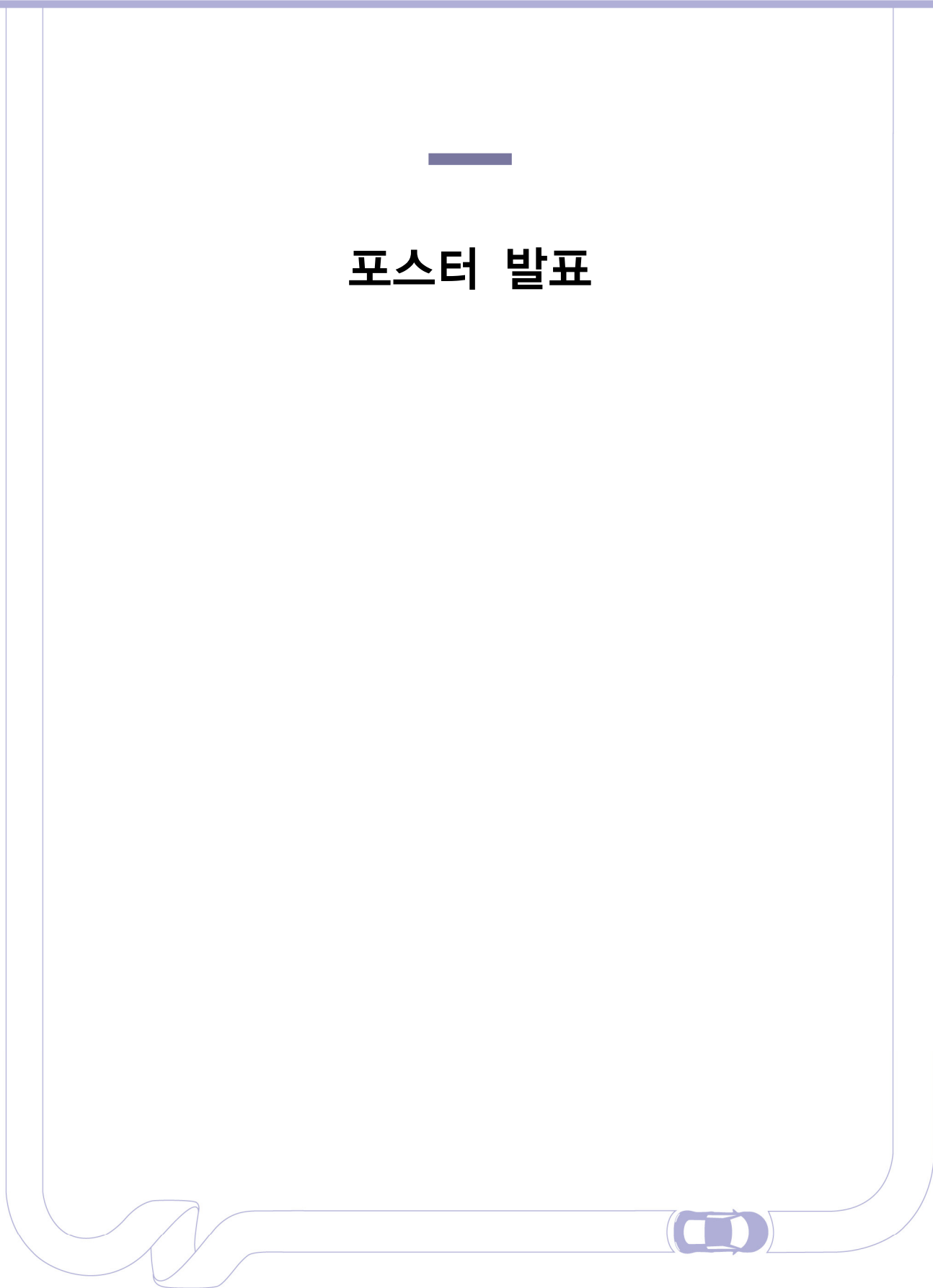




포스터 발표



자율주행차의 고장 및 사고상황 재현을 위한 시뮬레이션 요구사항 분석

강래현* · 김종화**

Analysis on the Requirements of Simulation Software Enabling Replication of Autonomous Vehicle Failures and Accident Scenarios

Laeheon Kang*, Jonghwa Kim**

Key Words : Failure Reproduction(고장 재현), Accident Reconstruction(사고상황 재현), Requirements Analysis(요구사항 분석), Autonomous Driving System(자율주행), Simulation(시뮬레이션)

ABSTRACT

For the development and commercialization of autonomous vehicle, reliability and safety of the both of components and systems have to be secured. To achieve this objective, international standards for the safety verification and evaluation methods are being developed. However, verifying and evaluating the response capabilities of autonomous vehicles in edge cases, using real vehicles is not only expensive but also poses risks. Therefore, a simulation environment that can virtually reproduce the identical scenario is required.

Therefore, in this paper, we analyzed the requirements for simulation to reproduce fault and accident situations of autonomous vehicles. First, to reproduce the fault situation, we are analyzing the predictable failure forms derived from the FMEA of the ADS architecture. Second, we analyzed the data of Event Data Recorder (EDR) and Data Storage System for Automated Driving (DSSAD) defined in the relevant standard (UNECE WP.29 EDR/DSSAD IWG) to reproduce the accident situation.

In the future, based on the analysis results, the simulator will be enhanced by developing a fault situation injection function and a re-simulation function to reproduce accident situations according to the behavior of autonomous vehicles and surrounding vehicles.

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보행자 이동 조건에 따른 긴급제동장치의 작동 특성 연구

강지승* · 이동현* · 이재형** · 김종혁** · 최지훈*** · 전우정****

A Study on the Operation of Emergency Braking System by Pedestrian Movement Conditions

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Key Words : ADAS(첨단 운전자 지원 시스템), AEB(긴급제동장치), FCW(Forward Collision Warning)

ABSTRACT

ADAS (Autonomous Driver Assistance System) is a rapidly proliferating technology in recent years, enhancing both the safety and convenience of driving. Autonomous Emergency Braking (AEB), as an integral function within ADAS systems, serves as an active safety system that automatically engages the braking mechanism in emergency situations to either avoid or mitigate collisions with other vehicles or pedestrians. The scenarios in which AEB systems operate can be broadly categorized into CAR to CAR and VRU (Vulnerable Road User) scenarios. VRU scenarios entail significantly more factors to consider compared to Car to Car scenarios. Conducting real-world experiments encompasses substantial costs and time constraints, making it practically challenging to test AEB performance across a wide range of scenarios and conditions. Hence, this study aims to narrow down the essential scenarios required for real-world AEB testing by comparing and analyzing the operational characteristics of AEB based on pedestrian movement conditions.

Pedestrian movement conditions can be broadly divided into movement direction, speed, and the point of collision between the vehicle and pedestrian. In this study, experiments were conducted using a 2023 model Hyundai Grandeur vehicle, based on EuroNCAP's CPNA (Car to Pedestrian Nearside Adult) and CPFA (Car to Pedestrian Farside Adult) scenarios. The analysis focused on the Time to Collision (TTC) when FCW (Forward Collision Warning), AEB partial braking, and full braking were activated, with the results shedding light on how pedestrian movement conditions affect AEB performance. It was observed that AEB partial and full braking TTC changed only with vehicle speed, showing minimal variation across scenarios. However, FCW TTC exhibited substantial variations based on the scenario. Comparative analysis of FCW TTC trends across scenarios revealed that when pedestrian movement speeds were identical, CPNA and CPFA collision points exhibited similar FCW TTC trends, with faster pedestrian speeds leading to shorter FCW TTC. Furthermore, the CPNA collision point demonstrated an increasing trend in FCW TTC as it shifted from CPNA 10% to CPNA 90%. Consequently, utilizing vehicle speed, pedestrian speed, and the collision point between the vehicle and pedestrian as input parameters, a model capable of predicting AEB activation sequences was developed using Matlab/Simulink's Look-up Table and Akima Spline algorithm. This model confirmed the feasibility of simulating AEB behavior reflective of real-world vehicle dynamics. Future work aims to establish a comprehensive database through ongoing experiments with various vehicle models to determine if similar trends based on pedestrian movement conditions are consistently observed.

