능동안전(제어) II

자율주행 차량 주행 안전을 위한 포트홀 검출 딥러닝 알고리즘

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Pothole Detection Algorithm for Safe Autonomous Driving using Deep Learning

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Key Words : Autonomous Driving(자율 주행), Deep Learning(딥 러닝), Pothole Detection(포트홀 검출), Object Detection(객체 검출)

ABSTRACT

This paper presents a deep-learning based pothole detection algorithm to enhance driver safety and comfort in autonomous vehicles. Contrary to motorways, urban environments show significantly numerous variables that affect comfort and safety in autonomous driving. Of these, the road condition stands as one of the most influential variables as not only is it unpredictable, but also highly susceptible to external factors such as obstacles and weather conditions. Potholes, in particular, that can arise from heavy rain and poor maintenance, have a high potential to lead to accidents if not recognized in time. In this paper, a deep learning algorithm for pothole detection has been developed for use with mono-eye camera. The algorithm utilizes a deep neural network based on the feature pyramid, and was trained and validated on an open dataset provided by AI-Hub.

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자율주행 기록장치(DSSAD) 데이터 추출 및 분석시스템 표준화 활동 소개

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Introduction of Standardization Activities for DSSAD Data Extraction and Analysis System

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Key Words : Automated driving(자율주행), DSSAD(자율주행 기록장치), Data extraction(데이터 추출), Traffic accident analysis(교통사고 분석), Standardization(표준화)

ABSTRACT

KADIF(Korea Autonomous driving Development Innovation Foundation) was recently launched to foster the foundation for the commercialization of convergence level 4+ autonomous vehicles in Korea in '27. The project group is promoting many projects under the banner of realizing a safe and convenient life for the people through fostering a new autonomous driving industry. Among them, we refer to the development of DSSAD(Data Storage System for Automated Driving), a driving information recording device for autonomous vehicles. This presentation introduces the standardization of the data extraction and analysis system, which is being carried out in the "Development of extraction and analysis system for DSSAD accident analysis" project hosted by the Korean National Police Agency. And we briefly address the composition and activities of the standardization committee launched this year for data extraction and analysis system of autonomous vehicle traffic accidents.

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LSTM 추정기를 이용한 MPC기반 4륜 독립 조향 차량 경로 추종

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MPC Based Four Wheel Independent Steering Vehicle Path Tracking using LSTM Estimator

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Key Words : Long short-term memory(장단기 기억), Model predictive control(모델 예측 제어), Path tracking(경로 추종), 4 wheel independent steering(4륜 독립 조향)

ABSTRACT

In this study, tire longitudinal force and lateral vehicle velocity were simultaneously estimated using the long short-term memory(LSTM) model, and demonstrated the feasibility of autonomous safe driving by using model predictive control(MPC) algorithms for path tracking in various driving environments (e.g. friction coefficient, driving velocity). In order to apply the proposed method to the real vehicle system, the robustness of the estimator and controller was verified. For robustness verification, an analysis of vehicle dynamic behavior for sensor noise and parametric changes was conducted. In addition, the extrapolated data were used to verify robustness in an environment outside the training set boundary. Finally, we compared the tracking and stability performance of the Front wheel steering(FWS) system and the 4-wheel independent steering(4WIS) system with a validated estimator, and verified that the vehicle of the 4WIS system showed better performance with faster recovery maneuvering.

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Direct Yaw Moment Control을 위한 최대 그립 한계 고려 실시간 타이어 그립 추정기 개발

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A Development of Real-Time Estimator on Maximum and Present Tire Grip for Direct Yaw Moment Control

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Key Words : Friction saturation limit, Wheel slip inhibition control, Direct yaw moment control(DYC), Torque-vectoring(TV), Wheel position sensor, Wheel force transducer

ABSTRACT

This study proposes a method for estimating the maximum and present tire grips of a driving vehicle in real time. Direct yaw moment control (DYC) based on detecting wheel slip does not significantly affect general driving due to wheel slip at medium and low speeds. However, during the high-speed driving of a high-performance vehicle or driving within a racing track, frequent wheel slips have a significant adverse effect on the driving performance. This is because a tire that loses grip cannot generate additional driving and steering forces. Therefore, if the tire operating force of each wheel can be estimated in real time and the tire friction saturation limit can be precisely calculated, the driving performance can be significantly improved compared to control for wheel slip regulation. In this study, a precise tire friction limit model was developed to improve the limit driving handling performance through DYC, and the reliability of the estimation of the present tire grip was verified through actual vehicle measurements.

