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Fail-safe control for one brake-by-wire actuator failure case using brake safety evaluation index and response surface method

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Limited natural resources and environmental problems have led to increasing interest in eco-friendly vehicles such as hybrid electric vehicles, fuel cell electric vehicles (FCEVs) and pure electric vehicles. Regenerative braking in traction motor which generates electric energy and saves it in a battery in braking situations enhances the energy efficiency of those eco-friendly vehicles. For cooperating with the fast regenerative braking system, brake-by-wire (BBW) systems could be reasonable substitutes for the current slow hydraulic brake systems due to their fast and accurate response. Advances in design and control technologies of BBW systems have enabled the introduction of such systems which could potentially be commercialized as replacements for current hydraulic brake systems in the near future. Because passenger safety directly depends on the functional safety and reliability of a brake system and the failure modes that may occur in a BBW system differ from those experienced in conventional brake systems such as hydraulic or pneumatic braking, a large variety of fail-safe, fault-tolerant and fault detection methods have been developed to enhance the safety and robustness of BBW systems. In previous work, we proposed brake safety evaluation index (E-BSI1) as a quantitative metric for evaluating the fail-safe control strategies of a BBW system. E-BSI1 is the combination of a longitudinal deceleration deviation term and a lateral deviation term of the vehicle in a braking situation. In the present study, we propose a new fail-safe control strategy for one BBW actuator failure case using a new brake safety evaluation index (E-BSI2) and response surface method. The E-BSI2 is the combination of a longitudinal deceleration deviation term and yaw rate ratio term of a vehicle in straight braking situations. The proposed E-BSI2 is used as an objective (cost) function in the response surface method for designing the optimal braking force re-distribution for one BBW actuator failure case.

Biography

Kwangki Jeon has completed his PhD from Seoul National University (School of Mechanical and Aerospace Engineering) of Republic of Korea in 2013. He is the Senior Researcher of Korea Automotive Technology Institute (KATECH), a chassis platform R&D center organization. He has published 7 papers in reputed journals. His research interests are vehicle dynamics, vehicle control and intelligent chassis systems.

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