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운전자 경고 신호를 위한 시각 및 청각 효과에 관한 연구

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Research on Visual and Auditory Effects for Driver Warning Signals

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Key Words : Driver warning signal(운전자 경고 신호), LED lighting(LED 조명), Attention level(주의 수준), Driver attention(운전자 주의), Auditory alerts(청각 알림)

ABSTRACT

In the realm of road safety, the prevention of accidents caused by hazardous lane changes remains a significant challenge. The continuing rise in the number of vehicles on the road, alongside diverse driving behaviors, highlights the necessity of efficient driver warning signals. This study centers on the creation and examination of driver warning signals that integrates both visual and auditory stimuli. In our experiment design, we installed LED lighting within the dashboard, with the capability of transmission in two different colors (red and white), three brightness levels ranging from level 1 to level 3, and three illumination modes (on, blink, and sequential). Concurrently, we will evaluate the efficacy of an auditory attention system. Moreover, we will investigate the collaborative approach in which LED lighting and auditory signals are presented to the driver simultaneously. Our aim is to investigate whether the combination of different modalities has any advantages or disadvantages compared to individual cues. We anticipate that this study will offer valuable insights for the development of advanced safety technologies, contributing to safer roads and more secure driving environments.

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마할라노비스 거리를 활용한 ADAS 센서 퓨전 향상에 관한 연구

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A Study on the Enhancement of ADAS Sensor Fusion Using Mahalanobis Distance

Sanghyun Ko*, Sehwan Lee*, Jaehyeong Lee**, Jonghyuk Kim**, Jihun Choi***, Woojeong Jeon****

Key Words : ADAS(첨단 운전자 지원 시스템), PreScan(ADAS 시뮬레이션 프로그램), Object Tracking(객체 추적), Data Association(데이터 연관 분석), Track Management, Gate Region(게이트 영역), Mahalanobis Distance(마할라노비스 거리), Euclidean Distance(유클리디안 거리), CPNA(Car to Pedestrian Nearside Adult), GNN(Global Nearest Neighbor)

ABSTRACT

With recent advancements in automotive technology, vehicles equipped with Advanced Driver Assistance Systems (ADAS) have become widespread, enhancing both driver convenience and safety. ADAS relies on a variety of sensors such as cameras and radars to detect objects and provide positional information. However, these sensors may momentarily lose track of objects, leading to errors when the existing track is altered. To prevent such errors, Object Tracking is essential. Object tracking can be divided into two main stages: the first stage involves independent object tracking for each sensor, while the second stage fuses the tracking results from multiple sensors. The critical process in the first stage is Track Management, which employs a Kalman filter-based Data Association to improve tracking accuracy by eliminating measurements that are not compatible with existing tracks. The gate region is crucial in Data Association, and it is defined using the Mahalanobis Distance rather than the conventional Euclidean Distance to consider the unique characteristics of each sensor's data. Both radar and camera sensors introduce measurement errors, which can be expressed in the form of a covariance matrix. This study conducted a covariance analysis of radar and camera sensor data in the ADAS vehicle simulation program, Prescan, and the Matlab/Simulink environment. The Mahalanobis Distance was calculated based on this analysis to establish gate regions that incorporate sensor characteristics. Initially, the scenario involved an ego vehicle's speed ranging from 10 km/h to 70 km/h in 10 km/h increments, with a pedestrian object moving according to the EuroNCAP CPNA 75 scenario (pedestrian speed 5 km/h) in the front. Radar and camera sensors were installed on the ego vehicle in this scenario to acquire sensor data, and a Kalman filter was applied to estimate precise values for each sensor. The Kalman filter's system model was designed linearly, and the covariance analysis was conducted for the error between estimated values and measured values. The results confirmed that by setting gate regions that account for radar and camera error characteristics, accurate track management for multiple individuals in close proximity can be achieved. Furthermore, it was observed that using the Mahalanobis Distance instead of the traditional Euclidean Distance for sensor fusion can resolve situations where sensor fusion fails to function properly due to insufficient gate regions. Future work aims to implement more precise sensor fusion by applying Global Nearest Neighbor (GNN) within the gate region defined by the Mahalanobis Distance.

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주변 차량 상태를 이용한 도심 자율주행 차량의 위치 추정 알고리즘 개발

곽지섭* · 노한석* · 권우진** · 이경수***,†

Development of Localization Algorithm for Urban Autonomous Vehicle Using Surrounding Vehicle State

Jisub Kwak*, Hanseok Noh*, Woojin Kwon**, Kyongsu Yi***,†

Key Words : Vehicle Localization(차량 측위), Pose Estimation(위치 추정), Autonomous driving(자율 주행), Vehicle detection(차량 인지), Sensor Fusion (센서 융합)

ABSTRACT

This paper presents a localization algorithm for urban autonomous vehicle using surrounding vehicle state. Vehicle localization is a key algorithm of autonomous driving and estimates the global position of vehicles using GPS sensors. However, depending on the driving environment, the condition of the GPS sensor may deteriorate, which mainly occurs in urban environments where high-rise buildings and road structures are concentrated. To improve this, several local sensors such as LiDAR and camera are used to secure the robustness of the pose estimation algorithm. Therefore, this paper configures the localization algorithm to correct the lateral position of autonomous vehicle using the state information of the surrounding vehicle recognized as LiDAR. It was developed based on extended kalman filter, which updates several measurements sequentially. The proposed algorithm is verified through real-time vehicle experiments in urban environment.

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하이브리드캐스팅 적용 서브프레임 개발을 위한 유한요소해석의 활용

김강민* · 양승영**

The Use of Finite Element Analysis for the Development of a Subframe with Hybrid Casting Application

Kang-Min Kim*, Seung-Young Yang**

Key Words : Subframe(서브프레임), Hybrid Casting(하이브리드 캐스팅) Structural analysis(구조해석), CAE(컴퓨터 이용 공학), Finite element analysis(유한요소해석)

ABSTRACT

The front subframe is one of the components responsible for robustly supporting the suspension and engine of a vehicle along with the chassis. It plays a crucial role in structurally supporting the loads from the road surface and vibrations generated by the engine. Additionally, it transmits vibrations felt by the vehicle's occupants and is used to enhance collision safety. Such subframes are essential components in monocoque body vehicles and are applied to various types of automobiles. Currently, ongoing research and development efforts are being carried out for the application of environmentally friendly electric vehicles.

The hybrid casting method is a technology that joins dissimilar materials through casting. When utilizing this technology to produce a subframe, it offers an environmentally friendly alternative to traditional welding-based manufacturing methods. However, when using hybrid casting, the bonding between materials can vary depending on the casting environment, leading to differences in strength based on the bonding quality. And, There is an issue where measuring and improving the bonding quality can be time-consuming and costly.

