A Review on Variable Steering Ratio
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Abstract—At present most of the automobiles have fixed steering ratio for steering mechanisms. Steering ratio refers to the ratio between the turn of the steering wheel and the turn of the wheels. But the interpretation of this system does not change with changing road and dynamic condition of automobile. Thus, there is a need to differ the steering ratio of automobile depending upon the conditions in which it is being driven. For example we require moderate steering ratio at high speed and low steering ratio during parking and driving in busy streets to maintain dynamic stability of the vehicle. Using microprocessor controlled steering the driver can swiftly change the steering ratio of its vehicle to adjust to the condition. The following study enlightens the use of microprocessor to vary the steering ratio at the will of the operator.

Key words: Variable Steering Ratio, Steering

I. INTRODUCTION

Variable steering ratios can be accomplish by using some specific gears and microprocessors to change the velocity ratio between steering wheel and steering shaft i.e. shaft interconnected to rack and pinion mechanism. This is done by using high precision gears and faster response microprocessor.

Variable steering ratios enables continuous and mellifluous variation of the steering ratio according to the vehicle’s motion state, therefore AFS improve the manoeuvrability of the vehicle at low speed and the stability at high speed. The competence to change a vehicle's steering ratio has many for deal such as faster ratio (fewer turns’ lock-to-lock) can give a vehicle a deft feel.

At high speeds, switching to a slower ratio bestowed a better sense of stability of vehicle. variable steering ratios can be accomplish in many ways such as by employing a planetary gearbox or a gearbox built into steering column between steering wheel and pinion gear and pinion gear

But mostly the variable steering uses traditional rack and pinion method with computer-controlled hydraulic power assist.

"Rack and pinion" describes the main mechanisms for moving the tie rods that themselves variably steer the front wheels.

This is achieved as the rack and pinion are placed closed together towards the centre and farther apart towards the outside.

This signifies that the movement of steering wheel is "amplified" as the wheel is turned more towards lock.

Mostly the linkages are mechanical so that the driver can feel the road through his or her hand. There is, however, a power assist that enables fewer efforts to be put in to turn the wheel.

II. TECHNIQUES IN VARIABLE STEERING RATIO

A. Constant Mesh Gear Box

R. S Jadoun, S K Choudhary [1] presents a variable steering ratio mechanism by using steering mechanism from Tata-Nano and constant mesh type gears from Bajaj-Super. Gear housing using wood was created by them and gear shifting arrangement was incorporated as shown in Fig. 1. It was observed that on engaging the 1st gear steering ratio is increased to 9.9:1. By engaging the 2nd gear steering ratio is increased to 7.2:1, and by engaging the 3rd gear steering ratio is increased to 4.9:1 On engaging the 4th gear steering ratio is increased to 3.5:1.

![Fig. 1: Steering Mechanism](image1)

B. Using an Electric Power Steering System

Roy McCann [2] presents a novel approach in this paper by investigating a method for improving vehicle stability by incorporating feedback from a yaw rate sensor into an electric power steering system. Presently, vehicle stability enhancement techniques are an extension of antilock braking systems in facilitate the driver during vehicle manoeuvres. One of the contributors to loss of vehicle control is the reduction in tangible feedback from the steering hand wheel when driving on wet or icy pavement. His paper presents research indicating that the use yaw rate feedback (as shown in Figure 3) improves vehicle stability by increasing the amount of tangible feedback when driving under adverse road conditions.

![Fig. 2: Constant Mesh Gear Box](image2)
C. Manually Operated Gear Shifting Catcher

Devanjan Mishra [3] urbanized a manually operated gear box with an integral catcher which is placed in the steering shaft for this case in between steering wheel and pinion of rack. According to the author, the main purpose of the gear box is to alter the steering ratio of the vehicle between two settings one for higher ratio and one for lower. For his case study the high steering ratio is taken as 22.5:1 and low steering ratio is taken as 16:1 as represented in figure 2. Thus in this study it was observed that the basic advantage of active steering, i.e., variable steering ratio can effortlessly be obtained using this gear box. The applications of this gear box have a broad assortment for various vehicles but this system is much less economical as compared to the high end expensive vehicle’s active steering. Thus it was observed that it can be used for conventional commercial vehicles available in souk today at a low cost.

D. Engine Control Unit (ECU) Assisted Power Steering


Based On The Driver’s demand For the Ideal Relationship Between Steering Wheel Torque And Vehicle Velocity, The Vehicle Speed comparative Coefficient Of The Assist Characteristic Can Be Determined By Making Steering Wheel Torque At Different Vehicle Lateral Acceleration Agree With The Request Of The Driver at a Particular Velocity.

The target of this paper is analyzing the authority Of the Straight-Line Type Assist Characteristic on the Steering Manoeuvrability and Road Feel, And Studying How to Apply Simulation Method to ascertain The Straight-Line Type Assist Characteristic of EPAS, Which Will Direct and Benefit the Adjustment of the Assist Characteristic during the Road Test

E. Using Vehicle Body Slip Angle:

Takahiko Yoshino, Hiromichi Nozaki[5] recommends a variable steering gear system using body slip angle feedback for the intention of improved manoeuvrability and stability in the vital cornering range and upwards, in surplus of the critical limit, and into the counter steer range by applying linear-variable control to the steering ratio from a body slip angle of 5.1°. This result is seen both in double lane changes, such as in hazard avoidance, and in J-turns with long drifting. Moreover, it shows an enhancement in drift controllability through timely counter steering. Overall, the present system can enhance the driver’s vulnerability avoidance capability.

F. Using Active Front Steering system (AFS).

Amitesh Kumar, Dr. Dinesh Kamble, tried to introduce about the perception of Active Front Steering (AFS) which is a reasonably newer technology for passenger cars developed by BMW, that execute an electronically controlled superposition of an angle to the hand steering wheel angle that is approved by the driver. However, the enduring mechanical connection between steering wheel and road wheels remains. AFS could adjust the vehicle performance by means of prevailing the road wheel angle in condition of the driver have zenith precedence, which avoid the people's concerns about the Steer-by-Wire system.

AFS enables continuous and situation-dependent adaption of the steering ratio according to the vehicle's motion state; therefore AFS improve the maneuverability of the vehicle at low speed and the stability at high speed. It was found by them that the performances of stability improvement with active steering system depend upon the quality of variation of the steering ratio to a definite scope.
REFERENCES


