ISSN 2395-1621

Steering Mechanism

[#1]Sunil S. Kadam, [#2]Prashant R. Jagtap, [#3]Prof. D. U. Patil

[1]kadamss1992@gmail.com,
[2]jagtapp0@gmail.com,
[3]dpucoer@gmail.com

[#12]Mechanical Engineering Department, Savitribai Phule Pune University
Universal Collage of Engineering and Research, Pune. (Maharashtra, India)
[#3]Universal Collage of Engineering and Research, Pune. (Maharashtra, India)

ABSTRACT

This article focuses on the synthesis of steering a steering mechanism that exactly meets the requirements of Ackermann steering geometry. It starts from reviewing of the four bar linkage, then discuses number of points that a common four-bar linkage could precisely trace at most. After pointing out the limits of a four-bar steering mechanism, this article investigates the turning geometry for steering wheels and proposes a steering mechanism with incomlete noncircular gears for vehicle by transforming the Ackermann criteriabinto the mechanism synthesis. The pitch curves, addendum curves, dedenndum curves, tooth profiles and transition curves of the noncircular gears are formulated and designed. Kinematic simulations are executed to demonstrate the target of design.

Keywords- Ackermann criteria, Steering Mechanism, Four-Bar linkage, Noncircular gears.

ARTICLE INFO

Article History

Received :1st April 2016

Received in revised form :

3rd April 2016

Accepted : 4th April 2016

Published online :

6th April 2016

I. INTRODUCTION

Four wheel steering is a method developed in automobile industry for the effective turning of the vehicle and to increase the manuverbility. In a typical front wheel steering system the rear wheels do not turn in the direction of the curve and thus curb on the efficiency of the steering. In four wheel steering the rear wheels turn with the front wheels thus increasing the efficiency of the vehicle. The direction of steering the rear wheels relative to the front wheels depends on the operating conditions. At low speed wheel movement is pronounced, so that rear wheels are steered in the opposite direction to that of front wheels. At high speed, when steering adjustments are subtle, the front wheels and the rear wheels turn in the same direction.By changing the direction of the rear wheels there is reduction in turning radius of the vehicle which is efficient in parking, low speed cornering and high speed lane change. In city driving conditions the vehicle with higher wheelbase and track width face problems of turning as the space is confined, the same problem is faced in low speed cornering. Usually customers pick the vehicle with higher wheelbase and track width for their comfort and face these problems, so to overcome this problem a concept of four wheel steering can be adopted in the vehicle. Four wheel steering reduces the turning radius of the vehicle which is effective in confined space, in this project four wheel steering is adopted for the existing vehicle and turning radius is reduced without changing the dimension of the vehicle.

II. BACKGROUND THEORY

In a typical front wheel steering system the rear wheels do not turn in the direction of the curve and thus curb on the efficiency of the steering. Normally this system is not been the preferred choice due to complexity of conventional mechanical four wheel steering systems. However, a few cars like the Honda Prelude, Nissan Skyline GT-R have been available with four wheel steering systems, where the rear wheels turn by an angle to aid the front wheels in steering. However, these systems had the rear wheels steered by only 2 or 3 degrees, as their main aim was to assist the front wheels rather than steer by themselves. With advances in technology, modern four wheel steering systems boast of fully electronic steer-by-wire systems, equal steer angles for front and rear wheels and sensors to monitor the vehicle dynamics and adjust the steer angles in real time. Although such a complex four wheel steering model has not been created for production purposes, a number of experimental concepts with some of these technologies have been built and tested successfully.

III.FOUR WHEEL STEERING SYSTEM

The Four wheels steering system can be used in two modes:
a) Crab turning radius mode:
In the Crab turning radius mode, where in all wheels turn in same direction. This system is used at high speeds. This helps reduced centrifugal force on turns and prevents skidding of vehicle.

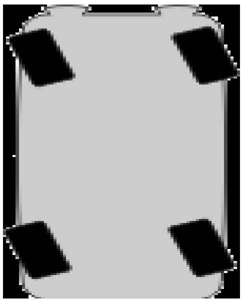

Fig.1. Crab turning radius mode

b) Reduced turning radius mode : In the Reduced turning radius mode, where in pair of wheels turn in alter direction. This system is used at low speeds. This enables the vehicle to turn in minimal possible space.

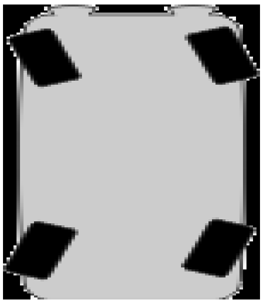

Fig 2. Reduced turning radius mode

IV.CONSTRUCTION AND WORKING

Our zero turn four wheel steering vehicle will move on power supply from an A.C. source. So we are connecting the plug of the battery eliminator to an A.C. supply now alternating current is supplied to the battery eliminator which is converted into D.C. supply and transferred to the switch board. The switch board is a combination of two ways switches and ON/OFF switch. Now to give the constrained motion i.e. forward and reverse motion, we are using a set of two on and off switch and two 2 way switches. To provide the forward motion we are moving the two way switch to the up position. Now pressing the corresponding on and off switch we are moving all the fourwheels in the forward direction thus resulting in a forward motion of the vehicle. In our model turning the wheel in 90 degree is optional and which can be achieved by pressing the joystick. When the wheels are to be rotated to 90 degree or less, then power is given to the two motors which are individually connected to the power supply. When power supply is given then the motors shaft rotates, in turn it rotates the spur gear which is mounted on its shaft. This gear rotates the bigger spur gear, which is connected to the shaft and it rotates the shaft, which transmits the power to the two wheels assembly which are connected to the two ends of the shaft. On the end of the shaft worm gears are fixed through which angular power is transmitted to the wheels. And all the four wheels turn to the left side or right side which is optional.