In this study, finite element analysis was employed to reverse calculate the bonding strength in order to save costs and time associated with measuring the bonding quality between dissimilar materials during component manufacturing using the hybrid casting method. In order to derive the bonding strength using finite element analysis, actual bonded specimens were modeled, and specimens produced using welding techniques and hybrid casting methods were compared and analyzed. Simulation results led to the selection of the bonding strength for the hybrid casting specimen, which exhibited identical results to the welded specimen. Based on simulation results, it can be assumed that a 100% bond between materials occurred when the same bonding strength was achieved during actual testing. In future research, there are plans to validate the reliability of the analysis through a comparison between the results obtained from simulations and those from actual specimen testing. Additionally, the intention is to utilize the analysis results in the production of real subframe products.

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자동차 전면 유리의 제상 성능 정합성 검증 연구

김수빈* · 김영재* · 김윤제**

A Study on the Consistency of Defrosting Performance of the Windshield in Auto-Vehicle

Subin Kim*, Youngjae Kim*, Youn-Jea Kim**

Key Words : Defrosting Performance(제상성능), Windshield(자동차 전면유리), Auto-vehicle(자동차), CFD(전산유체 해석), Consistency(정합성)

ABSTRACT

The windshield of a vehicle plays an important role in ensuring driver safety and maintaining visibility. To prevent issues such as frost and mist from occurring inside and outside the vehicle, research related to the defrosting performance of the windshield is being conducted. Evaluating defrosting performance requires accurate thermal flow analyses. Therefore, in this study, a defrosting duct was constructed within a chamber at an actual vehicle scale to evaluate its performance, and a finite element model was developed and verified. To evaluate defrosting performance, the temperature of the windshield was measured under condition with a mass flow rate of 0.1 kg/s, which corresponds to that of a typical midsize vehicle. A total of 45 thermocouples were arranged at equal intervals of 9 widths and 5 lengths on the windshield to measure the temperature and compare it with the temperature predicted through finite element analysis. A volume grid was created in the main flow area to ensure accurate thermal flow analyses, and a prism layer was added at the interface between the windshield and fluid. In total, 6 million grid systems were formed. Comparing the temperature fields of the experimental results and the finite element analysis results confirmed a similar defrosting pattern, with an average temperature difference of 0.72K.

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전기자동차 배터리 이상 알림 긴급호출 장치 설계

김유원*

Design of Emergency Call Device for Electric Vehicle Battery Alert Notification

Yoowon Kim*

Key Words : Electric Vehicle(전기자동차), BMS(배터리 관리 시스템), Thermal Runaway(열폭주), Emergency Call (긴급호출), SMS(문자메시지), Alert Notification System(비상알림체계)

ABSTRACT

In this paper, We propose the design of an emergency call device that can quickly alerts when an anomaly occurs at an electric vehicle battery, such as thermal runaway. For this purpose, We designed the hardware and software regarding the battery warning message structure, a battery warning notification via SMS to vehicle owner and 119 call center, the interface for an electric vehicle and BMS, and Internet-based data sharing. We plan to implement an emergency call device based on this design and conduct vehicle-based experiment.

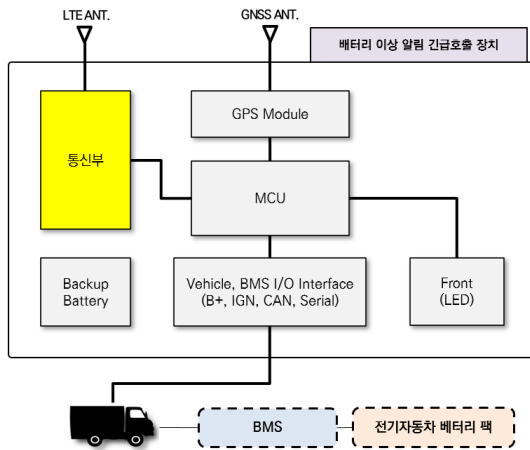


Fig 1. Electric Vehicle Emergency Call Device Block Diagram

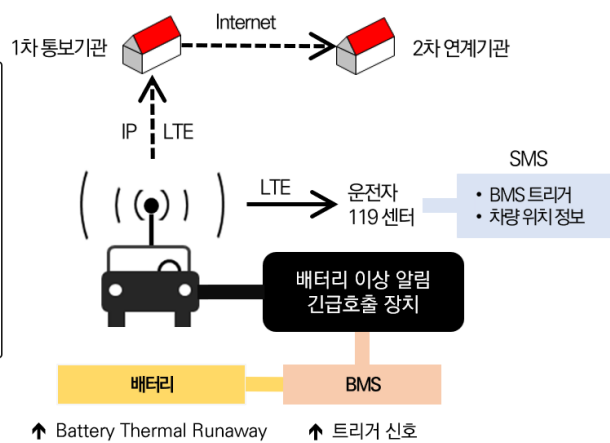


Fig 2. Electric Vehicle Battery Alert Notification System

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자율주행차의 Fail Operational 기술을 위한 ADS 설계

김인수* · 박재홍**

Design of ADS for Fail Operational

Insu Kim*, Jaehong Park**

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

ABSTRACT

The Fail Operational Autonomous Driving System (FO ADS) is a system that provides a high-level fallback function that prevents accidents caused by ADS abnormalities in Lv.4 autonomous vehicles and maintains autonomous driving functions until action is possible. FO ADS requires a redundant structure to determine its own failure and ensure its operation, and this paper describes the redundant ADS structure.

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V2X 기반 기본 안전 메시지를 활용한 자율주행차 사고재현 및 분석 연구

김천호* · 김유원** · 백세룡*** · 최용순***

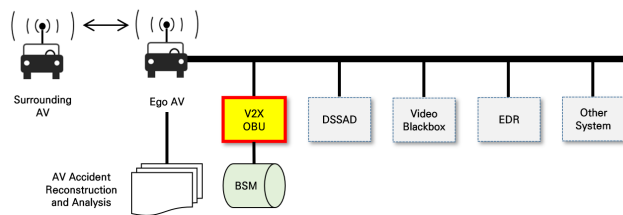
A Study on Autonomous Vehicle Accident Reconstruction and Analysis Using V2X-Based Basic Safety Message

Cheonho Kim*, Yoowon Kim**, Seryong Baek***, Yongsoon Choi***

Key Words : Automated Vehicle(자율주행자동차), Accident Reconstruction(교통사고재현), V2X(차량사물통신), BSM(기본안전메시지), EDR(사고기록장치), DSSAD(자율주행기록장치), DTG(디지털 운행기록장치)

ABSTRACT

When a car crash occurs, we analyze the traffic accident based on various data and identify the cause of the accident. Currently, we have been using video black boxes, CCTV, EDR, and DTG to reconstruct and analyze traffic accidents. In particular, we are considering using driving record data stored in DSSAD to analyze traffic accidents related to autonomous vehicles. In Republic of Korea, as of 2022, 258 temporary operating licenses of autonomous vehicles for autonomous driving have been issued and are being piloted on the road, and accidents with these autonomous vehicles occur frequently. We think that it will not be easy to reconstruct and analyze the perception, judgment, control, and control transition of an autonomous vehicle using existing accident analysis methods alone. In addition, as recent autonomous driving technology is moving towards convergence autonomous driving based on V2X communication, the need to utilize V2X-based data for analysis has increased. In this study, we studied how to define and utilize the data necessary to reconstruct and analyze accidents using V2X-based BSM. By using BSM, it is expected that it will be possible to increase the precision of investigations in reconstructing and analyzing traffic accidents through DSSAD and image information in the future.



