REVIEW ON DESIGN OF STEERING SYSTEM FOR TWO SEATERELECTRIC VEHICLE

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Abstract - *The EPS (electric power steering) system has beenused to replace the conventional HPS (hydraulicpower steering) system in vehicles. This systemassists the steering effort of the driver using anelectric motor and gear force reduction. In aprevious study, an EPS control method was proposed that used the driver's steering inputtorque and vehicle velocity. In addition, manypapers have introduced estimation and controlmethods for the EPS motor's angular velocity orangular torque to reduce the sense difference for the HPS. Therefore, this paper proposes anadvanced control strategy for EPS that uses thelateral force of the front wheels. In addition, we experimented with this proposed control algorithmusing a simulation and confirmed that it reduced the assist torque and saved motor power. Althoughit is difficult to obtain the lateral wheel force of thetires for the proposed method, it is able to reducethe torque ripple of the EPS actuator, as well astroublesome problems with steering wheelvibration. Moreover, this EPS control strategy canimprove a vehicle's dynamic stability. Electric power steering (EPS) systems have been used to replace hydraulic power steering systems invehicles. How to enhance the safety and reliabilitywhile reducing the manufacturing cost of EPSsystems is still of strong interest to the automotive industry. A theoretical analysis of four-wheel- steering (4WS) cars is presented. A discussion of low speed maneuvering shows why significantimprovements in parallel parking cannot beexpected. Using the classical two degree-of freedom "bicycle model" of the automobile, comparisons of highway maneuverability are made between 4WSand FWS (front-wheel steering) cars. The 4WSlateral response has less phase lag, which permits rapid lane changes with less high frequency motion of the steering wheel.*

Key Words: **steering system, vehicle dynamics, Ackermann steering geometry, etc.**

INTRODUCTION

Power steering systems for automobiles are becoming ever more popular because they reduce steering efforts of the drivers, especially during parking lot maneuver. Hydraulic power steering has existed for many years and is widely used. However, the efficiency of such systems is low because of an engine driven hydraulic pump whichruns all the time. The pump and associated piping also take up space and assembly time. Electric power steering (EPS), which use an electric motor with an electronic controller, came to the market few years ago. It solves the problems associated with the hydraulic power steering. The motor only operates when steering assistance is needed. Hydraulic pump and piping are eliminated. The EPS also allows us to adjust static toque boost curves bymodifying software in the electronic controllers without changing the torsion bars. The static toque boost curves can be alternated according to vehicle speed to improve steering feel.

Literature review

K. Lohith, et al [1] author explained, in this project Maruti Suzuki 800 is considered as a benchmark vehicle. The main aim of this project is to turn the rear wheels out of phase to the front wheels. The mechanism was modelled using CATIA and the motion simulation was done using ADAMS. A physical prototype was realized. The prototype was tested for its cornering ability through constant radius test and was found 50% reduction in turning radius as compared to two wheel and the vehicle was operated at low speed of 10 kmph.

Zhao Xue-Ping, et al. [2] the authors first analyzed the steering curve and the control of the current EPS system, then proposed a power sinusoidal steering curve and deduced a formula to calculate the reference torque. At last experimental results had indicated the feasibility of adjustable parameters and the effectiveness of deduced formula. Although it is necessary to design a parametric steering curves to replace the imitating one, which usually needs plenty of prototype tests. The power sinusoidal steering curve, the authors propose, is satisfying, and the intensity of the steering feel E of this curve exists and continues, which ensures smooth handling in all steering torques.

André Murilo, et al. [3] authors presents, the design of a parameterized model predictive controller forelectric power assisted steering. Using the proposed exponential parameterized MPC, it was possible to reduce computational effort drasticallyto meet stringent real-time requirements. Also, a Kalman Filter was included on the control strategyto estimate unmeasured states helping to computethe desired assist torque. Experimental outcomes highlighted a satisfactory EPAS tracking performance even under input, state constraints, parameter variation, road reaction, and measurement noise influence. Moreover, simulation results suggested that exponential parameterized MPC is sensible to the selected prediction horizon. Yet, simulation results demonstrate that the proposed EPAS control strategy does not violate predefined constraintswhich is fundamental for practical applications.

