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FOUR WHEEL STEERING SYSTEM

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ABSTRACT

This paper discuss about the Four Wheel Steering System. Now-a-days, there is development in steering system technologists are searching on the same project in order to produce the desired automobile to provide the smooth operation of turning vehicle, this system creates. There was design of equipment and calculations of the required smooth operation of turning vehicle Also, the complete knowledge about the specification, working, & mechanism and applications of the four wheel steering is covered.

Production cars are designed to under steer and rarely do they over steer. If a car could automatically compensate for an under steer/over steer problem, the driver would enjoy nearly neutral steering under varying operating conditions. Four-wheel steering is a serious effort on the part of automotive design engineers to provide near-neutral steering. Also, in situations like low speed cornering, vehicle parking and driving in city conditions with heavy traffic in tight spaces, driving would be very difficult due to vehicle's larger wheelbase and track width. Hence there is a requirement of a mechanism which result in less turning radius and it can be achieved by implementing four wheel steering mechanism instead of regular two wheel steering.

Keywords: Steering System, Four-Wheel Steering, Turning Vehicle.

1. INTRODUCTION

Fig.1.1: Steering System

Steering is the collection of components, linkages, etc. which allow a vessel (ship, boat) or vehicle (car, motorcycle, bicycle) to follow the desired course. An exception is the case of rail transport by which rail tracks combined together with railroad switches (and also known as 'points' in British English) provide the steering function. The mechanism should have self –rightening effect so that when the driver releases the steering wheel after negotiating theturn, the wheel should try to achieve straight ahead position

The main intension of this paper is to reduce the turning radius of a vehicle as much as practically possible without crossing the practical limits of design and assembly of the components of the steering system. Based on these requirements, a four wheel symmetric steering system is analyzed using kinematic approach and a conclusion is drawn regarding the geometry of the optimum steering system and the effect of this on the turning radius of the vehicle. This system is seen not to cross any practical limitations of the vehicle in terms of assembly and spacing. Also, the wheels are turned to the optimum extent possible and not exceeding this limit.

2. Types of steering system:

2.1 Conventional steering system:

In that steering system, only the front wheels are steered towards right or left According to the requirement because of at rear their dead axle is present.

2.2 Four-wheel steering system:

In that steering system, the all four wheels are to be steered according to the steer perform to drive towards left or right. Four-wheel steering, 4WS, also called rear-wheel steering or all-wheel steering, provides a means to actively steer the rear wheels during turning maneuvers. It should not be confused with four-wheel drive in which all four wheels of a vehicle are powered In most active four wheel steering system, the rear wheels are steered by a computer and actuators, the rear wheels generally cannot turn as far as the front wheels. Some systems including Delphi's Quadra steer and the system in Honda's Prelude line allow the rear wheels to be steered in the opposite direction as the front wheels during low speeds. This allows the vehicle to turn in a significantly smaller radius sometimes critical for large tucks or tractors and vehicles with trailers.

Purpose of automotive steering system:

The purpose of the steering system allows the driver to control the direction of the vehicle by turning the front wheels. The steering system consists of the following component parts.

3. LITERATURE SURVEY

3.1 Design and simulation of 4-wheel steering system

In standard 2 Wheel Steering System, the rear set of wheels are always directed forward and do not play an active role in controlling the steering. While in 4 Wheel Steering System, the rear wheels do play an active role for steering, which can be guided at high as well as low speeds. Production cars are designed to under steer and rarely do them over steer. If a car could automatically compensate for an under steer/over steer problem, the driver would enjoy nearly neutral steering under varying operating conditions. Also, in situations like low speed cornering, vehicle parking and driving in city conditions with heavy traffic in tight spaces, driving would be very difficult due to a sedan's larger wheelbase and track width. Hence there is a requirement of a mechanism which result in less turning radius.

