

# 포스터 발표



## ESR 레이더와 Mobileye 카메라의 센서 데이터 취득 시스템 구축에 관한 연구

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### A Study on the Acquisition System Reconstruction of the ESR RADAR & Mobileye CAMERA's Sensor Data

Yu-Rim Kwak\*, Seon-Hee Hwang\*\*, Jong-Hyuk Kim\*\*\*, Ji-Hun Choi\*\*\*\*, Woo-Jung Jeon\*\*\*\*

**Key Words :** CANcommunication(CAN통신), ADAS(첨단운전자보조시스템), Mobileye CAMERA(모빌아이 카메라), ESR RADAR(ESR 레이더), KVASER(CAN 통신 인터페이스 장치)

#### ABSTRACT

Various automakers release vehicles equipped with Advanced Driver Assistance System (ADAS) which use high-tech sensors and control systems to prevent or reduce accidents and help drivers to stay safe. There are radar, camera, lidar, ultrasonic and more sensors as ADAS sensors. they recognize the forward objects of the vehicles and operate FCW, AEB, and ACC functions which are the main functions of ADAS. In the future, it is necessary to understand the characteristics of ADAS sensors in case of traffic accidents of ADAS vehicles. In this study, Delphi ESR 2.5 RADAR ((hereinafter ESR) and Mobileye 6 ELD CAMERA (hereinafter Mobileye) were used to create an environment where sensor data are obtained and analyzed. ESR can output data about such as the relative distance and the azimuth angle to the target, while Mobileye can output data about spatial coordinates (X, Y) to the target via CAN(Controller Area Networks) communication. Using KVASER, a decoding algorithm was built in the MATLAB/Simulink environment to obtain location information of the targets in real time. The actual vehicle experiment was conducted on a general-purpose road in KIAPI (Intelligent Automotive Parts Promotion Agency) located in Daegu, mounting ESR and Mobileye on the experimental vehicle “Ioniq 5”, the spatial coordinate data were measured using Global Vehicle Target (GVT) as a static target. As a result, we found that spatial coordinate data from ESR and Mobileye appear very similar to each other, furthermore, we will analyze the maximum measurement distance and the error rate of each sensor in the future.

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## LKAS&AEB장착차량에 대한 교통사고 유형 분류 및 분석

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### Study on Classification of Traffic Accidents Types and Analysis about LKAS&AEB Equipped Vehicles

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**Key Words :** ADAS(첨단 운전자 지원 시스템), AEB(자동 긴급 제동), LKAS(차선 유지 지원 시스템), DB(데이터베이스),  
Traffic accident(교통사고)

#### ABSTRACT

ADAS(Advanced Driver Assistance Systems) is a system that provides convenience to drivers and helps prevent accidents in unexpected risk situations. This study aim to classify the traffic accidents focusing on LKAS(Lane Keeping Assist System) & AEB(Autonomous Emergency Braking).

This study investigates 63 ADAS-related traffic accidents in internet media, and analyzes traffic accidents types based on IGLAD(Initiative for the Global Harmonization of Accident Data)'s DB system.

Traffic accident types are classified into 33 variables, such as accidents type, road type, main contributing factor, etc. In common, both LKAS and AEB have many accidents while going straight on a single road, but LKAS accounts for 85% of Standalone traffic accidents and AEB accounts for 95% of Car-to-Car traffic accidents. In this way, this study classifies traffic accidents of LKAS and AEB using 33 variables and extracts the representative types.

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## 자율주행차의 센서 이상 탐지를 위한 이중 인지부 설계

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### Heterogeneous Recognition Unit Design for Detecting Sensor Abnormalities in Autonomous Vehicles

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**Key Words :** Autonomous driving(자율주행), Obstacle detection(장애물인식)

#### ABSTRACT

For the commercialization of autonomous vehicles, methods to prepare for failure of the autonomous driving system are required for safety. Many electronic devices that make up the autonomous driving system are capable of detecting and compensating for failures by self-diagnosis and redundancy. Means can be applied, but it is difficult to apply the same method to sensors having a small size and a limited optimal location to be installed. An abnormality in the sensor provides incorrect driving environment information to the autonomous driving system, which is an error that has a very high probability of causing an accident. In this paper, we describe a method to detect and deal with sensor anomalies using a dual recognition module to reduce errors caused by sensor abnormalities.

