자율주행자동차

자율주행 자동차의 안전한 제어권 전환을 위한 인터페이스 부품 동작 기준 및 시나리오

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Interface Components Operating Criteria and Scenarios for Safe Takeover of Autonomous Vehicles

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Key Words : Autonomous vehicle(자율주행 자동차), Evaluation scenario(평가 시나리오), Human machine interface (휴먼 머신 인터페이스), Safety standard(안전 기준)

ABSTRACT

As autonomous driving technology advances, interface components are being developed to provide convenience, and activities such as meeting, reading, and eating are taking place inside the vehicle. The National Highway Traffic Safety Administration (NHTSA) in the United States has eliminated the mandatory installation standards for manual control devices such as steering wheels and brake pedals, allowing fully autonomous vehicles to operate on roads without human intervention. Ensuring the safety of autonomous vehicles using interfaces in various environments is crucial for their commercialization. In hazardous situations, the system must transition demand to the driver, necessitating harmony between internal and external interface components of the vehicle. When applying advanced interface functionalities to autonomous vehicles, it is essential to consider the possibility of risks arising from both technical faults in the electric/electronic systems of autonomous driving technology and the intended functional performance insufficiencies of autonomous driving due to ISO 21448 (SOTIF). However, UNR157, the regulation for automated lane keeping systems, lacks sufficient information regarding defects or functionalities that may arise when applying interface technology. This study analyzes existing content on control transitions in autonomous vehicles and utilizes the PEGASUS 6-layer approach to classify the causes of autonomous driving disengagement situations. Standards for the operation of interface components based on various causes of autonomous driving disengagement in different environments were established, and evaluation scenarios were generated. Using the autonomous driving simulator MORAI SIM, driving scenarios were constructed, and the operation of interface components was evaluated with simulations. It is expected that interface components will safely respond to autonomous driving situations, thus ensuring the safety of autonomous vehicles.

본 연구는 정부(산업통상자원부)의 재원으로 한국산업기술평가관리원의 지원을 받아 수행되었음. (No. 20019115)

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정면충돌 시 자율주행자동차 승객의 안전도 평가 연구

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Safety Evaluation of Autonomous Vehicle Occupants in Frontal Crash

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Taehoon Lee**, Woo Jong Kang***, Kyungjin Kim***, Jaeho Shin***

Key Words : Safety evaluation(안전도 평가), Frontal crash simulation(정면 충돌 해석), Relaxed posture(편의 자세), Occupant injury(승객 상해), Autonomous vehicle(자율주행 자동차)

ABSTRACT

In the development of autonomous vehicles and occupant safety systems, vehicle occupant postures are anticipated to vary and current restraint systems are not expected to be suitable for a wide range of occupant postures. In particular, it is reported serious injuries occurred in frontal collisions in the reclined posture. Therefore, it is necessary to investigate the biomechanical occupant response in the reclined posture. This study analyzes the behaviors and injuries of human model (THUMS) in the relaxed positions. Frontal crash sled simulations with semi-rigid seats and three-point seat belts with pretensioners are performed and model biofedelities and injury tolerance are evaluated by comparing with post mortem human surrogate (PMHS) data. The results are applicable to the design of new restraint systems suitable for reclined postures.

본 연구는 '자율주행기술개발혁신사업, 주행 및 충돌상황 대응 안전성 평가기술 개발'의 연구결과로서 국토교통부와 국토교통과학기술진흥원의 지원 하에 수행되었으며, 이에 관계자 여러분께 감사드립니다.

