자율주행차

실차 시험 기반 경로예측 알고리즘이 포함된 자율주행자동차 모델을 통한 고속도로 컷인 시나리오 시뮬레이션

박명연* · 정재일**

Highway Cut-In Scenario Simulation Using a Real-World Test-Based Autonomous Vehicle Model with Path Prediction Algorithm

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Key Words : Simulation(시뮬레이션), Hihighway(고속도로), Path Prediction algorithm(경로예측알고리즘), Autonomous vehicle(자율주행자동차), Vehicle test(차량 시험)

ABSTRACT

This paper introduces a methodology for examining highway cut-in scenarios, which involves the integration of real vehicle testing and the development of a simulation model. The study utilizes a custom-designed target robot to establish a controlled and repeatable real-world testing environment. Models are constructed based on real-world test results and are intentionally designed to assess scenarios in simulation that are challenging to replicate in real-world test conditions. The research begins with the utilization of the target robot to create a secure and reproducible real-world testing environment for highway cut-in scenarios. Subsequently, a test vehicle is selected, and tests are conducted to evaluate the functionality of Automatic Emergency Braking (AEB) and Forward Collision Warning (FCW) systems. Drawing upon the outcomes of these tests, algorithms for predicting vehicle movements are developed. These algorithms take into consideration various factors including the vehicle model, speed, and heading angles of surrounding vehicles. Additionally, an AEB system designed to prevent accidents is crafted based on gleaned from the test results. The developed simulation model is subsequently utilized to analyze the safety of the test vehicle under challenging cut-in scenario situations. The analysis of simulation results provides into the safety performance of the vehicle.

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협력적 인식을 통한 안개 날씨의 자율주행차 안전성에 대한 영향 조사

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Investigating the Impact of Foggy Weather on Autonomous Vehicles Safety with Collaborative Perception

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Key Words : Adverse Weather(악천후), Collaborative Perception(협력적 인식), V2X(차량사물통신), Autonomous Vehicles(자율주행차),

ABSTRACT

Perception systems equipped with RGB sensors are crucial in enabling safe and accurate navigation for autonomous vehicles. These sensors are affordable and offer high resolution compared to other sensor types. However, the accuracy of RGB sensors can be significantly compromised in adverse weather conditions, such as fog. While previous studies have examined the impact of foggy weather on RGB sensors on single vehicles, there needs to be more research on the effects of foggy weather on collaborative perception using V2X (Vehicle-to-Everything) communication. By fusing sensor data from multiple vehicles, it is possible to overcome the limitations of individual sensors and enhance overall perception capabilities.

Existing research on collaborative perception primarily focuses on fusing perception data from multiple agents, with limited emphasis on the challenges of foggy weather when using RGB cameras. The OpenCOOD framework and its OPV2V RGB camera dataset provide consistent weather conditions for each frame and, therefore, lacks any scenario with fog.

In our work, we introduce foggy weather conditions into the OPV2V dataset by generating RGB camera data for each frame. We then train a BEV (Bird's Eye View) perception model to detect lane markings and drivable areas under different foggy scenarios. Our approach involves training multiple experiments with varying percentages of foggy and non-foggy data. The fusion model employed is our deep late fusion model. We evaluate the performance of the different models in different experiments and with different percentage of foggy data in the dataset.

Our findings demonstrate that, by comparing collaborative perception against single perception models for each scenario, our fusion method improves its accuracy in good weather and, more importantly, under the foggy scenarios under every scenario.

In conclusion, our study highlights the potential of collaborative perception to enhance the accuracy of RGB sensors in foggy weather conditions, thereby improving overall safety.

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차량 주행 경로를 고려한 LTAP/OD 충돌 시 승객 상해 분석

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Simulation of Occupant Injuries in LTAP/OD Crashes Considering Vehicle Driving Paths

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Key Words : Automated driving path(자율 주행 경로), LTAP/OD(좌회전 대 맞은편 직진), Crash simulation(충돌 시뮬레이션)

ABSTRACT

In this study, we evaluate the injury severity in left turn across path/opposite direction (LTAP/OD) crashes at intersections, focusing on the left-turn path of automated driving vehicles. Utilizing conventional vehicle accident databases and the US National Highway Traffic Safety Administration's datum, we calculate crash speeds for straight-through vehicles. Pre-crash speeds during left turns of automated driving vehicles are calculated using the nuScenes open dataset. Crash angles and crash points are calculated based on the driving path. By applying these boundary conditions with possible car-to-car crashes, crash simulations are performed. Based on crash analysis results, the severity of injuries to occupants are compared and specific crash conditions with a high risk of injury are analyzed.