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## 도시 자율주행을 위한 비선형 계획법 기반 목표 경로 최적화 알고리즘

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### Nonlinear Programming based Reference Path Optimization Algorithm for Urban Autonomous Driving

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**Key Words :** Autonomous driving(자율 주행), Path planning(경로 계획), Optimization(최적화), Nonlinear programming(비선형 계획법)

#### ABSTRACT

This paper describes a nonlinear programming (NLP) based reference path optimization algorithm for autonomous vehicles in urban environments. The primary objective of an autonomous driving vehicle is to track the desired path and avoid collision with the surrounding traffic agents. The reference path for path tracking task is given as a set of points from map information or local perception sensors, expressed in either global or local coordinate system. Due to the uncertainties and noise of the waypoint measurement data, the path information may have degraded path quality resulting in discontinuous position, heading and curvature profiles. Approaches to enhance waypoint quality include path smoothing based on low pass filter or polynomial function regression. Although these methods can effectively reject noisy profiles, the feasibility of the processed path is not guaranteed. In order to overcome this limitation, a path optimization algorithm based on nonlinear programming is proposed. The curvature and change in curvature of the given set of waypoints are minimized while the constraints considering feasible curvature, curvature derivative and waypoint deviation are imposed. The continuity of the processed path profile and low computation time demonstrates that the proposed algorithm can be applied to actual autonomous vehicle system in real time.

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## 보행자 AEB 시뮬레이션 데이터 분석 툴 개발

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### Development of Data Analysis Tool for AEB Simulation of Pedestrian Target

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**Key Words :** ADAS(첨단운전자지원시스템), AEB(긴급제동장치), Pedestrian(보행자), Traffic accident(교통사고), Data analysis tool(데이터 분석 툴), Euro NCAP AEB VRU Test, PreScan(ADAS 시뮬레이션 프로그램)

#### ABSTRACT

The number of pedestrian traffic accidents in 2021 was 35,665, and the number of deaths and injuries were 1,018 and 36,001, respectively. Casualties caused by traffic accidents are constantly occurring, and to prevent such accidents, each automobile manufacturer is actively researching ADAS (Advanced Driver Assistance Systems). AEB (Autonomous Emergency System), a representative function of ADAS related to pedestrian accidents, is a system that recognizes and judges the situation on its own and makes emergency braking even if the driver does not step on the braking device in case of a collision. In this study, we developed a simulation data analysis tool for the AEB function of pedestrian targets for using it on the accident analysis. To understand the AEB operation characteristics of the actual vehicle, the equipment certified by Euro-NCAP was installed on the IONIQ 5 selected as a VUT (Vehicle under test), and the experiment was conducted. Through experiments, the results of TTC (Time to Collision), stopping distance, collision status, collision speed for FCW, AEB partial braking, full braking according to speed were obtained. The AEB operation algorithm for pedestrian targets was developed by using the scenarios of MATLAB/Simulink environment provided by PreScan in Siemens. The data obtained from the actual vehicle experiment was applied to the AEB operation algorithm, and the AEB simulation data analysis tool based on GUI (Graphic User Interface) was developed using MATLAB's APP Designer. Accordingly, it is possible to analyze and compare results such as TTC, final stopping distance, and collision avoidance for FCW, partial and complete braking between the actual vehicle and simulation through the data analysis tool. As a result of the simulation by applying the AEB operation characteristics of the IONIQ 5 vehicle, it was found to be very similar to the experimental data, and it was confirmed that the simulation data analysis tool can be usefully used to understand the AEB operation algorithm. Based on this study, we plan to improve the system so that data analysis tools can be utilized for AEB operation sequences of various vehicles in the future.

