Development of sudden unintended acceleration detection algorithm using pedal simulator

Taeoh Tak [*], Donguk Kim[#] , Junho An[†] , Seungmo Choi[†] , Jisu Kim[†] , Daegyu Kim[†] , Sheng peng Zhang[†] , Seongchae Park[†], Changwook Jeon[†]

[*] Faculty of Mechanical Engineering
Kangwon National University,
1 Kangwondaehak-gil, Chuncheon-si, Gangwon-do, 200-701,
Republic of Korea
Email: totak@kangwon.ac.kr

[#] Graduate Student of Mechanica Engineering, Kangwon National University, 1 Kangwondaehak-gil, Chuncheon-si, Gangwon-do, 200-701, Republic of Korea
Donguk0928@naver.com

Abstract

Sudden unintended acceleration (SUA) is caused by various factors related to human error and/or mechanical failures. Focusing on the detection of pedal misapplication where driver mistakenly press acceleration pedal instead of brake pedal in some traffic situation, this research investigates the detection algorithm for pedal misapplication based on acceleration pedal motion variables such as acceleration pedal angle, force and angular velocity.

Since pedal misapplication is interaction between driver, vehicle and traffic environments, a simulator that can account for driver, vehicle and traffic environments is a useful tool to develop a detection algorithm. As shown in Figure 1, a driving simulator is set up where a driver can maneuver vehicle with steering wheel, brake and acceleration pedal interacting with traffic situations displayed on the screen. Traffic environments that include object cars, pedestrian crossings, traffic signals, etc., are

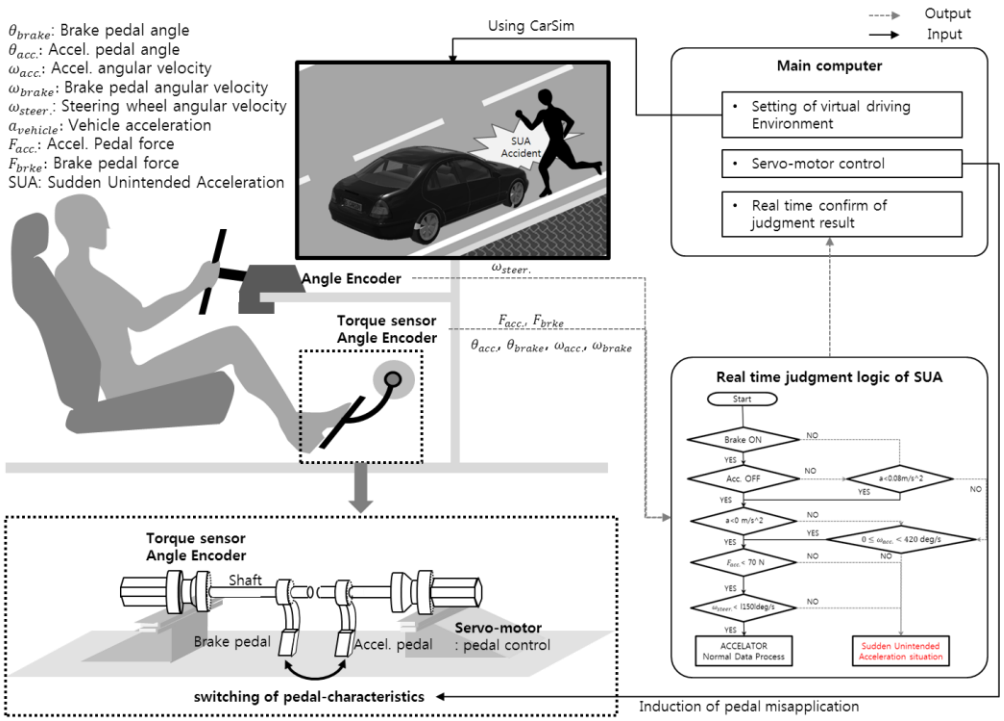

Figure 1. Simulator for sudden unintended acceleration detection algorithm

generated by Driving Simulator version of CarSim using steering, acceleration and deceleration input. The brake and acceleration pedals are controlled by two independent servo motors that can generate any form of pedal reaction forces from different cars. By swapping the function of acceleration and braking pedals as well as reaction force characteristics of the pedals, misapplication situations can be simulated without drivers' awareness.

Through the study of reported misapplication accidents in Korea, three typical situations are chosen and reproduced in the simulator. At the situations, by swapping the function and reaction force characteristics of the pedals, pedal misapplication is induced and acceleration pedal motion variables are recorded and analyzed using 20 test drivers.

Based on the observation of test drivers subjected to the pedal misapplication situations unknowingly, misapplication detection algorithm based on the acceleration pedal angel, angular velocity and force are developed. It turns out that depending on detection algorithms and parameters used, the success percent of differentiating misapplication and normal application by detection algorithm varies widely, where, pedal angular velocity and force are critical factors in the detection algorithm. This detection algorithm can be installed to the acceleration pedals to detect misapplication and issue warning signals or further to cut-off fuel to avoid or mitigate damages.

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