자율주행기술 & 제어

국립한국해양대학교의 C-ITS 기반 자율주행 기술: K-City 실증

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C-ITS Based Self-Driving Technologies of Korea Maritime and Ocean University – An Autonomous Journey on K-City

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Key Words : Cooperative Intelligent Transport Systems(협력 지능형 교통시스템), Cooperative Control(협력 제어), Dilemma Zone(딜레마 존), Autonomous Vehicle(자율주행 차량)

ABSTRACT

This paper presents an integrated perception–decision–control framework based on Cooperative Intelligent Transport Systems (C-ITS) to enable autonomous vehicles to drive stably at intersections, particularly in dilemma zones where stop-or-go decisions during yellow-signal transitions are ambiguous. Autonomous vehicles are increasingly required to make safe and accurate driving decisions in complex traffic environments characterized by frequent signal transitions at intersections. Dilemma zones formed during yellow-signal changes increase the risk of accidents, and perception sensors alone exhibit limitations in reliable decision-making. To address these limitations, a C-ITS–based integrated system is developed to allow autonomous vehicles to establish and execute optimal driving strategies through vehicle–infrastructure communication. During perception, data from onboard sensors (camera, LiDAR, and GPS) are fused with Signal Phase and Timing (SPaT) information provided by Roadside Units (RSUs) to determine the vehicle's position and signal state. Decision computes the optimal driving strategy by considering SPaT data, vehicle speed, and distance to the stop line. Under yellow-signal conditions, the remaining signal time and vehicle dynamics are analyzed to evaluate the appropriateness of acceleration or deceleration. Control delivers the computed decision to the vehicle controller, enabling safe stopping or smooth intersection traversal. It has been shown that the proposed C-ITS–based framework achieves stable transition behavior under yellow-signal conditions and enhances both safety and operational efficiency at intersections through real-world experiments.

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자율주행차량의 교차로 회전을 위한 차선 변경에 관한 연구

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A Study on Lane Changes for Autonomous Vehicles Turning at Intersections

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Key Words : Van-class vehicles(승합차급차량), Lane change timing(차로 변경 시점), Maintain specific lanes(차로 유지)

ABSTRACT

Van-class autonomous vehicles must maintain specific lanes at intersections and consecutive turning sections on multi-lane roads. For left turns, maintaining the first lane is required beforehand, while for right turns, maintaining the last lane is required beforehand. Therefore, to enable autonomous vehicles to turn at intersections and consecutive turning sections, a path must be provided that offers sufficient time and spatial margin for lane changes. Specifically, an algorithm is needed to determine the optimal lane position for turning by judging the lane change timing based on the previous lane's position and the feasibility of moving to the designated lane for the specified lane turn. The lane change decision algorithm can generate a path for a Van-class autonomous vehicle by calculating the lane required for the turn and the minimum distance needed to change lanes to reach that position. Furthermore, when consecutive turns occur, the vehicle can verify whether safe movement is possible by considering the location where each turn occurs and the location where the next turn will occur. The path generated through this process minimizes abrupt lane changes by the vehicle, enabling the expectation of safe driving for the autonomous vehicle.

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Point-to-Point Level 4 자율주행을 위한 HD Map 기반 경로정보 표준화 연구

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A Study on Standardization of HD Map-Based Path Information for Point-to-Point Level 4 Autonomous Driving

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Key Words : Autonomous Driving; Point-to-Point (P2P) Level 4, HD Map; Path Information, Trajectory; ADASIS V3, Standardization, Interoperability

ABSTRACT

In Level 4 autonomous driving, the implementation of Point-to-Point (P2P) services requires the provision of precise path information to ensure that vehicles can reach their destinations safely and efficiently. In particular, lane-level trajectory-based path information plays a critical role in trajectory prediction and motion planning. However, when proprietary trajectory formats are applied to different autonomous driving systems, issues of interoperability and limitations in scalability arise.

To address these challenges, this study proposes a method of mapping and applying lane-level trajectory path information to the standardized structure of ADASIS V3. ADASIS V3 defines road and path information within a hierarchical structure and provides trajectories and various metadata in a standardized format, thereby resolving interoperability and scalability issues among autonomous vehicles. In this study, we present a strategy for converting trajectory formats into the ADASIS V3 message structure and validate its feasibility through dataset-based evaluation.

The results demonstrate that the proposed approach significantly improves the reusability and interoperability of path information, and is expected to contribute to the realization of P2P-based Level 4 autonomous driving services.

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카메라–라이더 센서 융합 모델의 효율적 학습을 위한 유사성 기반 데이터 선택: 일반화 성능 및 강건성 향상

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Similarity-Based Data Selection for Efficient Learning of Camera-LiDAR Sensor Fusion Models: Enhancing Generalization and Robustness

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Key Words : Sensor fusion model(센서 융합 모델), Efficient(효율성), Generalization(일반성), Robustness(강선성), Data Selection(데이터 선별), Similarity(유사도), Clustering(군집화)

ABSTRACT

The training of sensor fusion models faces several challenges, including the demand for vast amounts of data and computational resources, degradation of generalization performance due to redundant data, and insufficient robustness to sensor noise. This study aims to enhance training efficiency, generalization performance, and robustness simultaneously by applying a similarity-based data selection strategy in the training process of camera-LiDAR fusion models.

Specifically, feature vectors extracted from images were used to measure similarities between data samples and cluster them accordingly. Representative samples were then selected from each cluster to construct the training dataset. This dataset was compared against randomly sampled datasets and the entire dataset and was applied to train the BEVFusion model.

Experimental results demonstrated that the proposed data selection strategy significantly reduced training time, thereby improving efficiency, while maintaining or enhancing generalization performance compared to conventional methods. Furthermore, robustness was also improved, showcasing the potential of this approach as a reliable data utilization strategy for large-scale autonomous driving training.

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Modeling of an Active Suspension System for e-Corner Module-Based Mobility Platform

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Key Words : Active suspension(액티브 서스펜션), e-Corner module(이코너 모듈), Vehicle modeling(차량 모델링)

ABSTRACT

This study focuses on the modeling phase of an active suspension system applied to an e-Corner module based mobility platform. The aim is to build a physical model that can describe the vehicle body's heave, pitch, and roll motions when the vehicle moves over different road and load conditions. Since each e-Corner module independently performs driving, steering, braking, and suspension functions, an accurate description of how the body moves and tilts is important for understanding the vehicle's overall behavior.

The proposed model represents how the suspension structure, vehicle body, and road surface move together, considering the spring and damping characteristics that influence vertical and tilting motions. It also includes the effect of active forces generated by the actuators inside each corner module, which help control the vehicle's height and body posture. Main parameters such as body and wheel masses, stiffness, damping, and geometric layout are defined using practical industrial data.

The developed model provides a basic framework for studying how the vehicle's height and tilt change under various road conditions. This model will be further expanded to design and test active suspension controllers that can coordinate the vehicle's vertical and tilting motions. The outcome of this study will contribute to improving the stability and comfort of future mobility platforms that use e-Corner modules.

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