

AN ACTIVE FRONT STEERING CONTROL BASED ON COMPOSITE
NONLINEAR FEEDBACK FOR VEHICLE YAW STABILITY SYSTEM

MOHD HANIF BIN CHE HASAN

UNIVERSITI TEKNOLOGI MALAYSIA

To my employer, Universiti Teknikal Malaysia Melaka for supporting my study
To my beloved family for their encouragement and love

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ABSTRACT

Vehicle stability control (VSC) is one of important topics in vehicle dynamics and active automotive control. This research is focusing on vehicle stability control by active steering system that utilizes steering control method to improve stability of the vehicle. This stability control system is solely based on kinematic and dynamics motion of vehicle. The development of mathematical model of vehicle dynamic that includes body and tyre dynamics is one of the most important steps to make sure the result obtain is close as possible to actual system. In the other hand, an analysis of transient state is very crucial in control system performance where one of the objectives is to track reference signal as fast as possible with minimum overshoot, fast settling time, and without exceed nature of actuator saturation limit. Hence, in order to achieve this target, a robust and high performance of control algorithm is essential for vehicle stability control. In this research project report, a Composite Nonlinear Feedback (CNF) strategy is used to control yaw rate of vehicle through active steering. Extensive computer simulation is performed with considering a various profile of cornering manoeuvres with external disturbance to evaluate its performance in different scenarios. The performance of the proposed controller is compared to conventional Proportional Integration and Derivative (PID) for effectiveness analysis.

ABSTRAK

Kawalan kestabilan kenderaan adalah salah satu topik penting dalam dinamik kenderaan dan kawalan aktif kerangka. Kajian yang dijalankan ini akan difokuskan pada kawalan kestabilan melalui sistem stering aktif yang menggunakan kaedah kawalan stering bagi memperbaiki kestabilan sesebuah kenderaan. Sistem kawalan kestabilan ini berasaskan sepenuhnya kepada gerakan kinematik dan dinamik sesebuah kenderaan. Pembinaan model matematik bagi dinamik kenderaan yang melibatkan dinamik kerangka dan tayar adalah salah satu langkah penting untuk memastikan keputusan yang diperolehi adalah sehampir yang mungkin dengan sistem yang sebenar. Selain itu, analisis keadaan fana adalah sangat penting dalam prestasi sistem kawalan dimana salah satu objektif adalah menjejaki isyarat rujukan secepat mungkin dengan penghasilan telajak yang minimum, masa reda yang cepat, dan tanpa melepasi tahap tepu yang normal bagi sesebuah penggerak. Oleh itu, dalam mencapai sasaran ini algoritma pengawal yang mantap dan berprestasi tinggi adalah menjadi satu kemestian dalam kawalan kestabilan kenderaan. Dalam laporan kajian ini, strategi Komposit Suapbalik Tak linear (CNF) digunakan untuk mengawal kadar rewang kenderaan melalui kaedah stering aktif. Simulasi komputer yang ekstensif digunakan dengan mengambil kira pelbagai gerakan dan profil selekoh dan juga gangguan luaran untuk menilai tahap kecekapan kawalan yang dibina dalam situasi-situasi berbeza. Kebolehan pengawal yang disyorkan akan dibandingkan dengan pengawal Perkadaran, Pengamiran dan Pembezaan (PID) yang konvensional untuk menganalisis tahap kecekapan.