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# 자율주행 및 3차원 지도



# 자율주행 차량을 위한 딥러닝 기반 실시간 신호등 탐지 알고리즘

송혜령\* · 이경수\*\*.<sup>†</sup>

## Deep Learning Based Real-Time Traffic Light Detection Algorithm for Autonomous Driving

Hyeryeong Song\*, Kyongsu Yi\*\*.<sup>†</sup>

**Key Words** : Autonomous driving(자율주행), Traffic light recognition(신호등 인지), Small object detection(소형 객체 인식), Feature pyramid network (피쳐 피라미드 네트워크)

### ABSTRACT

This paper presents a real-time traffic light detection algorithm for autonomous vehicles based on deep learning. Traffic light detection is essential function for safe driving of autonomous vehicles in urban environments. The need for our research arises from the limitations of state-of-the-art object detection algorithms in accurately detecting small objects like traffic lights. Previous approaches to address this issue have focused on improving the underlying detection algorithms. However, these methods still struggle with small object detection, necessitating further improvements. In this study, we propose an enhanced YOLOv5 model with a modified neck architecture incorporating the Bi-directional Feature Pyramid Network (BiFPN). This modification aims to improve small object detection while maintaining real-time processing capabilities. We trained and evaluated our proposed method on a public dataset containing various traffic light scenarios. Using the AI Hub public dataset and comparing our proposed algorithm to the YOLOv5 baseline, we demonstrated a 1.5% increase in mAP. This indicates significant improvements in small object detection accuracy and overall performance compared to other object detection models. In conclusion, this study contributes to the development of more reliable traffic light detection systems for autonomous vehicles by proposing an enhanced YOLOv5 model with BiFPN integration. Our approach offers a practical solution to the small object detection problem, particularly in the context of traffic light detection.

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## 자율주행차 측면충돌평가방안 마련을 위한 교차로 사고 심층분석 연구

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### An In-Depth Analysis of Car Accidents in Urban Intersection for Side Impact Tests of Automated Driving Vehicles

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**Key Words :** In-depth analysis(심층분석), Side impact test(측면충돌평가), Automated driving vehicle(자율주행차)

#### ABSTRACT

The postures of passengers, including drivers, in self-driving cars will be diversified from the current car seat type that only looks forward. Even if self-driving cars significantly reduce accidents, they should be able to maintain the current level of crash safety. The purpose of this study is to propose a side collision evaluation scenario for autonomous vehicles based on the types of side collision accidents that commonly occur at intersections. From 320,000 accidents of insurance companies in the last 5 years, 150 side collision accidents in urban intersections were derived by filtering (accident video, images, AIS 2+, accident type, etc.). As a result, side impacts occurred on the driver's side in 45 cases (30%) and the passenger side in 105 cases (70%). In addition, the main accident types of passenger-side collisions were 1) side collisions between vehicles going straight ahead and 2) accidents between vehicles going straight and turning left. As a result of this study, we propose two types of crash test conditions in which a collision occurs at right angles and oblique angles to the passenger-side of a vehicle.

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## 자율주행차 FOT 데이터의 융합 인터페이스 구성을 통한 시뮬레이션 연계 방법에 관한 연구

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### A study on the Simulation Connection Method Through Convergence Interface Configuration of Autonomous Vehicle FOT Data

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**Key Words** : Multi-agent simulation(멀티에이전트 시뮬레이션), Convergence interface(융복합 인터페이스), Interface connection(인터페이스 연계), FOT data(실도로 시험 데이터), Autonomous(자율주행)

#### ABSTRACT

For the commercialization of autonomous vehicles, verification of autonomous driving services is considered important. To this end, there has been a lot of research on simulation-based verification methods for autonomous driving services, and to develop a simulation for verification of edge-connected autonomous driving services in urban areas based on multi-agent technology, it is important to have the technology to integrate Field Operation Test (FOT) data of autonomous vehicles into the simulation. In this paper, we introduce research on simulation integration methods through the configuration of a converged interface for FOT data of autonomous vehicles.

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## 자율주행차의 실도로 주행평가를 위한 시나리오 구성 방법에 관한 연구

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### A Study on the Scenario Composition Method for Real Road Evaluation of Autonomous Vehicles

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**Key Words** : Autonomous vehicle(자율주행자동차), Field operational test(실도로 실증), Test Scenario(평가시나리오)

#### ABSTRACT

At a time when the transition to a future mobility society is accelerating thanks to the development of autonomous driving technology, various demonstration projects are underway to verify autonomous driving technology in the real road environment, and the composition of driving safety scenarios for autonomous driving technology evaluation plays a very important role.

In this study, a study was conducted on how to organize safety situations that may occur in the real road environment into autonomous driving scenarios. In order to produce a driving safety scenario, basic factors such as the type of road user, movement type, and road type constituting the scenario should be defined, and road characteristics of the demonstration area were evaluated for this purpose. In addition, since the demonstration area is a general vehicle operation area, it was produced by applying it as a major situation when constructing a scenario through an analysis of the type of accident that occurred before.