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## 튜닝 브레이크 시스템 비교 평가를 위한 평가항목 선정

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### Selection of Evaluation Items for Comparative Evaluation of Tuning Brake Systems

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**Key Words :** Tuning(튜닝), Evaluation Item(평가항목), Brake System(브레이크 시스템), Performance Comparison(평가기준)

#### ABSTRACT

Recently, the automobile tuning industry has been improved due to the efforts of the government and local governments, but the tuning market is still weak compared to the finished vehicle market. One of the reasons for this is low consumer confidence in the performance of tuning products. The purpose of this study is to select evaluation items that can compare tuning brake systems so that general consumers without professional knowledge can easily compare tuning products. The evaluation items of the selected tuning brake system are 5 items in total: braking performance, braking noise, durability, light weight and economic feasibility. Each item is evaluated on a total scale of 5 points. Low dynamic performance is one of the most important performance indicators of a brake system and evaluates the braking force of the brake. Braking noise is an item that evaluates the noise level generated during braking and is a major indicator of riding comfort. Durability is closely related to safety. Economical and lightweight items are items that can increase the choices of general consumers. Braking performance and braking noise were evaluated by referring to the SAE J2521 and SAE J866 standards of the Society of Automotive Engineers. For durability, refer to the JASO C406 standard of the Japanese Automotive Standards Organization. The economic feasibility was made based on the consumers of all products that have received tuning parts certification. Light weight reduction is evaluated through a relative comparison with OE products of existing finished vehicles.

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## 합리적 소비 관점에서의 기존 휠 시험법들을 활용한 비교 평가 방안에 관한 연구

민윤상\* · 이태희\*\* · 심경석\*\* · 이원종\*\*\* · 장원기\*\*\*\*

## A Study on the Comparative Evaluation Method Using Existing Wheel Test Methods from a Rational Consumption Perspective

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**Key Words :** Wheel(휠), Rational consumption(합리적 소비), Test(시험), Comparative evaluation(비교평가)

### ABSTRACT

The wheel is an important part and must have high durability and safety because supports the weight of the car body and transmits driving force. Therefore, since 2018, self-certification of part (KC certification) has been required for Vehicle wheels with less than 3.5 tons distributed in Korea. For self-certification of parts, wheels of the same design must also be certified if the specifications (P.C.D, number of holes, and offset) of the wheels are different. However, there are currently about 246 registered overseas aftermarket wheels, and the registration rate is very low compared to the actual type of wheels distributed. Therefore, unauthorized products are expected to be distributed in the actual distribution market, but most consumers purchase only with size information when purchasing wheels. If the wheel is selected only with the size information, damage to the wheel may occur during driving when the allowable load value of the wheel is lower than the weight of the vehicle, leading to a vehicle accident. in this paper, intends to present test methods and standards so that consumers can directly compare and evaluate the five criteria: self-certification of part, durability, performance, weight, and price

### 후 기

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## 광대역 소음 모사 모델을 활용한 OSRVM 소음원 예측 연구

박민균\* · 김윤제\*\*

### Prediction of OSRVM Noise Source Using Broadband Noise Simulation Model

MinGyun Park\*, Youn-Jea Kim\*\*

**Key Words** : Outside Rear View Mirror(사이드미러), Aeroacoustics(공력소음), CFD(전산유체역학)

#### ABSTRACT

The engine noise from the internal combustion engine vehicle (ICV) is loud enough to mask the noise from other parts. The masking effect means that if two or more sounds are present at the same time, no other sounds are heard by the loudest sound. To reduce the noise generated by the engine, a method of attaching sound absorbing materials to the hoods surrounding the engine was used. The engine is the largest source of noise in ICV. Recently, the proportion of electric vehicles is gradually increasing. In other words, the engine will soon disappear. With the disappearance of engines and the approaching age of motorized electric vehicles, the importance of noise reduction is increasing. One of the loudest noises is the sound of wind around the Outside Rear View Mirror (OSRVM). Wind noises are caused by pressure fluctuations in the unstable flow field. The noise simulation was based on a change in driving speed. In this study, aeroacoustics was predicted based on numerical analysis results. In addition, the pressure value and the Sound Pressure Level (SPL) representing aeroacoustics were compared and analyzed. Based on the results, the noise source was predicted.