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타워크레인 건설기계 안전성 평가기술 개발

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Development of Safety Evaluation Technology for Tower Crane Construction Equipment

Seongjae Moon*, Jaewon Choi**, Jinhwan Lee***, Jaehyoung Ryu****

Key Words : Tower Crane(타워크레인), Safety(안전), Evaluation(평가), Electric(전기), Electronic(전자)

ABSTRACT

Currently, in the construction market, efforts are being made to break away from dependence on human resources by promoting mechanization and robotization of construction equipment. Accordingly, the functions and performance of construction equipment, which were previously machine-oriented, are also making remarkable progress due to technological advancements in the electrical and electronic fields. The purpose of this study is to promote the advancement of construction machinery by deriving and presenting the current status, problems, and improvement directions of the system, including inspection methods and type approvals, in the electrical and electronic field of tower cranes among construction machinery. The improvement measures derived as a result of this study can be reflected through the collection of experts opinions, and can be used as important data for policy reflection by expanding and applying items through continuous research and review in the future.

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차량의 급발진 사고 방지를 위한 E-STOP 시스템 개발

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Development of E-STOP System to Prevent Sudden Unintended Acceleration in Automobiles

Byeongrae Son*, Changsin Park*, Hoyoung Shin**, Useong Kang**, Youngwoong Cho**, Chanki Son**, Honghee Kim**, Hyeseong Hong**, Changyeong Yu**, Jinyoung Kim**

Key Words : E-STOP system(비상정지 시스템), Sudden unintended acceleration(급발진 사고), Vehicle(차량), Safety device(안전장치), Traffic accident(교통사고), Control(제어)

ABSTRACT

Recently, as demand for electric vehicles (EVs) and hybrid vehicles (HEVs) has increased, vehicle accidents have increased rapidly, and it has become an issue as sudden unintended accidents of vehicles have become frequent. Sudden unintended accidents of vehicle are mainly caused by vehicle defects or poor driving of the driver. The cause of the sudden unintended accidents of the vehicle should be identified, but for now, the only solution is to reduce the damage caused by traffic accidents in the event of a sudden acceleration. Although it is recommended to prevent accidents with foot brakes and side brakes in case of sudden unintended accidents of vehicles, a detailed look at various incidents to analysis in what circumstances the sudden unintended accidents occurred shows that it is impossible for individuals to calmly cope with the moment of the accident. Since sudden unintended accidents of vehicles can occur to anyone, the cause of the accident should be identified, but currently safety devices are needed to prevent traffic accidents caused by sudden unintended accidents.

In this study, we aims to develop an E-STOP (emergency stop) system to prevent sudden unintended accidents of vehicles. The E-STOP system is designed to control the operation of the accelerator rather than stopping the motor by pressing the E-STOP button connected to the accelerator circuit line in relay when the vehicle makes sudden unintended accidents. The E-STOP system allows electronic control devices to be controlled through interaction based on the values of various sensors or switches in the vehicle. In addition, it is configured to prevent additional damage by sending signals to the surrounding environment through an indicator that informs the current status of the vehicle during E-STOP operation.

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뒤보기 착좌 승객 고속 전방 충돌 보호를 위한 연구

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A Study on Rearward-Facing Occupant Protection in High-Speed Frontal Crashes

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Key Words : Rearward Facing(뒤보기 착좌), Seatback Airbag(시트백에어백)

ABSTRACT

Recently, as the development of autonomous vehicles has accelerated, research on swivel or reclined seating has been actively conducted for the convenience of passengers.

The conventional airbags for frontal crashes, Driver Airbag (DAB) and Passenger Airbag (PAB), have limitations in effectively protecting passengers during frontal high-speed collisions in various seating situations particularly with rearward-facing seating configurations.

In this study, potential injury risks for THOR ATD in high-speed collisions of rearward facing seated passengers were studied.

In addition, countermeasures (e.g., seatback airbags) that could potentially reduce injury risks of the rearward-facing passengers were developed and used in the high-speed (DV of 56km/h) frontal impact sled tests.

This study is expected to serve as the basis for research to protect various future seated passengers, especially rearward-facing seated passengers.

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악의 주행 조건에서 자율주행 차량의 측위 평가 시뮬레이션 환경 개발

박영진* · 조희섭** · 손준우** · 박명옥*

Developing Simulation Environment for Evaluating Positioning Performance Under Adverse Driving Conditions

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Key Words : Automated driving (자율주행), Adverse driving (악의 주행), Simulation Environment(시뮬레이션 환경)

ABSTRACT

The market for mobility is growing rapidly across many industries. In particular, verification and evaluation technologies are evolving to ensure the safety of autonomous vehicles from the development stage. Autonomous driving simulation technology is increasingly being used in R&D to efficiently and low-costly verify and evaluate the safety of autonomous vehicles before they are put on the road. In this study, we categorized various adverse conditions that a vehicle may encounter while driving and examined the impact of each on the sensors' ability to perceive the surrounding environment to build a scenario for evaluating precision positioning technology. In order to minimize the safety issues associated with conducting scenario-based evaluations in real road environments, consider factors that cannot be controlled in reality such as weather conditions, and ensure the reproducibility of the evaluation, we established a scenario-based evaluation environment for positioning technology in a software simulation. Through this, it was confirmed that the risk scenarios derived from each sensor can be combined with the risk scenarios obtained from other factors that cause adverse driving conditions and run in the simulation to enable more realistic positioning performance evaluation.

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운행상용차 프레임 변형량에 따른 전기차 개조 적합성 연구

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Study on the Suitability of Electric Vehicle Modification According to the Amount of Frame Deformation of Commercial Vehicles

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Key Words : EV conversion(전기차 개조), Electronic vehicle(전기 자동차), Frame body(프레임 바디)

ABSTRACT

Research is underway to convert internal combustion engine cars into electric cars rather than discarding them for Net-Zero strategy, and research is underway to demonstrate freight cars with high operating frequency and high carbon emissions in advance.

Due to the nature of the domestic transportation industry, freight cars often drive with overloaded cargo, resulting in deformation due to fatigue accumulating in the frame by continuously loading high-load cargo. During EV conversion, additional deformation occurs in the frame by assembling the battery in a specific part of the frame, and the changed center of gravity and load accumulates additional fatigue in the already deformed frame, thereby reducing the driving and collision safety of the vehicle.

To prevent this, we present a method to determine the suitability of EV conversion according to the amount of frame deformation by comparing the change of load and the amount of deformation when the battery is mounted on the frame of the deformed driving vehicle based on the standard frame of the vehicle.

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Dual-MoC 방식의 EPB 구동 메커니즘 설계

박태상* · 정충표* · 진성호**

Mechanism Design for Dual MoC Type EPB

Taesang Park*, Choongpyo Jeong*, Sungho Jin**

Key Words : EPB(전자식 주차 브레이크), Dual MoC(듀얼 모터 온 캘리퍼), Single MoC(싱글 모터 온 캘리퍼), One-way clutch(원-웨이 클러치)

ABSTRACT

Currently, the driving brakes of most cars use hydraulic pressure to reduce speed, and when parking, electronic parking brake (EPB) technology, which provides braking force using a motor, is being applied. There are two types of electronic parking brakes: the Motor on Caliper (MoC) type, which has an integrated motor and caliper structure, and the Cable-puller type, which consists of a motor and a cable. MoC-type EPB is classified into Single MoC and Dual MoC depending on the number of pistons, and the application of Dual MoC, which has two pistons, is expanding to large vehicles that require high parking performance. In Dual MoC, force distribution to two pistons is important, and in this paper, we will describe the structure of Dual MoC that can distribute force to two pistons using planetary gears, one-way clutch bearings, and gear trains.