Condition for True Rolling

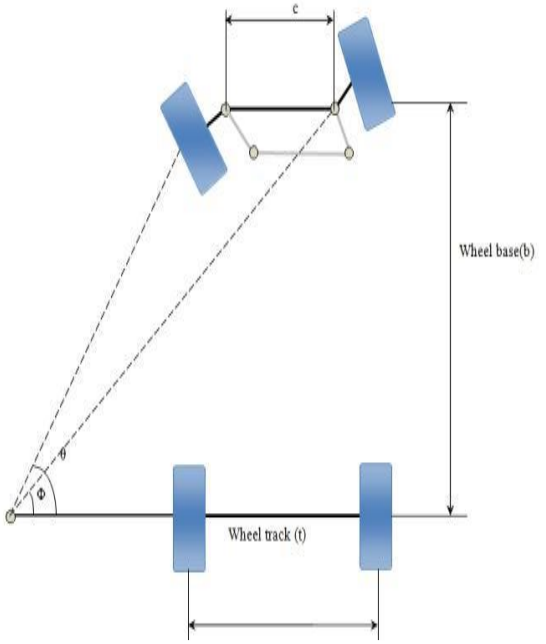

Fig.3.1: True Rolling Condition

While tackling a turn, the condition of perfect rolling motion will be satisfied if all the four wheel axes when projected at one point called the instantaneous center, and when the following equation is satisfied:

$$\cot \emptyset - \cot\theta = {}^{c}/_{b}$$

3.2 Development of four wheel steering system for RC vehicle

Nowadays, the every vehicle existed mostly still using the two wheel steering system to control the movement of the vehicle whether it is front wheel drive, rear wheel drive or all-wheel drive. But due to the awareness of safety, four wheel steering vehicles are being used increasingly due to high performance and stability that they bring to the vehicles. In this report, the performance of four wheels steered vehicle model is considered which is optimally controlled during a lane change maneuver in three type of condition which is low speed maneuver, medium speed maneuver and high-speed maneuver. The configuration of this work is a technique for predetermination of system's stability based on pole placement method. Simulation results reveal the effectiveness of the proposed model and controller. The analysis will be conducted using MATLAB software to analyze and to prove whether four wheel steering system is better than the two wheel steering system. After that, the suitable configuration will be chosen that suit the remote control (RC) vehicle model to transform from two wheel steering system to four wheel steering system.

Steering system

The handling characteristics of a road vehicle refer to its response to the steering commands and to the surrounding inputs, such as wind gust and road disturbances, that effect the direction of the vehicle. There are two basic problems in vehicle handling: one is the control of the direction of motion of the vehicle; the other is its ability to stabilize its direction of motion against external disturbances.

The vehicle as a rigid body has six degrees of freedom, translations along the x, y and z-axis, and rotations about this axis shown in Fig.2.1 The primary motions due to the handling behavior of a vehicle are longitudinal, lateral, and yaw motion. During turning maneuver, the vehicle body rolls about the x- axis. This roll motion may cause the wheels to steer, thus affecting the handling behavior of the vehicle. Furthermore, bounce and pitch motions of the vehicle body, may also affect the steering response of the vehicle. However, the inclusion of these motions only become necessary in the analysis when considering the limits of handling characteristics.

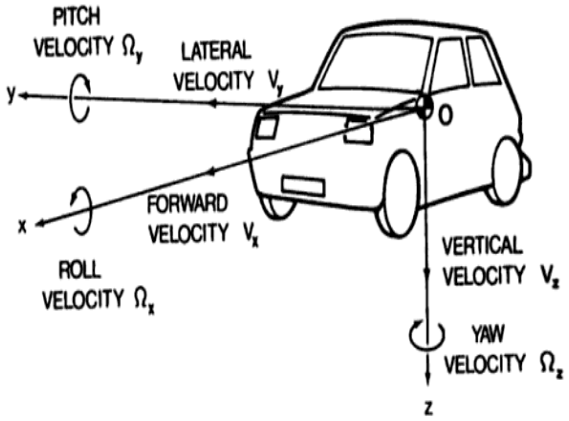

Figure.3.2: Vehicle six degree of freedom

Simplified linear model for the handling behavior of passenger car in which suspension characteristics are not taken into account will be discussed. The model demonstrates the effects on handling behavior of major vehicle design and operational parameters, such as tire properties, location of the center gravity, and forward speed and lead to conclusions of practical significance concerning directional control and stability. The response of the vehicle to steering input and its directional stability associated with a fixed steering wheel, which are usually referred as fixed control-characteristics will be analyzed.

International journal of engineering research and technology "wheel steering system".