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## 자율주행 차량의 비신호 횡단보도 통과 주행을 위한 종방향 거동 전략 연구

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### Longitudinal Motion Planning Strategy of Passing Non-signalized Crosswalk for Autonomous Vehicles

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Kyongsu Yi\*\*,†

**Key Words :** Longitudinal Motion Planning(종방향 거동계획), Autonomous Vehicle(자율주행 자동차), Non-signalized Crosswalk(비신호 횡단보도), Pedestrian(보행자)

#### ABSTRACT

This paper presents a method of longitudinal motion planning of autonomous vehicles to deal with the non-signalized crosswalk environment. Based on the traffic laws in South Korea, vehicles should slow down when passing the non-signalized crosswalk to prepare for situations where a nearby pedestrian starts to cross. If a pedestrian intends to cross or is in the crossing phase, vehicles should stop in front of the stop line and wait until the pedestrian finishes the crossing maneuver. To realize these behaviors in autonomous vehicles, the stop position and stop flag are determined when vehicles encounter the crosswalk. The duration time of the stop flag activation is determined according to the behavioral status of the nearby pedestrian. Longitudinal motion for the stopping or passing maneuver is planned according to the determined stop position and stop flag. The proposed algorithm has been validated via autonomous driving tests with our test vehicle in the real world. The test results show that the proposed algorithm enables the test vehicle to abide the traffic laws and behave safely against crossing pedestrians in the non-signalized crosswalk.

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## 차량 기반 REESS 내화시험 기법에 관한 연구

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### A Study on Vehicle-based REESS Fire Resistance Test Method

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**Key Words :** Electric vehicle(전기자동차), Rechargeable energy storage system(재충전식 에너지 저장 시스템), Fire resistance test(내화시험), Global technical regulation(세계기술기준), Vehicle-based test(차량기반시험)

#### ABSTRACT

As xEV (all types of electric vehicles) sales expand, it is getting more important to ensure vehicle safety against battery fires. Although there has been a UN R.100 test method as an international standard, Korea has independently developed a test apparatus for REESS (Rechargeable Energy Storage System) using LPG Bunsen burners and specifically stipulates the fire resistance test method in KMVSS (Korea Motor Vehicle Safety Standard). The KATRI proposed a fire resistance test method for REESS of KMVSS to IWG (Informal Working Group) of WP29 in 2013, and registered it as a part of GTR (Global Technical Regulation) No. 20 in 2018. The REESS fire resistance test method of KMVSS is superior to the UN R.100 in the reproducibility of measurement results, and has an advantage of heating batteries with a uniform temperature distribution. However, it is a component-based test apparatus that prescribes a methodology for testing a single battery unit rather than a battery installed in a vehicle. In this study, a vehicle-based test was performed to examine the applicability of the REESS fire resistance test method of KMVSS. The comparison between the UN R.100 and the KMVSS methods based on the temperature data measured at major locations in a typical electric vehicle is discussed in detail.

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## 연속굴착형 TBM(Tunnel boring machine)의 터널시공 기술소개

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### Introduction of Tunnel Construction Technology of Continuous Excavation Type TBM (Tunnel Boring Machine)

Jung woo Jo\*, Joo young Oh\*\*, Hyune jun Park\*\*\*, Sang min Lee\*\*\*, Moon gyu Kim\*\*\*,  
Dong geon Lee\*\*\*, Young tae Choi\*\*\*

**Key Words :** Continuous excavation(연속 굴착), Securing the excavation reaction force(굴진 반력 확보), Excavation management hydraulic system(굴진 관리 유압시스템), Elector robot system(이렉터 로봇시스템)

#### ABSTRACT

In recent years, urban underground transportation infrastructure is attracting attention as a countermeasure to the increasing demand for expansion of metropolitan transportation infrastructure and traffic congestion costs, and the development of mechanical excavation technology in urban tunnel construction is essential.

The existing NATM method has several problems due to blasting, and it is necessary to develop a domestic technology of the TBM (Tunnel Boring Machine) method, which has proven stability and economical efficiency through overseas ultra-long tunnel construction. In this paper, we propose the development of an erector for parallel installation of segments and improvement of the excavation rate through the development of a continuous excavation type TBM system for the development of large-scale TBM technology of 7~8m or longer.