K.N. Spentzas, [4] the authors observed that the 4WS has a maneuvering advantage over a 2WSvehicle only if its rear wheel can turn in the opposite direction to its front wheels, because onlyin that case we have relative reduction of the turning radius. Also the kinematic analysis of 4WS road vehicles presented permits to generalize the well-known theory that Ackermann-Jeantaux developed for the 2WS vehicles. As expected kinematic theory of 2WS vehicles is sub case of generalized kinematical theory of 4WS vehicles.

Ziman He, et al. [5] the authors describes, the mathematical model of EPS and proposed threecontrol modes which are power assist control mode, return-to-center control mode and dampingcontrol mode and three compensation control methods. Then the control model was built in softwares like Matlab/Simulink. Through changing the parameters of controller model, a series of simulation tests were carried out. Thesimulation results indicate that the control strategy proposed in this paper can bring goodmaneuverability and stability for EPS and the dynamic performance of vehicle can be improved greatly.

Masahiko Kurishige, [6] the authors states, a new control strategy to improve steering manoeuvrability was studied with the results are the proposed control algorithm improves steering wheel returnability on low μ roads, using the proposed controllers, the driver's sense of Slipperiness is not lost on low μ roads, using the estimated alignment torque feedback controller, no supplemental sensors like steering angle sensors or motor angle sensors are required and using bothof the two proposed controllers, no harmful subjective effects occur on high μ roads.

Masahiko Kurishige, [7] the authors explained, the new control strategy to improve steering-wheelreturnability was studied with the results which are the proposed control algorithm improvessteering wheel returnability remarkably, the proposed controller also improves on-center feeling, the proposed controller requires no supplemental sensors like steering wheel angle sensors or motor angle sensors and also using the proposed controller, no harmful subjective effects occur.

Shoichi Sano, [8] the authors state, this technologyappears to be a promising steering system based on quite a new concept which a relatively simple mechanism. May improve the vehicle handling performance in ways that the existing front wheel steering system may not be able to achieve. Also a careful study on desirable control techniques for steer angle of rear wheel in the four wheel steeringsystem led to the "vehicle speed function based system" which could change the steer angle ratio of rear to front wheel. Depending on the vehicle speed, so that the rear wheels were steered in the same direction as the front ones at high speed and in the opposite direction at low speed. This was followed by a presentation of the "steer angle function system" that could produce the same effects as the vehicle speed function system under typical driving conditions. In the new steering system, the rear wheels are steered in the same direction as the front ones in a small steering wheel angle range, while in a large steering wheel angle range, they are steered in the opposite direction tothe front ones. At least three major parameters have to be considered very carefully in determining the function for the steer angle function based system which controls the steer angle of rear wheelas a function of the front one. One is the "steer angle ratio of rear to front wheel in a small steering anglerange," the second is the "maximum reverse steer angle of rear wheel in a large steering wheel angle range," and the third is "changes in the difference between the front and rear wheel steering angles relative to the steering wheel angle". So to achieve better vehicle control performance at high speed and better Unmaneuverability at medium and low speeds. these parameters have to be set at prope levels. The steer angle function based four wheel steering system can be put into material form by simply connecting the front and rear steering gear boxes with a mechanical linkage and installing an additional mechanism in the rear wheel steering gear box which inverts input/output gains as appropriate. A providing ground test was conducted on an experimental vehicle equippedwith the steer angle function based four wheel steering system. The findings indicate that this typeof vehicle may be better than the conventional front wheel steering vehicle in several respects. Including a shorter phase delay in lateral acceleration response to steering. better vehicle handling performance in some speed manoeuvres. smaller minimum turning radius and better manoeuvrability in narrow places.