Through this study, the definition of basic components for the production of autonomous driving scenarios and autonomous driving scenarios using them were produced. The manufactured driving scenario will be verified by implementing a simulation environment.

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## 오픈소스 기반 접근성이 높은 자율주행 시뮬레이션 실증 3D 맵 제작 연구

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### A Study on the 3D Map Making for Self-Driving Simulation with High Accessibility Based on Open Source

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Lennart Lorenz Freimuth Jahn\*, Yongseob Lim\*\*\*, Jinung An\*\*\*, Gyeungho Choi\*\*\*

**Key Words** : Self-driving vehicle(자율주행차), 3D map(3차원 지도), Unreal engine(언리얼 엔진), Openstreetmap(오픈 스트리트 맵), Virtual simulation(가상 시뮬레이션)

#### ABSTRACT

With the increasing demand for self-driving vehicles, the need for high-quality 3D maps has grown, as they provide a way to simulate driving conditions and test autonomous vehicle systems. However, creating such maps can be challenging and costly, especially when using proprietary tools and data sources. This thesis presents a study on the development of a 3D map-making method for self-driving simulations that is accessible and based on open-source technology. The goal of the study is to propose a method that enables researchers and developers to quickly create and modify 3D maps for use in self-driving simulations. The study involves the implementation of an open-source toolchain that includes the Unreal engine and the OSM(OpenStreetMap) data source. The toolchain is designed to facilitate the creation of high-quality, realistic 3D maps that can be used in self-driving simulations. It is also designed to be accessible to a wide range of users, including those with limited technical knowledge. To test the effectiveness of the toolchain, simulations are implemented in the 3D map, which includes elevation data. The results of the simulation show the usefulness of the 3D map for self-driving simulations. Overall, the study demonstrates the potential of open-source technology to facilitate the development of 3D maps for self-driving simulations. The study also highlights the importance of accessibility in the development of tools for the self-driving industry, as well as the need for continued research and development in this field.

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## K-City 연계 자율주행차 3단계 실증을 위한 가상 시뮬레이션 환경 구축 방안 연구

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### A Study on Virtual Simulation Environment for the 3-Step Demonstration Plan of Autonomous Vehicles Based on K-City

Hangeom Ko\*, Inseong Choi\*\*, Jungki Lee\*\*\*, Jiwon Jung\*\*\*\*, Jonghwa Kim\*\*\*\*\*

**Key Words** : K-City(자율주행 실험도시), Automated vehicle(자율주행차), Virtual testing environment(가상 시험환경)

#### ABSTRACT

When it comes to developing advanced Connected & Automated Vehicle(hereinafte, CAV) technology, various tests and validation becomes such essential stage. In particular, the validation and evaluation process of the CAV algorithms under scenarios generated from the real-world traffic data are one of the most crucial stages, and yet, one of the most time-consuming and cost-intensive stage. The <Autonomous Driving Technology Development Innovation Project>consists of a total of 5 strategic fields, 30 key fields and 88 detailed projects. One of the key fields, “Level 4 Autonomous Driving Integration Demonstration Technology”, are currently looking for 3-stage demonstration of ‘Virtual Testing Environment-Test Bed-Living Lab’. In this way, we can support the CAV Lv.4 Integration Demo projects and expand it to an CAV assessment facility evaluating CAV technology and service safety.

It is the time for Korea to continuously put utmost effort into building CAV testing environment to an advanced and sophisticated level based on such reference of M-City 2.0, an CAV test track in world’s first M-City in Michigan, U.S.A. Accordingly, KATRI(Korea Automobile Testing and Researching Institute) and MORAI are in close contact for such cooperative research based on M-City and M-City 2.0 plans. Specific data, including NDE data, sensor data with weather condition change, and object perception data, will be provided by Mobility Data Center for our further research.

Testing CAVs on actual roads requires a significant amount of costs. Comparatively, expenses can be greatly reduced by testing using simulation systems. What’s more, thousands of data can be generated and collected by test automation. In this way, simulation not only allows accurate evaluation on the performance of CAV vehicles but also provide a solution to sort out any possible issues and to make a continuous improvement. Lastly, since several tests can be configured and conducted under the same, equal conditions, each tests will have consistent results facilitating to draw a certain conclusion in an optimal condition.

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## 창작 모빌리티 경진대회 참가용 자율주행자동차 개발에 관한 연구

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### A Study on Development of Autonomous Vehicle for Competition

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**Key Words** : Autonomous vehicle(자율주행자동차), Self-manufacturing(자작형), Autonomous system design(자율주행 시스템설계), Autonomous system manufacturing(자율주행시스템제작), Competition(경진대회),

#### ABSTRACT

In this paper, an autonomous vehicle was developed to participate in the new section of 2023 Student Creative Mobility Competition. Hardware to autonomous driving control was designed, these systems were applied to a self-manufacturing electric vehicle, LIDAR, GPS, and camera were used for environmental recognition. An autonomous driving algorithm was developed by configuring an upper controller and a lower controller for longitudinal and lateral control. Developed autonomous vehicle was capable of straight-ahead acceleration, braking, and steering, which are part of the competition, and the details of the development will be disclosed and educated for participating teams.

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