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## PreScan을 활용한 딥러닝 기반 AEB 보행자 인식 시스템 개선에 관한 연구

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### Study on the Improvement of AEB Pedestrian Detection System Based on Deep Learning Using PreScan

Joeun Lee\*, Jonghyuk Kim\*\*, Jihun Choi\*\*\*, Woojeong Jeon\*\*\*\*, Hasun Park\*\*\*\*\*

**Key Words :** ADAS(첨단운전자지원시스템), AEB(긴급제동장치), Pedestrian Detection(보행자인식), Deep Learning  
(딥러닝), YOLO(딥러닝기반객체검출), PreScan(ADAS 시뮬레이션 프로그램), EuroNCAP AEB VRU

#### ABSTRACT

Recently, the Ministry of Land, Infrastructure and Transport announced an amendment to expand the subject of mandatory Automatic Emergency Braking (AEB) system to all models. AEB is one of the Advanced Driver Assistance Systems (ADAS), which uses cameras and radar sensors to detect vehicles or pedestrians and automatically avoid or mitigate collisions. As the number of vehicles with AEB increases, the need for measures to simulate and analyze traffic accidents related to AEB is emerging. Therefore, in terms of pedestrian AEB, this study attempted to improve the pedestrian detection system in the PreScan with MATLAB/Simulink environment and analyze the performance of the algorithm. The existing PreScan AEB system is limited in that it cannot be flexibly applied to various situations because it only uses features such as long axis, short axis and eccentricity to determine pedestrians. Therefore, we improved the existing system using the YOLO(You Only Look Once) algorithm, which is currently widely used in the field of deep learning, and HOG(Histogram of Oriented Gradients) & SVM(Support Vector Machines) of machine learning. After the pedestrian was detected, bounding boxes were obtained and they were used to calculate the TTC and distance with the pedestrian. Furthermore, based on the EuroNCAP AEB VRU test protocol-CPNA in KIAPI, the actual experiment was conducted using IONIQ5. As a result of applying the experimental values to the simulation system, the feasibility of the improved algorithm was verified by being very close to the actual AEB operation performance. The YOLOv4 was the best in pedestrian detection distance, and it was also best when measuring AP and FPS with datasets combining simulation and real images. In the future, many conditions will be tested to cope with various types of collisions such as children and cyclists, and the system will be improved to be detected even in dark situations.

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## 개선행 군 구급차 레이아웃 평가

이희영\* · 이강현\*\* · 육현\*\*\* · 김선주\*\*\*\* · 김형태\*\*\*\*\* · 이해주\*\*\*\*\* · 최두루\*\*\*\*\*

### Evaluation of the Improved Military Ambulance Layout

Hee Young Lee\*, Kang Hyun Lee\*\*, Hyun Youk\*\*\*, Sun Ju Kim\*\*\*\*, Hyeong Tae Kim\*\*\*\*\*,  
Hae Ju Lee\*\*\*\*\*, Doo Ruh Choi\*\*\*\*\*

**Key Words :** Improved Military Ambulance(개선행 군 구급차), Stretcher Height(주들 것 높이), Medical Devices' Arrangement(의무장비 배치), Negative & Positive Pressure Threshold(음양압 기준치)

#### ABSTRACT

개선행 군 구급차는 군 의무호송 주력 장비로써, 군 운용환경에서 구급대원이 동승하여 응급환자 이송, 응급의료를 위한 혈액운반, 진단용 검사 대상물 및 진료용 장비 운반, 군 보건사업 수행에 필요한 체계 장비이다. 또한, 구급차 내부에 응급의료에 관한 법률에 따라 의무 장비를 탑재하고, 탈·부착식 음·양압 장비, 공조장치, LTE 통신을 활용하는 이동 원격 진료체계, 무정전 전원장치를 설치하여 의무 작전을 완벽하게 수행할 수 있도록 한다. 본 연구는 개선행 군 구급차를 개발하는 과정에서 의학자문 및 레이아웃 평가가 수행되었으며, 자문 주제는 심폐소생술 시 주들 것의 베이스 높이 검토, 주들 것이 마중레일 작동방식에 대한 비교 설문, 응급구조사 활동반경을 고려한 구급차 안 의무장비 위치 평가였다.

