K-CRASH 충돌/EDGE

Intelligent Traffic Accident Data Processing and Smart Analysis System

김천호*

Intelligent Traffic Accident Data Processingand Smart Analysis System

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Key Words : PC-Crash(피시크래쉬), Traffic Accident Simulation(교통사고 시뮬레이션), Collision Dynamics Analysis (충돌 역학 분석), Accident Reconstruction(사고 재현), AI-based Analysis(인공지능 기반 분석), Autonomous Vehicles(자율주행차), Deep Learning(딥러닝)

ABSTRACT

With the commercialization of autonomous vehicles and advances in AI technology, the transportation environment is rapidly evolving. Traffic accident analysis is a critical process for identifying accident causation and preventing recurrence; however, conventional field investigation and qualitative analysis alone have limitations in elucidating complex accident mechanisms. Analysis of 100 actual traffic accident cases from prior research revealed that only 23% were amenable to PC-Crash-based simulation analysis, while analysis time was reduced by an average of 60% per case compared to manual methods. Simulation programs are essential for quantitatively reconstructing sophisticated collision dynamics in multi-vehicle accidents and velocity variations at each phase.

This study presents a smart analysis tool that maximizes analytical efficiency through machine learning-based video processing and frame analysis for vehicle speed and trajectory tracking, traffic accident database construction based on collision dynamics analysis, and field surveying methods utilizing photogrammetry. The system is designed to integrate with accident reconstruction programs utilized by Korean law enforcement agencies for future application in autonomous vehicle accident reconstruction, liability determination, and analysis. This system is applicable to traffic accident investigation agencies, insurance companies, and courts, and is expected to contribute to traffic safety policy formulation and enhanced safety in the era of autonomous vehicles.

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정밀 도로지도 기반 객체인식 연동 및 속도 분석

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HD Map-Based Integration of Object Detection and Speed Analysis

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Key Words : HD map(정밀도로지도), Object detection(객체인식), Dashcam(블랙박스), Speed analysis(속도분석)

ABSTRACT

High-definition (HD) maps have primarily been developed and utilized for autonomous driving applications. However, the precision and standardized spatial information embedded in HD maps provide significant potential for accident analysis. Traditional traffic accident investigations often rely on dashboard camera (black box) footage and satellite imagery, where the accuracy of speed estimation is highly dependent on the analyst's expertise and the manual selection of reference points. This subjectivity frequently leads to inconsistent results. To address these limitations, this study proposes an accident analysis framework that integrates HD map data with object detection techniques for speed estimation using black box videos. The proposed method employs an object detection model to automatically identify and track relevant objects within accident footage. By mapping the detected object positions onto the precise spatial coordinates provided by HD map data, the actual distance traveled by the object can be calculated. Subsequently, the number of video frames over a given interval is used to derive the speed of the moving object. This approach eliminates the reliance on manually chosen fixed points and reduces the variability caused by human interpretation. As a result, the method enables more consistent and reliable speed estimation in accident analysis. The study highlights the potential of combining HD map data with object detection models to establish a novel methodology for accident reconstruction and traffic safety research. Beyond the context of autonomous driving, this work demonstrates how HD maps can serve as a valuable tool in forensic traffic analysis, offering a new direction for leveraging geospatial intelligence in transportation safety.

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실차 시험을 통한 보행자 긴급제동장치 엣지 케이스 감정 기법에 관한 연구

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A Study on Accident Reconstruction for Pedestrian AEB Edge Cases through Full-Scale Vehicle Test

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Key Words : Pedestrian AEB(보행자 긴급제동장치), Accident Reconstruction(사고재구성), ADAS(첨단운전자보조시스템)

ABSTRACT

When a pedestrian accident involves a vehicle equipped with a Pedestrian Automatic Emergency Braking (AEB) system, the National Forensic Service may conduct forensic analysis to determine driver negligence upon request from investigative authorities. Understanding the operational characteristics and limitations of the AEB system assists in estimating the driver's hazard perception timing. However, manufacturers do not disclose system logic, and ADAS sensor data in the EDR are recorded only for limited vehicle models. Therefore, this study proposes a method to reconstruct the vehicle and pedestrian positions, speeds, and collision points from accident footage and data, and to verify AEB activation through full-scale vehicle tests.

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K-crash 자율주행 Edge case 실험 결과 분석

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Analysis of Experimental Results for Autonomous Driving Edge Cases on K-Crash

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Key Words : ADAS(첨단운전자보조시스템), ODD(작동설계영역), NCAP(신차안전도평가), Edge Case(엣지케이스)

ABSTRACT

The Advanced Driving Assist System (ADAS) primarily involves technologies that individually or collectively implement functions of Lv. 1~2, which are necessary elemental technologies prior to the Lv. 3~5 classified as autonomous driving. However, ADAS is generally highlighted more for its effect on safety enhancement rather than the perspective of autonomous driving meant to replace the driver. This recognition is further amplified as various global New Car Assessment Programs (NCAP) adopt it as an evaluation item in the active safety domain, awarding points based on accident prevention and damage minimization. However, compared to Lv. 3~5, the Operational Designed Dimension (ODD) for each ADAS function has a limited operational domain and operating conditions.

This paper analyzes the ODD of the ADAS function evaluation scenarios presented by NCAP, among others, and in contrast, suggest s scenarios for edge cases that can deviate from the operational domain based on actual accident cases. The reviewed edge scenarios were tested on actual vehicles equipped with ADAS functions. The experiments confirmed that the risk of accidents increases when there are variables in the driving situation outside the scope presented by NCAP, and this paper proposes improvements.

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사고기록장치(EDR) 속도 데이터를 활용한 자동차 주행속도 추정 연구

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A Study on Estimating Vehicle Driving Speed Using Event Data Recorder(EDR) Speed Data

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Key Words : EDR(사기록장치), Accident reconstruction (사고 재현), PC-Crash(사고재현프로그램), Traffic accident analysis(교통사고 분석), Vehicle speed estimation(차량 속도 추정)

ABSTRACT

Accurate vehicle speed estimation is essential for accident reconstruction and liability assessment. Event Data Recorder speed, however, often reflects wheel rotation rather than vehicle body motion, leading to discrepancies. This study analyzes three real-world accidents where EDR-recorded speed differed from actual vehicle dynamics. Using PC-Crash, reconstructions were performed both by directly applying EDR data and by aligning trajectories with physical evidence such as video, tire marks, and damage patterns. Results show that EDR speed aligns with wheel speed but diverges from body speed, especially in yaw and low-friction conditions. While PC-Crash reproduced cases where wheel speed underestimated body speed, it could not replicate scenarios where wheel speed exceeded body speed, such as wheel lift-off. The findings highlight that these discrepancies stem from recording methodology rather than error or malfunction. This approach improves the reliability of accident reconstruction and provides a framework for clarifying EDR data interpretation.

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