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이동 물체 인지와 LiDAR SLAM의 병렬 구조를 통한 자차량 이동량 추정 성능 향상

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Performance Improvement of Ego-Vehicle Odometry Estimation by Parallel System of Moving Object Detection and LiDAR SLAM

Woojin Kwon*, Kyongsu Yi**,†

Key Words : LiDAR(라이다), SLAM(동시적 위치추정 및 지도작성), Moving object detection(이동 물체 인지), Localization(측위), Odometry(이동량)

ABSTRACT

This paper presents preventing incorrect odometry estimation of LiDAR-based simultaneous localization and mapping (SLAM) resulted by moving objects on urban road. Most of SLAM estimate sensor odometry by matching measurements of prior step and current step. Thus, static environment is essential to SLAM systems. But a sensor can be exposed easily to dynamic objects and LiDAR point cloud from the objects can reduce the performance of SLAM. In this paper, we propose a 3D LiDAR SLAM system based on static LiDAR point cloud in outdoor dynamic urban environments. Firstly, we select points corresponding to moving objects using detection module using geometric model-free approach (GMFA) and static obstacle map (STOM). Then, static LiDAR point cloud are formed by removing selected points from raw LiDAR point cloud and input to LeGO-LOAM framework. Also, we resolve computational bottleneck by GMFA through parallel operation of GMFA and LeGO-LOAM. We conduct experiments in urban road using a 32-channel 3D LiDAR and real-time kinematics GPS (RTK GPS) on a test car. The validation result is achieved by comparing with proposed method and LeGO-LOAM.

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칼만 필터 기반 파라미터 추정을 이용하는 자율주행 자동차의 성능저하 진단 알고리즘 개발

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Development of a Diagnostic Algorithm for Performance Degradation of Autonomous Vehicles Using Kalman Filter-based Parameter Estimation

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Key Words : Diagnostic algorithm(진단 알고리즘), Performance degradation(성능 저하), Kalman filter(칼만 필터), Autonomous vehicle(자율주행 자동차), Parameter estimation(파라미터 추정)

ABSTRACT

This study proposes a diagnostic algorithm for performance degradation of autonomous vehicles using parameter estimation based on Kalman filter. The performance of autonomous vehicles can be degraded by various reasons such as wear and frictional character change. The diagnostic algorithm is needed to cope with the performance degradation of autonomous vehicles for maintaining reasonable performance. In this study, the Kalman filter-based parameter estimation algorithm was designed for development of diagnostic algorithm for performance degradation of autonomous vehicles. The Kalman filter was designed for estimation of longitudinal damping coefficient of the vehicle. It is designed that the estimated longitudinal damping coefficient is used for diagnosis of performance degradation of autonomous vehicles. In this study, discrete level as diagnosis result was designed and the level is the degradation level of driving performance of autonomous vehicle. The diagnostic algorithm proposed in this study was developed in Matlab/Simulink environment. The performance evaluation of the diagnostic algorithm was conducted on path tracking scenario under various degradation conditions. The results showed that the diagnostic algorithm proposed in this study could diagnose the relative degradation level of the autonomous vehicle. It is expected that the diagnostic algorithm can be used for performance monitoring of autonomous vehicles.

※본 연구는 2022년도 정부(과학기술정보통신부)의 재원으로 한국연구재단의 지원(NRF-2022R1F1A1075167)을 받아 수행되었음.

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