첫째, 주들 것 옆에 서서 심폐소생술을 실행하는 경우 응급구조사에게 더 큰 피로감이 발생하고 심폐소생술 효과가 낮기 때문에 주들 것의 높이를 우리나라 남성의 평균 무릎높이인 451mm에 근접하도록 맞추기를 권장하였다. 둘째, 주들 것의 상/하차 동작과 수동식/자동식 마중레일 작동방식에 대해 응급구조사의 조작편의성, 응급구조사의 조작 안전성, 환자의 안전성 등을 비교 설문한 결과, 모든 문항에서 자동식(주들 것 상차: 3.13점, 3.07점, 3.20점 / 주들 것 하차: 3.33점, 3.20점, 3.20점)이 수동식(주들 것 상차: 2.87점, 3.00점, 2.93점 / 주들 것 하차: 2.40점, 2.53점, 2.80점)보다 평균 점수가 높았다. 마지막으로, 응급구조사 활동반경을 고려한 구급차 안 의무장비들(제세동기, 환자감시 모니터, 약장사물함, 흡입기)의 치료의 편의성, 위치의 익숙함, 위치의 활용성, 동선의 제한성에 대한 설문 결과, 전반적으로 의무장비들이 적절하게 배치되어 있다고 평가(3.0점~4.2점)하였다.

개선행 군 구급차를 개발하는 과정에서, 본 연구를 통해 여러 가지 의미 있는 제언을 할 수 있다. 주들 것으로 환자 이송 시 침대높이는 응급구조사의 무릎높이에 근접할수록 흉부압박의 효과가 크다. 또한, 자동식 마중레일이 수동식보다는 전반적으로 편리하다고 평가하였으나 업무의 편리함보다 마중레일 고장 시 겪을 불편함에 대한 우려가 크기 때문에 의료진은 군 운용환경을 고려했을 때 수동식 마중레일 구조를 권장하였다. 구급차 내부의 의무장비 배치에 대해서는 의료진의 의견을 반영하여 개선이 필요하겠다. 향후 개선행 군 구급차는 산악지형, 격오지 등의 지역에서 민수용 뿐만 아니라 군수용으로든 다각도로 활용될 예정이다.

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## ADAS 장착 차량의 교차로 교통사고에 대한 EDR 유효성 검증

임예솔\* · 권오민\*\* · 인병덕\*\*\* · 박정만\*\*\* · 박종진\*\*\*\*

### EDR Verification for Intersection Traffic Accidents of ADAS Equipped Vehicles

Yesol Im\*, Ohmin Kwon\*\*, Byungdeok In\*\*\*, Jeongman Park\*\*\*, Jongjin Park\*\*\*\*

**Key Words :** Autonomous Vehicle(자율주행자동차), Advanced Driver Assistance System(첨단운전자보조시스템), Forward Collision-Avoidance Assist(전방충돌경고장치), Event Data Recorder(사고기록장치), Traffic Accident Investigation(교통사고조사), Intersection(교차로)

#### ABSTRACT

According to the Road Traffic Authority's traffic accident statistics, traffic accidents at intersections in 2021 accounted for 49% of all traffic accidents. Traffic accidents at intersections are caused by various unexpected situation such as unprotected left turns and non-compliance with traffic laws. ADAS has been developed for highways and is only available in limited situations at intersections with various accident scenarios.

In this paper, traffic accident of ADAS equipped vehicles at intersection are analyzed using EDR. Through EDR analysis, it can be determined that the driver's act of stepping on the accelerator pedal by 32% isn't the cause of deactivate of FCA. Dash cam is analyzed to find the cause of FCA release. It is estimated that the accident occurs because the sensor doesn't recognize Sonata as an accident-inducing vehicle due to unprotected left turn and lack of offset condition. In the existing EDR, the cause of the release of FCA can be identified by recording items related to accelerator pedal, brake pedal and steering wheel. However, there is a limit to identifying the cause of deactivate of FCA by using the existing EDR. In the future, if a record item related to sensor recognition ability is added, the cause of FCA's traffic accident can be identified.

