Artificial Intelligence are mostly approached by model-based control. However, model-based control requires high computational power and engineered skilled parameter tuning, and there is a fatal flaw that does not guarantee performance in non-linear environments. To compensate for this, reinforcement learning-based control techniques have recently attracted a lot of attention in academia and have emerged as a strong replacement for model-based control. But still, reinforcement learning-based control techniques also have challenges in terms of safety. In this paper, we will propose a method to overcome the safety defects of reinforcement learning-based control techniques. We present Safe-Critical Reinforcement Learning, which combines a stable deep reinforcement learning-based speed controller with a control barrier function, and apply it to one of the ADAS, Adaptive Cruise Control scenarios to demonstrate its effectiveness.

Acknowledgement

본 논문은 2022년도 산업통상자원부 및 한국산업기술평가관리원(KEIT) 연구비 지원에 의한 연구임('20018904') 또한, 본 연구는 과학기술정보통신부의 재원으로 한국연구재단, 무인이동체원천기술개발사업단의 지원을 받아 수행되었음.(No. 2020M3C1C1A02084772)

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