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자율주행자동차 사고 분석을 위한 영상기록장치 시야각 및 왜곡 분석에 대한 연구

백세룡* · 이대봉** · 정승윤*** · 김정민**** · 김천호*****

A Study on the Field of View and Distortion Analysis of Video Data Recorder for the Analysis of Accident in Self-Driving Vehicles

Seryong Baek*, Daebong Lee**, Seungyoon Jung***, Jeongmin Kim****, Cheonho Kim*****

Key Words : Video data recorder(영상기록장치), Field of view(시야각), Distortion(왜곡), Traffic accident investigation (교통사고분석), Self-driving vehicles(자율주행자동차)

ABSTRACT

Although self-driving Level 3 is set to begin, legal and institutional problems related thereto have not been settled completely. Therefore, confusion is expected in the event of a self-driving vehicle accident. According to Article 18 (Video Data Recorder) of the Regulation on the Safe Operation Requirements and Test Operation of Self-driving Vehicles, self-driving vehicles should satisfy the front FOV (field of view) of 130° or wider, the rear FOV of 120° or wider, the resolution of 1280 × 720 or higher, and the frame rate of 24 fps or more. In the case of ordinary video data recorders, although their manufacturers announce FOVs of 130° or wider, they are diagonal FOVs and show lower FOVs when they are converted to horizontal FOVs. This study fabricated equipment capable of measuring the vertical and horizontal FOVs and distortion of video data recorders, and measured FOVs and distortions from 30 types of video data recorders. Information about the measured FOVs and distortions can be used to correct video data to be collected from future accident investigations. It is expected that results of this study are likely to be used to determine legal responsibilities for the traffic accidents of self-driving vehicles.

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사고 위험 시나리오의 현실성 제고를 위한 복잡도 지수 기반 실도로 주행 데이터 탐색을 통한 상세 시나리오 생성 연구

서도현* · 이성우** · 송봉섭***

A Study on Concrete Scenario Generation Integrating Real Test Driving Data and Complex Measures for Fidelity of Safety-Critical Scenarios

Dohyun Seo*, Sungwoo Lee**, Bongsob Song***

Key Words : Safety-critical scenario(사고 위험 시나리오), Complexity measure(복합도 지수), Augmented scenario
(증강 시나리오), Fidelity (현실성)

ABSTRACT

For the validation of automated driving functions, a distance-based approach would require billions of driven kilometers. To reduce costs and impractical amount of time required, scenario-based approach in a simulated environment is being employed. There are two main types of scenario generation method: knowledge-based generation either uses pre-defined rules by experts or integrates external knowledge during the generation. Data-driven generation purely samples collect dataset. Knowledge-based can generate risky situation, but they are limited to generate realistic situations that include all the real-world. On the other hand, data-driven generation based on real driving data can be tested for reality and complexity situation encountered on the road traffic. However, they may still not cover non-critical most of the time.

In this paper, a new data selection method based on complex measures for augmented scenarios incorporating concrete scenario (*i.e.*, ASAM OpenSCENARIO) into real-world driving data is proposed. The process of generating augmented scenario includes three phases. In the first phase, data schema corresponding to the field test data is generated by both vehicle detection and sensor fusion algorithms and stored in the database. The real driving data is selected by a complexity measure to characterize self-driving scenarios and extract data within a specific temporal sequence of scenes. In the second phase, surrounding vehicle measurements constrained by the roadway geometry should be applied to real-driving road. To deal with this limitation, vehicle measurements from real-driving data are transformed roadway geometry based curvilinear coordinate conversion. In the third phase, scenario file with the concrete scenario, high definition map, and surrounding vehicle is implemented in a virtual environment. Finally, we compare the performance of autonomous driving function with respect to two set of scenario data generated concrete scenario and augmented scenario.

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전기모터의 냉각을 위한 커버장치 개발

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Development of a Cover Device for Cooling an Electric Motor

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Hyunwoong Mun***, Donghwan Kim***, Myeongjong Kim***, Kwanghoon Yun***,
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Key Words : Electric motor(전기모터), Cooling(냉각), Motor cover(모터 커버), Electricalization(전장화), Electric vehicle(전기자동차)

ABSTRACT

The global automobile market is undergoing a major transition to electric vehicles, and internal combustion engine vehicles have been improving their power-train to cope with emissions regulations. Emissions regulations, increased convenience devices, and the development of autonomous driving have led to the electricalization of automobiles, and the amount of power required by automobiles is increasing as the number of electronic devices required by electricalization. An efficient power system is required to cope with the increased amount of power, which is also related to the increase in battery voltage. As the voltage of the vehicle develops from a 12 volt voltage to a high voltage, the core components, such as electric motors powered by high voltage systems, must be accompanied by cooling technology.

In this research, we aims to develop a cooling motor cover that is applied to electric motors of electric vehicles and E-mobility to prevent temperature rise due to high heat by circulating air inside the motor's housing. The cooling cover device designed the structure of the air hole according to the size and number of brushes of the motor based on the 10 kW brushed DC motor. The cooling efficiency according to the installation of the cover unit was measured using a temperature sensor, and cooling results of approximately 10 degrees or more were obtained at the highest temperature.

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수소버스 구동시스템 평가장비 성능 및 신뢰성 평가

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Performance and Reliability Evaluation of Test Equipment for P/T Driving System of Hydrogen Fuel Cell Bus

GyoEun Son*, DuckSoo Hong*, SuMin Baek*, MinGyu Lee*, Seokjin Kim*

Key Words : Hydrogen fuel cell bus(수소버스), Powertrain driving system(구동시스템), Test equipment(평가장비), Performance(성능), Reliability Evaluation(신뢰성 평가)

ABSTRACT

The power output of the hydrogen bus drive system is represented by the integrated power output of the fuel cell and battery modules. In order to evaluate the integrated performance of not only the motor output but also related major components and the drivetrain of hydrogen bus vehicles, a high torque dynamo of more than 10,000 Nm, a high-speed dynamo system of more than 20,000 rpm, and a battery simulator are required, and the prototype development of the integrated performance evaluation equipment has been completed over the past three years.

The developed high-speed dynamometer has a rated power of 419KW and a maximum speed of 23,000rpm, and the high-torque dynamometer has a rated power of 419KW and a rated torque of 4,000Nm. In order to drive a hydrogen bus, it is necessary to increase the torque transmitted to the wheels, and in this study, a planetary gearbox with a gear ratio of 4:1 is adopted so that the torque transmitted to one wheel is about 10,000 Nm or more.

In this presentation, after completing the manufacturing of the prototype module of the drive system evaluation equipment, we will present the research and development contents on the installation of the dynamometer and main infrastructure, commissioning of the installation equipment, and evaluation of the performance and the reliability of the equipment.

This research was carried out with the support of Ministry of Land, Infrastructure and Transport(MOLIT) and Korea Agency for Infrastructure Technology Advancement(KAIA) as a result of research on the “Development of hydrogen fuel cell bus safety evaluation technology and test equipment”. I would like to take this opportunity to thank everyone involved.

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AEB의 위험 차량 판단 지연에 따른 교차로 시뮬레이션

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Intersection Simulation Based on AEB Risk Vehicle Decision Delay Time

Yunsik Shin*, Jayil Jeong**

Key Words : Autonomous Emergency Braking(긴급자동제동), Urban area(도심지역), I-ADAS(교차로 운전자 지원 시스템), Sensor Delay(센서 딜레이)

ABSTRACT

In this study, high-frequency accident scenarios were derived based on domestic and international real accident data to identify safe driving ranges at intersections. The derived scenarios served as the foundation for the application of an algorithm to predict the paths of the Automatic Emergency Braking (AEB) system, Ego vehicle, and Target vehicle, aiming to prevent collisions. Through simulations, the safety of autonomous vehicles in intersection situations was ensured by considering sensor angles, vehicle risk perception delays, and speed ranges that influence collisions.