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## Lv.4/Lv.4+ 자율주행차 인프라가이드 기술의 법적 쟁점

장정아\* · 이인식\*\*

### Legal Issues of Lv.4/Lv.4+ Automated driving Infrastructure Guidance Technology

Jeong Ah Jang\*, Insik Lee\*\*

**Key Words :** Automated Vehicle Infrastructure Guidance(자율주행차 인프라가이드), Legal Issues(법적 쟁점), Lv4/Lv4+ 자율주행, Service operation(서비스운영), SAE J3216

#### ABSTRACT

Development of infrastructure guidance service technology for Lv4/Lv4+ automated vehicles is underway. Infra-Guidance service is to support fast and efficient deployment of high driving automation. It adopts the state-of-the-art sensing technology to detect dynamic behavior of transportation participants on a real-time basis as well as cooperative perception technologies. The infrastructure assisted guidance is created based on the dynamic information, and provided to V2X-equipped vehicles via V2X communication network. These services are related to CDA Cooperation Class(A:Status-sharing, B: Intent-Sharing, C: Agreement-seeking, D: Prescriptive) presented by SAE J3216. Infrastructure guidance services are targeted at CDA Cooperation Class B-D. This study examines domestic legal issues for commercializing the infrastructure use case. We analyzed as 3 sectors in terms of infrastructure, service operation and liability/insurance with the current law. Continuous research is needed to revise and enact detailed provisions for infrastructure guidance service technology for Lv4/Lv4+ automated vehicles

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## IPA 분석을 통한 자율주행 V2E 및 V2H 우선순위 연구

장정아\* · 김태완\*\*

### Importance-performance Analysis for Priorities of V2E and V2H for Automated Driving

Jeong Ah Jang\*, Taewan Kim\*\*

**Key Words :** V2E(Vehicle-to-Environment, (자율주행)차량대 환경인지센서), V2H(Vehicle-to-Human, (자율주행)차량대 사람), Sensor Cleaning(센서클리닝), IPA(Importance-Performance Analysis, 중요도-성취도분석), Priority(우선순위)

#### ABSTRACT

This study conducted an IPA analysis on the technical/institutional requirements for V2E performance securing technology and V2H technology for automated driving. V2E performance securing technology is a device for maintaining the performance of automated sensors equipped in automated vehicles. An IPA survey was conducted on 13 items, including technical requirements for V2E sensor cleaning technology and institutional regulation guidelines. V2H technology relates to a display device such as a text/image for communication between an automated vehicle and a road user. V2H technology conducted an IPA survey on 16 items, including technical requirements and institutional requirements, such as the "in-flight" information notification function of automated vehicles. As a result of IPA analysis of 66 expert groups, technical/institutional priorities could be confirmed. This study is expected to use the research results in presenting future promotion strategies.

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## 튜닝부품 연결장치 평가항목 선정 및 항목별 기준 확립

조범지\* · 박민경\* · 문광욱\* · 김현일\* · 이지호\* · 이태희\* · 이원종\*\* · 장원기\*\*

### Selection of Evaluation Items for Tuning Parts Towbar and Establishment of Standard for Each Item

Beom Ji Jo\*, Min Kyung Park\*, Kwang Uk Moon\*, Hyun Il Kim\*, Jee Ho Lee\*, Tae Hee Lee\*,  
Won Jong Lee\*\*, Won Ki Jang\*\*

**Key Words :** Towbar(연결장치), Evaluation items(평가항목), Evaluation standard(평가기준), Score sheet(배점표),  
Evaluation method(평가법)

#### ABSTRACT

In this research, among the six types of tuning parts (wheels, silencers, suspensions, towbar, brake calipers, stabilizers) that are in high demand for tuning purchases and certification, existing evaluation methods were used to ensure consumer confidence in the towbar. Based on this, we established evaluation standard, verified performance, and proceeded with the aim of providing information. Evaluation items related to corrosion resistance, durability, performance, economy, and weight reduction were selected as test evaluation items. Of the evaluation items, KS D 9502 was used for corrosion resistance, and the evaluation method for coupling device certification evaluation standards (tuning parts certification evaluation standards) was used as a reference for durability and performance. Economic efficiency and weight reduction were compared with OE products as standards. Corrosion resistance is determined by the corrosion initiation time, durability and performance are determined by the state of the test product during or after the test, and economy and weight reduction are compared on a 100% basis with OE products.