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V2X 단말기 장착 차량의 물리적 위험 유발 요인 분석

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Physical Risk Factor Analysis of V2X On-Board Unit Equipped Intelligent Vehicle

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Key Words : LTE-V2X(4세대 차량사물통신), Physical Risk Factor(물리적 위험 요인), Intelligent Vehicle(지능형 자동차), On-Board Unit(V2X 차량단말기)

ABSTRACT

This paper presents physical risk factor analysis of vehicle to everything(V2X) On-Board Unit(OBU) equipped intelligent vehicle. Since Long Term Evolution(LTE) based V2X(LTE-V2X) has been selected to the standard of vehicular communication in Korea, vehicle safety needs to be investigated considering LTE-V2X communication vulnerability. One of the most challenging communication vulnerabilities is due to the physical factor such as roadside objects, dynamic parameter (relative velocity and speed) and weather conditions. The effect of physical risk factors has not just been surveyed through LTE-V2X related works but also conventional communications (e.g. dedicated short-range communications : DSRC). This extends the potential threat and allows get prepared to handle safety critical situation due to the physical factors of the V2X communication. This can be done while ensuring similarity on between LTE and DSRC in terms of vehicular communication. It has been shown from surveyed literature studies that LTE-V2X communication performance is more likely to get affected by its material and size of the objects, relative velocity, and dust including icy road conditions with dense road traffic.

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Transformer 모델을 이용한 차량 주행 패턴 시각화

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Visualizing Vehicle Driving Patterns Using the Transformer Model

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Key Words : Transformer(트랜스포머), Deep learning(딥러닝), Clustering(클러스터링)

ABSTRACT

The topic of analyzing and utilizing data on vehicle driving patterns can present a new environment in terms of drivers' vehicle operation. This study collected data, including steering angles, wheel speed, acceleration pedals, and brakes, from drivers. It utilized an LSTM-Autoencoder algorithm with Self-Attention to visualize the driving patterns of the vehicles. To improve the performance of Loss and Accuracy, the study utilized the Transformer model, which originated in the field of natural language processing (NLP) and has proven its efficiency and flexibility in various fields such as image recognition, voice recognition, and time series data analysis. Compared to the existing models (LSTM-Autoencoder and LSTM-Autoencoder with Self-Attention), the Transformer model used in this study demonstrated significant improvements. Specifically, in comparison to the prior use of Self-Attention, the Loss value was reduced by approximately 99.90% to 0.00529, and the Accuracy was increased to 99.74%, representing a 2% improvement. Additionally, compared to the original LSTM-Autoencoder model, the Loss value saw an improvement of approximately 99.93%, and the Accuracy showed a 4.4% enhancement.

후기

2024년 한국교통대학교의 지원을 받아 수행하였음.

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대리모델 및 확률모델을 기반으로 한 자율주행자동차 테스트 시나리오 생성 방법 관련 기초연구

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A Preliminary Study on Generation of Testable Concrete Scenario Based on Surrogate and Stochastic Models for Automated Vehicles

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Key Words : Parameter space(파라미터 공간), Concrete scenario(상세 시나리오), Surrogate model(대리 모델), Stochastic model(확률 모델)

ABSTRACT

In this paper, a generation method for testable concrete scenarios based on surrogate and stochastic models is proposed to achieve a desired distribution with respect to performance measures for test and validation of autonomous driving systems. Once a logical scenario is defined, a set of concrete scenarios are generated depending on the parameter space where the number of parameters is defined as its dimension. The generation of concrete scenarios implies selection of scenario parameters and they may be chosen by either linear-spacing or random sampling methods. However, it is in general limited for these approaches to generate a set of concrete scenarios with a desired distribution with respect to performance index, e.g., time-to-collision (TTC) and lateral collision index. Thus, the generation method for testable concrete scenarios with a desired distribution is proposed as three key steps. First, a set of concrete scenarios are selected randomly and their simulation results are used to build up a surrogate model in the form of multi-layer perceptron (MLP). Second, an additional set of augmented scenarios are searched via gradient of the surrogate model to achieve a desired distribution of scenarios in terms of threat measures. Then, a generation model to select a set of scenario parameters randomly among testable concrete scenarios is proposed. Finally, suppose two different Gaussian distributions with respect to a threat measure are given as the desired ones for simulation tests in the car-following scenario. It is demonstrated that stochastic generation of the testable concrete scenarios as proposed above has a similar distribution of concrete scenarios compared with the desired one to the threat measure.

This work was supported in part by the Korea Agency for Infrastructure Technology Advancement (KAIA) Grant by the Ministry of Land, Infrastructure and Transport, under Grant 22AMDP-C162184-02.

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