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힘평형이 적용된 모듈형 다단 패시브 타입 페달 시뮬레이터

신동환* · 진성호* · 권오석** · 정충표*** · 박태상***

Modular Multi-Stage Passive Type Pedal Simulator with Force-Balancing

Dong-Hwan Shin*, Sungho-Jin*, Oh-Seok Kwon**, Choong-Pyo Jeong***, Taesang Park***

Key Words : Pedal simulator(페달 시뮬레이터), Passive type(패시브 타입), Concept(컨셉), Multi-stage(다단)

ABSTRACT

In recent years, in the field of vehicle braking, research for converting an existing hydraulic braking system to an electro-mechanical braking system is being actively conducted. The electro-mechanical braking system consists of an electro-mechanical caliper, wire, pedal simulator, etc. Among these, the pedal simulator does transfer driver's braking intention to electro-mechanical caliper. Meanwhile, if the pedal simulator cannot be generated the pedal effort similar to the existing hydraulic braking system, the driver will feel a sense of insecurity as well as a sense of heterogeneity. Therefore, in the development of a pedal simulator, the ability to simulate the pedal effort of the existing hydraulic braking system is important. On the other hands, in realizing the pedal effort of the pedal simulator, there are an active type pedal simulator that simulates pedal effort by mounting an electric motor and a passive type pedal simulator that simulates pedal effort using only mechanical elements. The passive type has the advantage of being implemented at a smaller volume and lower cost compared to the active type, but has a disadvantage that it is difficult to cope with various vehicles. In this study, in order to overcome the shortcomings of the passive pedal simulator specialized for one vehicle, we describe the concept of a modular passive type pedal simulator for various vehicles, which is capable of adjusting stiffness for each displacement. Furthermore, by using the force-balancing mechanism, this pedal simulator prevents noise and uneven wear, and enables long-term uses.

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EV 중량 및 전기식 유압 부스터를 고려한 전·후륜 제동시스템 모듈러 설계에 관한 연구

심재훈* · 신웅희** · 황세라* · 이중희* · 임원석* · 우영주**

A Study on Modular Design of Front·Rear Brake System Considering EV Weight and Electric Hydraulic Booster

J. H. Shim*, U. H. Shin**, S. R. Hwang*, J. H. Lee*, W. S. Yim*, Y. J. Woo**

Key Words : Electric Vehicle(전기차), Hydraulic Braking(유압 제동), Electronic Brake Force Distribution(EBD), Regenerative Braking(회생 제동), Electric Hydraulic booster(전기식 유압 부스터)

ABSTRACT

Many car manufacturers in the world are trying to produce and develop a variety of electric vehicles in response to increasing demanding market needs. However, there are some critical problems to overcome compared to developing the internal combustion engine vehicles. Especially, brake system has a lot of demanding tasks in relation to deciding specification of brake system because of heavy vehicle weight, narrow power electric room space and the volume of electric hydraulic booster. In this paper, a new approach is proposed for deciding the front and rear brake systems in order to design the brake system of electric vehicles effectively. To do this, we study correlations among vehicle weight, power electric room package and electronic hydraulic actuator. And then, we also study combination of hydraulic braking and regenerative braking which can be applied because of electric vehicles. Finally, it will contribute to build up modular design for brake system which is optimized for architecture of electric vehicles.

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다중 재귀 최소 자승 추정 알고리즘 기반 모빌리티의 회전체 건전성 모니터링 방법 개발

라한별* · 이지웅** · 오광석***

Development of a Method for Health Monitoring of Rotating Object for Mobility Based on Multiple RLS Algorithms

Hanbyeol La*, Jiung Lee**, Kwangseok Oh***

Key Words : Health monitoring(건전성 모니터링), Rotating object(회전체), Recursive least squares(재귀 최소 자승), Forgetting factor(망각 인자), Torque constant(토크 상수), Back EMF constant(역기전력 상수)

ABSTRACT

This study presents a method for health monitoring of rotating objects for mobility based on multiple recursive least squares(RLS) algorithms. In various mobility systems, a number of rotating objects like motor have been used for various functions such as driving, steering, suspension, etc. The performance of the rotating objects is degraded continuously by friction·wear property of the mobility system. The performance degradation of the rotating objects causes low handing / low driving performances and even fatal accidents. Therefore, health monitoring algorithm of rotating objects is one of the important technologies for mobility fail-safe and maintenance areas. In order for health monitoring of rotating objects, three recursive least squares algorithms with forgetting factor were designed in this study to estimate uncertainty of rotating dynamics and parameter changes. The health monitoring algorithm proposed in this study consists of two steps such as uncertainty estimation and parameter changes estimation. In the uncertainty estimation step, uncertainty of mathematical model(DC motor) for rotating object is estimated by RLS with single forgetting. In the parameter changes estimation step, differences between nominal and changed parameter(torque constant and back EMF constant) values are estimated based on the estimated uncertainty using RLS with single forgetting. In order to improve estimation accuracy, time delay function was applied to the estimated signals based on the first order differential equation and forgetting factors used for the RLS were reasonably tuned. The health monitoring algorithm was constructed in Matlab/Simulink environment and simulation-based performance evaluation was conducted using DC motor model. The evaluation results showed that the proposed algorithm estimates the actual parameter differences reasonably using velocity and current information. It is expected that the estimation algorithm architecture proposed in this study can be used for health monitoring of rotating objects in various mobility systems.

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다차로 좌회전 교차로에서 자율주행 차량을 위한 종방향 거동 계획

유진수* · 김창희** · 이경수***,†

Longitudinal Motion Planning for Autonomous Vehicles at Multi-Lane Turn Intersection

Jinsoo Yoo*, Changhee Kim**, Kyongsu Yi***,†

Key Words : Autonomous driving (자율주행), Motion Planning (거동 계획), Model Predictive Control (모델 예측 제어), Intersection (교차로)

ABSTRACT

This paper proposes the development of longitudinal motion planning algorithm for autonomous vehicles at multi-lane turn intersection that guarantees ride comfort and the safety. In the urban intersection where road networks are complicated and multiple lanes exists for left turn, vehicles frequently intrude near-by lanes while making a turn in multi-lane intersection, especially during a multi-lane left turn. Due to such invasion during a multi-lane turn, a proper motion planning is required to prevent the potential collision from surrounding vehicles. In this paper, we designed a motion planning algorithm composed of a mode decision and a model predictive controller based optimal longitudinal controller. The mode decision defines the possible collision region with surrounding vehicles, and the MPC based longitudinal controller determines the desired optimal control input that maintains the safety and ride comfort. The effectiveness and performance of the proposed algorithm is evaluated through MATLAB simulation with multi-lane left turn scenario at intersection. The simulation environment such as road width and curvature reflect the real road specifications. The simulation result describes that the proposed motion planning ensures the ride comfort and safe crossing at the intersection against lane-intruding surrounding vehicles.

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믹사모 애니메이션을 활용한 실제 보행자 행동패턴 모델링

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Pedestrian Behavior Pattern Modeling Using Mixamo Animation

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Key Words : Pedestrian behavior patterns(보행자 행동 패턴), Automotive safety systems(자동차 안전 시스템), Adobe mixamo(아도비 믹사모), Autonomous vehicles(자율주행 자동차), Accident reproduction(사고 재현)

ABSTRACT

In 2022, the OECD reported that Korea's pedestrian fatality rate was 2.5 times higher than the average of OECD member countries. Given this context, modern automotive safety systems targeting Level 4 autonomous driving in Korea emphasize recognizing and responding to diverse pedestrian behaviors. Especially, pedestrian accident tests, which cannot be conducted with real vehicles, must be simulated repeatedly. However, current simulation software for replicating diverse pedestrian motions are limited. This study utilized over 1,800 motion data from Adobe Mixamo to closely model real-life behaviors. Users could combine various behavior patterns to create pedestrian animations. To ensure smooth transitions between animations, the position, rotation, and scale values of each body part were utilized. The developed modeling technology, capable of naturally representing pedestrian behaviors in virtual environments, is anticipated to be beneficial for automotive safety systems and accident reproduction simulations. Further research will categorize pedestrian accidents using IGLADS data, distinguishing various situations. By providing the most frequently used animations as default presets for each type, it is expected to enhance user convenience.