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## 비조화비를 이용한 차량 속도 분석의 교차 검증 사례 분석

최영수\* · 윤용문\*\*

### Case Study of Cross-Validating Vehicle Speed Analysis using Cross-ratio

Youngsoo Choi\*, Yongmun Yun\*\*

**Key Words :** Traffic accident(교통사고), Cross-validation(교차 검증), Vehicle speed(차량 속도), Cross-ratio(비조화비)

#### ABSTRACT

In the field of forensic traffic accident investigation, the speed of a vehicle before an accident is a significant factor, and recently, video data of a surveillance camera and event record data of a vehicle such as an EDR (Event Data Recorder) are used for speed analysis. As type of data used for speed analysis becomes more diverse, cross-validation between analysis results becomes more important. In this study, we proposed a continuous vehicle speed analysis method that is considered the projective invariant values of cross-ratio and video frame image. In addition, it was confirmed that the result of the method proposed in the actual accident case was more than 95% consistent with the result of the traditional speed analysis method, and it was confirmed that it is helpful in estimating the accident situation in detail through in continuous vehicle speed information in time. As a result, it was shown that the proposed method can be used to effectively cross-validate traditional analysis methods in the field of forensic traffic accident investigation and increase the reliability of accident analysis results.

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## ADAS 카메라 및 레이더 센서의 횡방향 거리 측정 특성에 관한 실험적 연구

황선희\* · 김중혁\*\* · 최지훈\*\*\* · 전우정\*\*\*\* · 박하선\*\*\*\*\*

## An Experimental Study on the Lateral Distance Measurement Characteristics of ADAS Camera and Radar Sensor

Seonhee Hwang\*, Jonghyuk Kim\*\*, Jihun Choi\*\*\*, Woojeong Jeon\*\*\*\*, Hasun Park\*\*\*\*\*

**Key Words :** ADAS(첨단 운전자 지원 시스템), AEB(긴급제동장치), EuroNCAP(유럽자동차안전도평가), Overlap(오버랩)

### ABSTRACT

Recently, ADAS (Advanced Driver Assistance System) are being installed in most vehicles for traffic safety and driving convenience. In particular, it is mandatory to install the AEB(Autonomous Emergency Braking), a representative driving safety system, to prevent and reduce traffic accidents in Europe, the US, and Korea. When the AEB recognizes the risk of collision with a vehicle or pedestrian, it warns the driver and controls the vehicle's braking system. Camera and radar sensors are mainly used as ADAS sensors related to the operation of AEB, and both sensors measure the longitudinal and lateral distances to the obstacle and recognize the type and location of the obstacle. Therefore, it is necessary to determine the measurement accuracy of the camera and radar sensor to evaluate whether the front obstacle is accurately recognized when an ADAS vehicle accident occurs. In this study, Mobileye's 6 ELD camera sensor (hereinafter referred to as Camera) and Delphi's 2.5 ESR radar sensor (hereinafter referred to as Radar) were installed in VUT (Vehicle Under Test) IONIQ5. For the overlap range (100 % ~ 50 %) of EuroNCAP AEB CCRs (Car-to-Car Rear stationary) and the limit situation (45 % or less) exceeding the standard range, Accuracy was evaluated by measuring the lateral distance to GVT (Global Vehicle Target) with Camera and Radar, respectively, and comparing it with the offset value of the actual GVT. As a result, for the camera sensor, the maximum average measurement error is about 0.099 m, and the maximum standard deviation is about 0.039 m. For the radar sensor, the maximum average measurement error is about 0.12 m and the maximum standard deviation is about 0.23 m. Since the standard deviation of the measurement value of the radar was relatively larger than that of the camera, it was found that the camera was more robust in lateral distance measurement than the radar. The longitudinal measurement characteristics of the camera and radar sensor will also be identified through additional experiments.

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