Nowadays most of the vehicles use the two wheel steering mechanism as their main handling system. But the efficiency of the two wheel steering vehicle is proven to be low compared to the four wheel steering vehicles. Four wheel steering system can be employed in some vehicles to improve steering response, increase vehicle stability while moving at certain speed, or to decrease turning radius at low speed. Four-wheel steering is a technologically, tremendous effort on the part of automotive design engineers to provide near-neutral steering. In situations like low speed cornering, vehicle parking and driving in city conditions with heavy traffic in tight spaces, high speed lane changing would be very difficult due to vehicle's larger wheelbase and track width which brings high inertia and traction into consideration. Hence there is a requirement of a mechanism which result in less turning radius and it can be achieved by implementing four wheel steering mechanism instead of regular two wheel steering. 4-Wheel Steering System is not a new technology but it has not gained popularity over 2-Wheel Steering System even though experiments have proved that it has excellent maneuverability, high stability and it is a solution to over steer/under steer. If 4-Wheel Steering is a better replacement for age old 2-Wheel Steering, why has it not replaced it yet?

Keywords: Under steer/Over steer, Wheel Configurations, Four Wheel Steering, Turning radius.

PRINCIPLE OF PROJECT

1.This mechanism consists of rack& pinion mechanism, bevel gear, spur gear mechanism.

2.The rear steering shaft extends from the rack bar of the front steering gear assembly to the rear steering.

4. DESIGN OF PROJECT

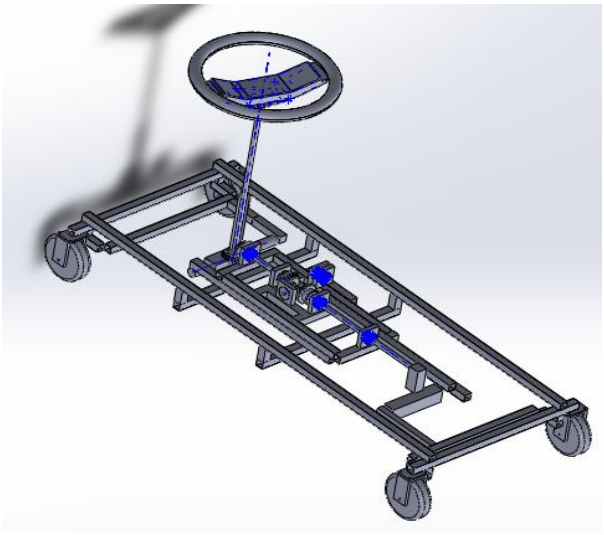

Fig.4.0: Software Design of System

4.1 CONSTRUCTION

Our project consists of a steering setup, spur gears, bevel gears and lock nut. The three modes are:

4.1.1. Front wheel steer

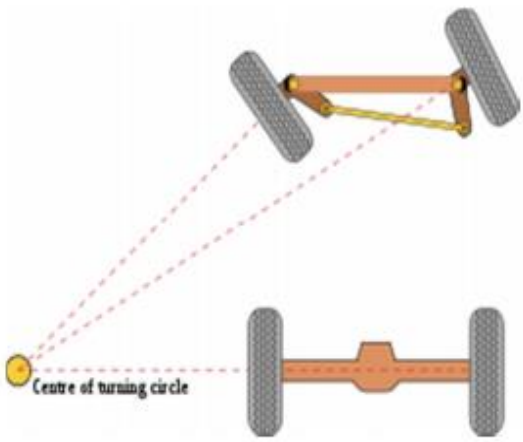

Fig.4.1.1. Front wheel steer

4.1.2. Both front and rear wheel steer in same direction:

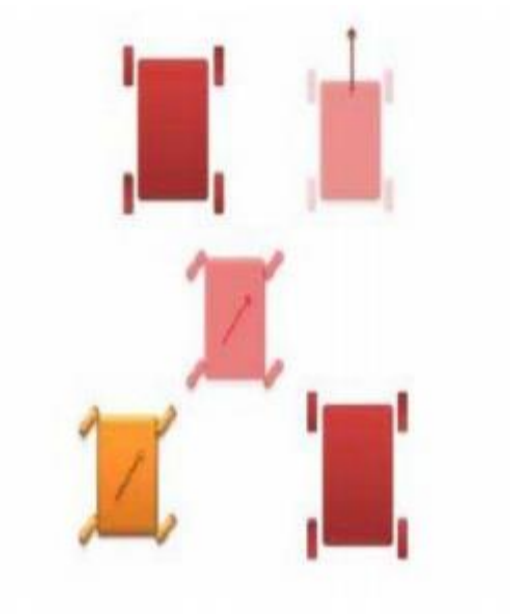

Fig.4.1.2. Both front and rear wheel steer in same direction

4.1.3. Both wheels in opposite direction:

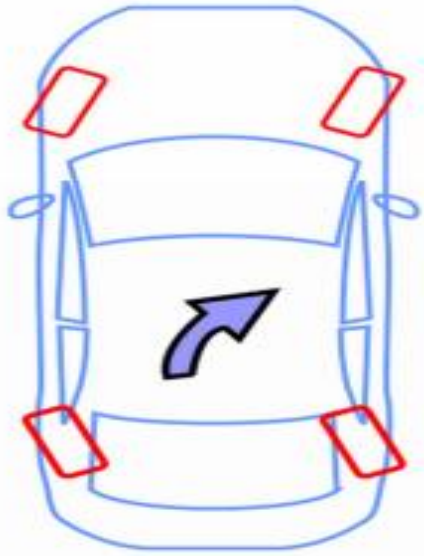

Fig.4.1.3. Both wheels in opposite direction

When the lock nut is removed, the steering operation is carried out in normal condition. That is only front wheels steer. But when the lock nut is inserted, the other two modes can be used. When the gear arrangement is pushed to one position, the spur gears get engaged and the steering of rear wheel is ensured and is in same direction as that of the front wheels. When the gear arrangement is moved to other side, the spur gear disengages and the bevel gear gets engaged. Due to bevel gear arrangement, the rear wheel steers in opposite direction to the front wheel. This results in third mode steering.

5. ADVANTAGES AND APPLICATIONS

Advantages:

The vehicle's cornering behavior becomes more stable and controllable at high speeds as well as on wet or slippery road surfaces.

1) The vehicle's response to steering input becomes quicker and more precise throughout the vehicle's entire speed range.

2) The vehicle's straight-line stability at high speeds is improved.

3) Negative effects of road irregularities and crosswinds on the vehicle's stability are minimized.

4) The vehicle is less likely to go into a spin even in situations in which the driver must make a sudden and relatively large change of direction.

5) By steering the rear wheels in the direction opposite the front wheels at low speeds, the vehicle's turning circle radius is greatly reduced. Therefore, vehicle maneuvering on narrow roads and during parking becomes easier.

6) Superior cornering stability.

7) Improved steering responsiveness and precision.

8) High-speed straight-line stability.

9) Notable improvement in rapid lane changing maneuvers.

10) Smaller turning radius and tight space maneuverability at low speed.

11) Relative wheel angles and their control.

Application:

- Acura RLX (P-AWS)
- BMW 850CSi (only Euro spec models)
- BMW 7-Series (2009 onward, part of sport package)
- BMW 5-series (2011 onwards, Integral Active Steering option)
- Toyota Camry / Vista JDM 1988–1999 (Optional)
- Toyota Carina ED / Toyota Corona EXiV (world's first dual-mode switchable 2WS to 4WS)
- Toyota Celica (option on 5th and 6th generation, 1990–1993 ST183 and 1994–1997 ST203) (Dual-mode, high and low speed)

- Toyota Sourer (UZZ32)

6. CONCLUSIONS AND SCOPE OF WORK:

An innovative feature of this steering linkage design and its ability to drive all four (or two) wheels using a single steering actuator. Its successful implementation will allow for the development of a four-wheel, steered power base with maximum maneuverability, uncompromised static stability, front- and rear-wheel tracking, and optimum obstacle climbing capability.

Having studied how 4WS has an effect on the vehicle's stability and driver maneuverability, we now look at what the future will present us with. The successful implementation of 4 Wheel Steering using mechanical linkages & single actuator will result in the development of a vehicle with maximum driver maneuverability, uncompressed static stability, front and rear tracking, vehicular stability at high speed lane changing, smaller turning radius and improved parking assistance. Furthermore, the following system does not limit itself to the benchmark used in this project, but can be implemented over a wide range of automobiles, typically from hatchbacks to trucks. This coupled with an overhead cost just shy of Rs. 15,000 provides one of the most economical steering systems for improved maneuverability and drivers‟ ease of access. With concepts such as "ZERO TURN" drive as used in „Tata Pixel‟ and "360o Turning" used in „Jeep Hurricane‟, when added to this system, it will further improve maneuverability and driver's ease of access.

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