4.1. Steering Of Rear Wheels
When the steering wheel is turned from its straight- ahead position by an angle of 120 degree or smaller, the 4WS system performs to increase in-phase steering of the rear wheels angle. When the steering wheel angle exceeds 120 degree, the rear wheels gradually straighten up then turn in the opposite direction.

4.2. Parallel Parking
The car requires just about the same length as itself to park in a spot. Also since the 360° mode doesn‘t require steering inputs the driver can virtually park the vehicle without even touching the steering wheel. All he has to do is give throttle and brake inputs, and even they can be automated in modern cars. Hence such a system can even lead to vehicles that park by themselves.

V. DESIGN ANDANALYSIS

Line Diagram of the Prototype A line diagram of the prototype was prepared, as shown in Fig. 2, which indicates the linear dimensions of the prototype, as well as the instantaneous centre of the body, when the wheels are inclined in the required position for 360° rotation.

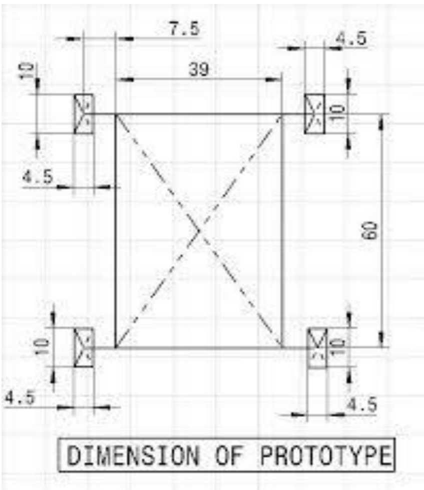

Fig. Dimensions of Prototype

The dimensions of the prototype were measured to be as given below:

Wheelbase = 50cm Track-width = 50cm Frame length = 67cm Frame width = 39cm

Distance of Instantaneous Centre from rear left wheel = 50cm As evident from the figure, the instantaneous centre falls at the geometric centre of the prototype, and as a result, the path of the wheels, trace a circular path. The lines produced from the inclined wheels meet at the centre.

VI. ANALYSIS PROCEDURE

The axis of the rear wheels were produced to either side of the vehicle. The steering was then turned to achieve maximum steer condition, and the axis of the front wheels were produced backwards. The axis of the front left wheel and the front right wheel met at a point on the rear wheel axis produced towards one side, 3.78 m from the left wheel. This was obtained while measuring the conformity of the steering system with Ackermann‘s condition for stability. The inner wheel‘s steering angle was measured to be lj = 26.84°, and that of the outer steering wheel as Ů = 18.57°. The stability conditions for the mechanism confirm to Ackermann‘s conditions. The average steering angle was calculated as

Ů+ lj) /2 = (18.6+26.8) /2 = 22.7°

The outer wheel turning radius was calculated as

¥(x²+l²) =¥(1.8²+0.39²) = 1.84 m

x = distance from point of intersection of front wheels on rear wheel axle produced to left rear wheel

l = wheel base of prototype The inner wheel turning radius was calculated as

¥((x-w)²+l²) =¥((1.8-0.39)²+ 0.39²) = 1.46m w = track width of prototype.

VII. TIME ANALYSIS

The time taken for both - 360° steering mechanism and normal steering mechanism for two operations were recorded. The first operation was parallel parking and the second was the turning of the vehicle in 360° The obtained readings are as follows:

TABLE I

TIME ANALASIS OF MODEL

Type	**Time taken for 360^0 mechanism**	**Time taken for normal steering**
Parallel Parking	45 seconds	116 seconds
360^0	21 seconds	188 seconds

VIII. ADVANTAGES

1. Better steering control at high speeds on turns.
2. Lesser tyre wear.
3. Zero turning radius makes vehicle turn in minimum space.
4. Easy parking in low space conditions.
5. Both reduced turning radius and zero radius turning is possible, Makes versatile operation.

IX. CONCLUSION

Four wheels steering system is must nowadays. It is very useful in low speeds. From four wheels steering systems we overcomes the all problems and we get a necessary desire output. The accuracy is maintaine in this type of steering system .This paper focused on a steering mechanism which offers feasible solutions to a number of current maneuvering limitations. A prototype for the proposed approach was developed by introducing separate mechanism for normal steering purpose and 360 steering purpose. This prototype was found to be able to be maneuvered very easily in tight spaces, also making 360° steering possible.

The time analysis, for the time required to perform a parallel parking maneuver and a 360 degree turn was carried out, and it was established that the implementation of the modification, led to decrease in the time required for the performance of the above operations.

REFRENCES

- K Lohith, Dr. S. R. Shankapal, M.H.Monish Gowda, “DEVELOPMENT OF FOUR WHEEL STEERING SYSTEM FOR A CAR”, Volume 12, Issue 1, April 2013.
- Md. Danish Akhtar, Global Acadmy of Technology, “WHEEL STEERING SYSTEM”
- Unknown, Four Wheel Steering Report, http://www.scribd.com/doc/34677964/Four-Wheel-Steering-Report, Retrived on 13th sep 2012.

