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Adaptive yaw rate control based on cornering detection in electric rear-wheel steering

TAEHONG KIM [1)]

Hyundai Mobis Company
17-2, 240 Beon-Gil, Mabuk-Ro, Giheung-Gu,Yongin-Si, Gyeonggi-Do,
446-912, Republic of korea (E-mail: taehong@mobis.com)

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With the continuous evolution of vehicle dynamics and autonomous driving technologies, steering systems are increasingly required to provide both precision and adaptability under a wide range of driving conditions. Electric rear-wheel steering (ERWS) has emerged as a key technology to enhance vehicle maneuverability and high-speed stability. This paper proposes an adaptive yaw rate control strategy based on real-time cornering detection, designed to maintain a consistent turning radius that aligns with the driver’s steering intent, regardless of vehicle speed variations.

Conventional yaw rate control strategies typically generate a target yaw rate as a function of vehicle speed, which can lead to inconsistent cornering behavior when speed changes occur during a turn. Such behavior often requires additional corrective steering input from the driver, resulting in reduced driving comfort and degraded handling consistency. To address this limitation, the proposed approach generates the target yaw rate exclusively based on the steering input, decoupling yaw rate control from vehicle speed. As a result, the vehicle maintains a stable turning radius even under acceleration or deceleration during cornering.

key component of the proposed system is a cornering detection algorithm that identifies steering maneuvers in real time. This algorithm is based on a lightweight perceptron-inspired classification model derived from machine learning theory, which distinguishes cornering states from non-cornering driving conditions using vehicle dynamic signals. Accurate and timely detection of cornering enables selective activation of the adaptive yaw rate control logic only when steering maneuvers are present, ensuring robustness and avoiding unnecessary control intervention during straight-line driving.Once a cornering state is detected, the control system computes a target yaw rate that reflects the driver’s steering intent and corresponds to a fixed turning radius. Unlike conventional approaches, this target yaw rate is not adjusted according to vehicle speed, allowing the vehicle to naturally adapt its yaw response to speed variations while preserving the intended cornering trajectory. The rear-wheel steering system then generates the appropriate rear steering angle to track the target yaw rate, supporting stable and predictable vehicle behavior.The proposed control architecture is integrated into the ERWS control unit and designed to operate in coordination with existing vehicle dynamics control systems. Simulation results demonstrate that the proposed method significantly reduces yaw response variation during speed changes in cornering scenarios, thereby minimizing the need for corrective steering input. The vehicle exhibits a consistent turning radius and improved yaw response coherence, leading to enhanced driver confidence and passenger comfort.Experimental validation conducted on a test vehicle further confirms the effectiveness of the proposed strategy under real-world driving conditions, including rapid speed changes and varying road friction levels. The results show that the ERWS system successfully maintains the driver-intended cornering behavior without relying on speed-dependent yaw compensation.By generating a steering-angle-based target yaw rate combined with reliable cornering detection, the proposed approach provides a robust and intuitive yaw control solution for ERWS-equipped vehicles. This methodology contributes to improved handling consistency and reduced driver workload, and it offers strong potential for application in advanced driver assistance systems and autonomous driving platforms.Future work will focus on extending the proposed framework to cooperative front–rear steering control and enhancing cornering detection performance using more advanced learning-based classifiers. These efforts aim to further improve lateral control precision, safety, and ride comfort in complex driving environments.

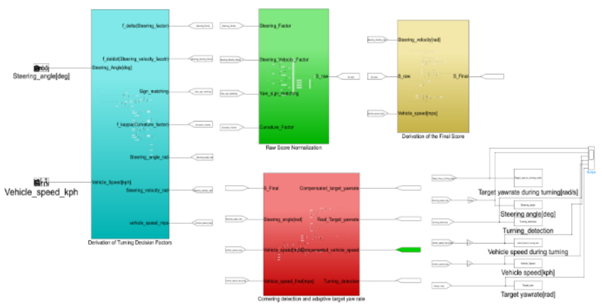

Fig.1 Simulink model block diagram

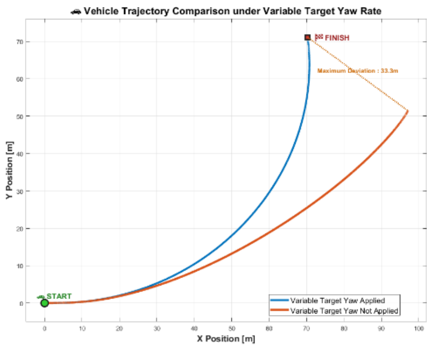

Fig.2 Vehicle Trajectory Comparison