Aly Badawy, [9] author explain in this Paper modelling and analysis of an EPS (Electric power steering), our focus on closed-loop system analysisand understanding the behavior of a close loop system and algorithm specified. The purpose ofEPS to provide assist the driver. Fulfil by the torquesensor is a measured torque and, send the single tothe controller. The controller also receives various information from a different sensor. The EPS consists of various components like rack and pinion, assist motor, steering input shaft, intermediate shaft, and control module. In this paper reduce order modeling combined the massesmeans two and more masses combined one masses and reducing the order modeling. In a Closed-loop system validating a model in various experiments to solve graph. Use two main algorithms first Return algorithm and the second Damping algorithm.

Hao Chena, et al [10] author study EPS base on ADAMS. The main function of EPS is to reduce the steering effort and effort is applied by motor and is control by control module. In Adams straight line boot curve design and develop for improving the performance eps system. In Adams full vehicle's mechanical system model design, analysis and improve performance of eps.

Zeng Qun, et al [11] Author design in this paper modeling and simulation of a eps system. Eps system is replace the hydraulic power steering for improve performance, reduce cost and comfort.Using Matlab and daynamic mathematical model built and achieve result dynamic behavior of eps.

Thin Zar et al [12] author Design and Analysis of Steering Gear and Intermediate Shaft for Manual Rack and Pinion Steering System. Main area of paper is analysis rack and pinion system. In this paper analysis the stress in between two melting gears and fatigue analysis the steering shaft. Results compared to theoretical values. Also checkfactor of safety.

Vivan Govender [13] author Describes The Beginning of the driving; new challenges are put in eps. Electric Power Steering (EPS) entirely used as drivers assist, reducing the driving effort, EPS use as an actuator. Steering control is crucial importance for driving, this area required for research and development. Engineer also research on wire control steering system means the steering column removal and replace by wire. This paper explain validation of rack position for electric power steering. In Synthesis is analysis controller stability is control. The more effect of various system and control on the stability margins are presented.

Guoying Chen, et al [14] authors presents a practical active return-to-center control strategy with steering wheel angle signals based on return state identification. In the strategy, the return state of the steering system is recognize rapidly according to the two signals steering wheel angle velocity and steering wheel torque. For validating the proposed strategy, a fine EPS model including BLDC assisted motor is construct based on carsim and simulink co-simulation platform. Based on high-performance motor control technology, EPS system has been wildly provide on vehicle to improve steering system handling stability and reduce fuel consumption. This paper proposes a practical active return-to-center control strategy with steering wheel angle signals based on return state identification.

Mikihiro Hiramine, et al. [15] authors explained Electric Power Steering is more advantage than hydraulic power steering. Eps required more power motor and increasing efficiency of motor. developed the new motor control unit (MCU) for the EPS. Motor and electric control unit required better installation. We take on new technology of redundant 2 Drive design for eps. Use 2 drives motor technology is consists of two winding, two torque sensor, and two inverter drive units. If there one drive unit failure eps maintained with other drive motor unit. There is growing requirement of less fuel consumption and CO2 emission since the fuel consumption is getting higher every year. The electric power steering (EPS) is increasing its number because it reduces load to the engine compared to hydraulic power steering.

Sanket Amberkar et al [16] author explain Electric power steering (EPS) is an advanced steering system that uses an electric motor to provide steering assist. a new technology it absence the large-scale operational history of conventional steering systems. Also conventional systems cannot be used to command an output independent of the driver input. As a result EPS systems may have additional failure modes, which need to be studied. In this paper we will consider the requirements for successful EPS operation. The steps required to develop diagnostics based on the requirements are also discussed. The results of this paper have been implemented in various EPS- based programs.

Yasuo Shimizu, et al. [17] the author's states New electric power steering developed use electric motor to provide assistance. It is a system combining the latest in power electronics and high power motor technologies. The development was aimed at enhancing the existing hydraulic power steering's energy efficiency, driver comfort as well as increasing active stability. This paper describes the overall concept of EPS and outlines the components and control strategies using electronics. The EPS was tested on a front wheel drive vehicle weighing 1000kg in front axle toad. The results showed a 5.5% improvement in fuel economy. The EPS has also achieved returnability that gives the driver more moderate feelings matching the vehicle in action as well as the active stability control strategy for high speed driving.

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