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자율주행 차량을 위한 HD-Map 적용 딥러닝 기반 실시간 신호등 탐지 및 추적 알고리즘

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HD-Map Applied Deep Learning Based Real-Time Traffic Light Detection and Tracking Algorithm for Autonomous Vehicles

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Key Words : Autonomous Driving(자율주행), Traffic Light Detection(신호등 탐지), Traffic Light Tracking(신호등 추적), High Definition Map(고정밀지도)

ABSTRACT

This paper presents an advanced real-time traffic light detection and tracking algorithm tailored for autonomous vehicles, leveraging the capabilities of You Only Look Once version 8 (YOLOv8) and Bag of tricks for Simple Online and Realtime Tracking (BoT-SORT). Recognizing traffic lights accurately is paramount for the safe navigation of autonomous vehicles, especially in intricate urban settings. The contemporary challenges lie in the precise detection of traffic lights, which are often small objects, and in real-time tracking. To address these challenges, we employed the YOLOv8 model to detect both vehicle and pedestrian traffic lights across eight distinct classes, achieving a mean average precision (mAP) of 74%. For real-time tracking, the BoT-SORT algorithm was utilized. To further enhance real-time performance, the model was optimized using Tensor Real-Time (TensorRT), resulting in significant improvements in frames per second (fps). The algorithm was integrated into the Robot Operating System (ROS), making it readily deployable in autonomous vehicles. A novel approach was introduced by projecting 3D coordinates from High Definition (HD) Maps onto a 2D image plane using Global Positioning System (GPS) data. This projection was matched with detected bounding boxes, effectively eliminating false positives. By employing this method, we were able to utilize a relatively lower confidence threshold, thereby extending the detection range. In essence, this research offers a robust traffic light detection algorithm, especially in areas where vehicle-to-everything (v2x) communication is not feasible. The proposed methodology not only addresses the challenges of small object detection but also ensures real-time performance, making it a pivotal contribution to the realm of autonomous driving.

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자율주행 차량에서의 다중 센서 추론을 위한 인공지능 시스템

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Hetero Sensor Fusion Inference for Autonomous Vehicle

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Key Words : Realtime system(실시간 시스템) Multimodal model(멀티모달 모델) Distributed computing(분산 처리)

ABSTRACT

This paper presents the HSFI (Hetero Sensor Fusion Inference) system, designed to enhance autonomous vehicle performance by providing real-time fusion and inference of heterogeneous sensor data. Employing a 10 Gigabit Ethernet (10GbE) connection and a time-filtered synchronous algorithm, HSFI ensures efficient and reliable tensor byte communication. The system is highly portable and compatible with key deep learning frameworks like PyTorch. Through rigorous testing and ablation studies, HSFI demonstrates significant improvements in Planner Rate and Runtime while reducing system load and computation time. Despite the overhead of tensor transmission over the 10GbE network, the system's overall efficiency is remarkable. In summary, HSFI represents a promising leap in autonomous vehicle technology, facilitating more dependable real-time sensor fusion and inference systems.

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자율주행자동차 데이터 기록장치의 기록 조건 및 항목에 대한 방향성 연구

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A Study on the Direction of Data Triggers and Elements for Automated Vehicle Data Recorder

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Key Words : EDR(사고기록장치), DSSAD(자율주행정보 기록장치), Automated Vehicle(자율주행자동차), Data Elements (기록항목), Data Triggering Condition(기록조건), Data Recorder(기록장치)

ABSTRACT

This study presents the direction of data triggers and elements to be recorded in automated vehicles in the future in relation to the event data recorder(EDR) and data storage system for automated driving(DSSAD). It does not distinguish between the EDR and DSSAD, but suggests data triggers and elements in preparation for overall automated vehicle accidents and dangerous situations. To propose, the current status of discussions on EDR/DSSAD internationally and the case of investigating accidents with automated vehicles under temporary driving licenses in Korea were analyzed. Based on the analysis, the direction of data triggers and elements of the EDR/DSSAD of automated vehicles were presented.