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RTMAPS를 이용한 딥러닝 기반의 가상 카메라 센서 구현

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Implementation of Deep Learning Based Virtual Camera Sensor Using RTMAPS

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Key Words : ADAS(첨단운전자지원시스템), AEB(긴급제동장치), FCW(전방충돌 경고 시스템), SCANeR Studio(차량 시뮬레이터 운용 프로그램), YOLOv4(객체 탐지 딥러닝 알고리즘), RTMAPS(Real-Time Multisensor Applications)

ABSTRACT

Recently, advanced driver assistance system (ADAS) has seen widespread use in vehicles with the goal of improving driver safety and convenience. One of the key functions within ADAS is the Autonomous Emergency Braking (AEB) system. When the AEB system is activated, the Forward Collision Warning (FCW) is the first function to alert drivers to a potential danger. If brake is not applied by the driver, the vehicle's system takes control to apply emergency braking and bring the vehicle to a stop. Consequently, when analyzing accident related to emergency braking system, simulating accident from the driver's perspective is necessary. This can be achieved using a vehicle simulator equipped with AEB. AEB operation typically involves object detection in front of the vehicle using radar sensor and camera sensor. In SCANeR Studio, a vehicle simulator program, virtual radar and camera sensor can be implemented for analysis. In this study, the goal is to acquire camera sensor data using the YOLOv4 deep learning algorithm from images obtained from the virtual camera sensor in the vehicle simulator. However, when deep learning algorithm was applied based on MATLAB/Simulink, a significant reduction in operating frequency occurred, dropping from standard 100 Hz to 1 Hz. To solve this issue, dSPACE's RTMAPS (Real-Time Multisensor Applications) is applied to improve the operating frequency up to 30 Hz, and the output of object position information from the camera sensor data is confirmed. In the future, the plan is to optimize the vehicle simulator to enhance the operating frequency up to 100 Hz. Additionally, sensor fusion between the camera sensor and radar sensor will be implemented to create a simulation environment for emergency braking that closely resembles real vehicle.

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Prescan을 활용한 ADAS 센서 퓨전 및 MIO 판별에 관한 연구

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A Study on ADAS Sensor Fusion and MIO Identification Using Prescan

Sehwan Lee*, Sanghyun Ko*, Jaehyeong Lee**, Jonghyuk Kim**, Jihun Choi***, Woojeong Jeon****

Key Words : ADAS(첨단 운전자 지원 시스템), AEBS(긴급 제동 시스템), SCC(스마트 크루즈 컨트롤), MIO, Prescan(ADAS 시뮬레이션 프로그램), Data Association(데이터 연관), Track Management(트랙 관리), GNN(최단 거리 이웃)

ABSTRACT

Cars equipped with Advanced Driver Assistance Systems (ADAS) have seen a significant increase in their supply in recent times to improve the safety and convenience of vehicle driving. Among various ADAS functions, the identification of vehicles in front or Vulnerable Road Users (VRUs) and the accurate determination of the Most Important Object (MIO) that poses a collision risk are achieved using radar and camera sensors. To accomplish this, techniques such as Object Tracking, Sensor Fusion, and Collision Prediction models must be applied. In this study, Track Management was performed by iteratively applying Kalman filtering and Data Association to sensor data from radar and cameras measured in the Prescan and Matlab/Simulink environments. This allowed continual creation, maintenance, updating, and elimination of tracks for the detected targets, resulting in systematic and reliable object tracking. Furthermore, fusion targets for radar and camera sensor data were determined separately using Mahalanobis distance and Global Nearest Neighbor (GNN), leading to sensor fusion that incorporates the characteristics of each sensor. Finally, a collision risk prediction model was applied to sensor fusion data to ensure the accurate identification of the MIO. Anticipations include enabling accident analysis related to ADAS functions and making sensor fusion-integrated accident reconstruction simulations closer to real-world applications possible. Future plans involve further improvements in the ADAS sensor fusion and MIO identification algorithms discussed in this study through a wider range of ADAS real-world experiments.

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고정밀 도로 교통 환경 디지털 트윈 기반 도로교통 시뮬레이션

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Simulation of High-Fidelity Road Traffic Environment Based on Digital Twin for Road Traffic

Wonsang Lee*, Jonghwa Kim**, Jun Hong***

Key Words : Digital twins(디지털트윈), Simulation(시뮬레이션), Autonomous vehicles(자율주행차).

ABSTRACT

Traffic simulation is becoming increasingly important in urban planning and transportation systems. By analyzing traffic flows, infrastructure planning and safety planning can be carried out systematically. Furthermore, it can support the validation and decision-making of transportation policies. In this study, we aim to implement traffic flow simulation by building a high-precision road traffic virtual environment based on digital twins.

In order to develop a high-precision road traffic simulation based on digital twins, it is necessary to digitally twin the road traffic environment using public map data. To build a digital twin, it is necessary to analyze public map data to place objects and create roads, as well as technology to build road nodes and reproduce lanes. MORAI SIM has developed a technology that utilizes Mgeo to create lane meshes, traffic signs, etc. and integrates 3D objects to create a digital twin environment. In addition, we analyzed UI/UX features for users to effectively use the simulation. By defining functions for scenario items such as scenario settings, weather environment settings, and speed settings for vehicles and pedestrians, we derived basic UI/UX functions for autonomous driving and control simulators. Regarding UI/UX functions for the traffic flow simulator, we derived UI/UX functions for calculating the mixing ratio of autonomous vehicles compared to regular vehicles, multi-ego settings for deploying autonomous vehicles, and data extraction functions.

Through this, we are working on creating objects that affect autonomous vehicle-motorized vehicle mixing situations and developing UI/UX features to make it easier for users to analyze traffic flow simulations.

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관제 통합단말기를 이용한 VILS 환경 구축

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Configuring a VILS Environment with the Control-Integration-Panel

Wonsang Lee*, Jonghwa Kim**, Jiwon Jung***

Key Words : K-City, VILS, V2X.

ABSTRACT

Autonomous vehicles are vehicles that can drive themselves without the need for a driver. As the technology in these vehicles continues to improve, the new autonomous features consumers encounter are becoming more sophisticated. However, this is limited to auxiliary functions, and as the level of automation improves in the future, autonomous driving system errors are expected, and to solve these errors, research is being actively conducted at home and abroad to provide services to autonomous vehicles through V2X (Vehicle to Everything) technology and overcome the limitations of system errors.

In this paper, an autonomous driving VILS (Vehicle In the Loop Simulation) system for evaluating autonomous driving systems was built using V2X standard-based Control-Integration-Panel, ASAM (OpenX), and autonomous driving simulator advancement. We developed an HMI interface for interconnecting an Control-Integration-Panel with a precise virtual K-City environment and tested an actual vehicle-control interlocking system, and we plan to test an autonomous driving VILS system using autonomous vehicles in the future.

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Research on Anti-Submarine Restraint Devices for Passengers in Relaxed Seating Posture

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Key Words : Submarine(서브마린), Relaxed seating posture(릴렉스 착좌), Vehicle restraint device(차량 안전장치)

ABSTRACT

With the development of ADAS (Advanced Driver Assistant Systems) technology, the degree of freedom of passenger seating in vehicles is increasing. Some vehicle manufacturers have already implemented to set relaxed seating posture on the passenger seat through a remote button. However, research on passenger injuries caused by such relaxed seating positions is still in progress, and in particular, research on the submarine phenomenon, in which passengers are separated from the belt, is urgently needed.

In the present study, main factors affecting occupant's submarining were derived and studied. For this purpose, a literature search on submarine-related study was conducted. In addition, based on a literature review, a crash analysis was conducted on the primary derived factors to analyze the impact of various restraint devices on the passenger's submarine. The hybrid-5% and Thor-50% dummies were chosen as target dummies to represent the injury of female and male occupants, respectively. Advanced restraint devices such as seat cushion airbag, adaptive passenger-side airbag and enlarged knee airbag were adopted for the crash analysis to evaluate the performance of each devices. It was shown that the interior of the vehicle was not found to be a major factor in the occurrence of submarines, while the type and seating posture of passengers were found to have a significant impact on the occurrence of submarines. In terms of restraint devices, seat cushion airbags were found to be most effective in controlling the dummy's submarine, and knee airbags were also found to be effective. In other words, it is judged that lower body restraint is more effective than upper body restraint for controlling the occurrence of submarines.

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패시브 타입 브레이크 페달 답력 시뮬레이터에 대한 연구

정충표* · 박태상* · 이재성* · 진성호**

Study on Passive Type Brake Pedal Reaction Force Simulator

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Key Words : Passive type pedal simulator(패시브 타입 페달 시뮬레이터), Brake pedal simulator(브레이크 페달 시뮬레이터), Pedal reaction force(페달 반력)

ABSTRACT

Recently, the production and distribution of electric vehicles, which replace internal combustion engines, have expanded, and many elements that make up the vehicle are becoming electronic for the safety and convenience of drivers. Among elements related to vehicle braking, electronic parking brakes have been commercialized, and electro-mechanical brakes are under development for commercialization. Lastly, in the case of the brake pedal, the integrated electric booster method that generates brake pedal reaction force with the power of the motor is gradually being applied, but it has the limitation of high costs due to the use of a separate actuator. Accordingly, in this paper, we propose a passive type brake pedal reaction force simulator structure and compare the pedal effort deviation through actual production and testing.

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사고기록장치 데이터 분석 및 사례 연구

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Analysis and Case Study of Event Data Recorder

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Key Words : Event data Recorder(사고기록장치), Cross validation(교차검증), Principal direction of force(충격력 방향), Short-Time Fourier Transform(단시간 푸리에 변환)

ABSTRACT

In addition to dashcam and CCTV footage, the utilization of Event Data Recorders (EDRs) installed in vehicles for traffic accident analysis has recently increased. EDRs are generally integrated into the airbag control unit as a data recorder. When certain conditions are met, such as a vehicle impact, they are programmed to record. The recorded data contains crucial vehicle information required for comprehensive traffic accident analysis. Included in the data are the pre-crash driving speed, engine rpm, accelerator pedal displacement, and brake switch activation. However, EDRs not only lack the capability to record the absolute time of an event but also face ongoing doubts regarding the reliability of stored data. Our research involved designing software to extract data from EDRs in PDF format for effective analysis. In addition, we also cross-validated the reliability of the data by checking the driving paths, acoustic data, and vehicle damage types recorded in the video in various real-world cases.

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휠 베어링 열처리 패턴을 고려한 플랜지부 피로 수명 예측

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Fatigue Life Prediction Considering Induction Hardening Pattern of Wheel Bearing

Yunsun Choi*, Yeonsik Lee*, Jangwoong Park*

Key Words : Wheel bearing(휠 베어링), Fatigue analysis(피로해석), Bearing life(베어링 수명), Induction hardening (고주파 열처리)

ABSTRACT

The wheel bearing is one of the most important components in vehicle to translate the rotary motion and support the vehicle weight. Because performance should be maintained until the end of actual service life, it is important to confirm fatigue property thought fatigue test. However, due to the characteristic of fatigue test, it is efficient to implement it through analysis to save cost.

In this study, the damage location was predicted using improved induction hardening patterns and mechanical properties. The damage location and fatigue life were confirmed through analysis simulating the flange fatigue test of wheel bearings. The stress selection method was used to consider the mechanical properties of induction hardening and other parts, and the validity of the results was confirmed by comparing the analysis results and test results. The programs MSC.Marc and FEMFAT were used for analysis.

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자율주행 자동차의 사고유형 분류 및 특성에 관한 연구

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A Study on the Classification and Characteristics of Accident Types in Autonomous Vehicles

Sangheon Ha*, Byungdeok In**, Jeongman Park**, Jongjin Park***

Key Words : AV(Autonomous vehicle), ADS(Automated Driving System), ADAS(Advanced Driver Assistance System), Traffic accident(교통사고), Accident Investigation(사고조사)

ABSTRACT

The European Union reports that more than 90% of traffic accidents are caused by human factors, and if they are replaced by autonomous vehicle(AV), it can be expected that the occurrence of accidents will be greatly reduced. On the contrast, according to a recent report by the NHTSA (National Highway Traffic Safety Administration), there were 1072 accidents in cars with ADAS (Advanced Driver Assistance System) and 378 accidents in cars with ADS (automated driving system) for within two years from July 2021 to July 2023. Accordingly, there is a need for detailed investigation items to clarify the responsibility and analysis of the cause of the accident in the event of an AV accident.

In this study, 101 AV accidents reported to the DMV (California Department of Motor Vehicles) in 2023 were classified using IGLAD, following a prior study that analyzed the types of traffic accidents through accident cases of general vehicles and ADAS-equipped cars.

Through this, Through this, the type of autonomous vehicle accident was identified, and the accident situation and road environment by type were analyzed to derive differences from non-autonomous vehicle accidents, and found that 67 out of 101 accidents occurred in autonomous driving mode, followed by collisions while driving, collisions while waiting for intersections, and collisions caused by traffic jams. Further, in 24 of the 67 autonomous driving mode accidents, the other vehicle escaped after the accident. It is found that there is a high risk of escape in the event of an AV accident. As it is expected that an accident analysis method in preparation for AV accident will be needed in the future, and it is intended to help select detailed investigation items for autonomous driving accidents through analysis of actual AV accident cases.

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PG내 VILS 시험안전지원을 위한 V2X 연계지원 방법 연구

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Research on V2X Linkage Support Method for VILS Test Safety Support in PG

Jongho Han*, Yoonki Yoon**, Eunju Yang**, Sujin Hwang***, Bongseob Kim****, Byungdo Kang*****

Key Words : Prving Ground(주행시험장), VILS(실차기반시물레이션), V2X(차량-사물간 통신), Test Safety Support (시험안전지원), Linkage Support(연계지원)

ABSTRACT

본 논문은 PG내 VILS차량의 시험안전지원을 위하여 VILS차량 주변으로 시험차량(일반)이 접근해올 때 V2X기반의 연계지원 방법에 관한 연구를 수행하였다. 우선 VILS차량에 설치되어 있는 센서시스템에 대해서 조사분석을 하였고, 이를 기반으로 VILS차량과 시험차량간 연계지원 방법에 대해서 구성해보았다. 구성으로는 시험차량에 연계 지원을 위한 데이터전송모듈 및 이를 기반으로 전송가능한 데이터 정보로 위도, 경도, 속도, 방향 등을 고려하였다. 향후 본 연구를 통하여 PG내에서 VILS차량이 자율주행평가를 수행하고 있을 때 주변시험차량이 접근해오는 정보를 알 수 있으며, 이 정보를 통하여 VILS차량의 자율주행평가 시에 시험을 안전하게 수행하였으면 한다.

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