



Research Paper

# FOUR WHEEL STEERING SYSTEM FOR FUTURE

Dilip S Choudhari<sup>1\*</sup>

\*Corresponding Author: Dilip S Choudhari, ✉ [ds\\_choudhari@rediffmail.com](mailto:ds_choudhari@rediffmail.com)

A Four Wheel steering (4WS) System is also known as “Quadra Steering System”. In this paper, both front as well as rear wheels can be steered according to speed of the vehicle and space available for turning. Quadra steer is system that gives full size vehicles greater ease while driving at low speed, and improves stability, handling and control at higher speed. Quadra steering system works in following three phases Negative phase, Neutral phase, Positive phase. It enables the car to be steered into tighter parking spaces. It makes the car more stable at speed (less body roll). It makes the car more efficient and stable on cornering, easier and safer lanes change when on motorways. The steering system allows the driver to guide the moving vehicle on the road and turn it right or left as desired. The main aim is that turning of the vehicle should not require greater efforts on the part of the driver. The Quadra steer steering system offers a 21% reduction in turning radius. So if a vehicle is capable of making a U-turn in a 25-foot space, Quadra steer allows the driver to do it in about 20 feet.

Keywords: Quadra, Negative phase, Neutral phase, Positive phase

## INTRODUCTION

The steering system allows the driver to guide the moving vehicle on the road and turn it right or left as desired. Further such turning of the vehicle should not require greater efforts on the part of the driver there are mainly two types of steering system:

### Conventional Steering System

Usually during the steering of the vehicle, only the front wheels are steered towards right or left according to the requirement and the rear

wheels are mere followers of the front wheels in this system.

### Four Wheel Steering System

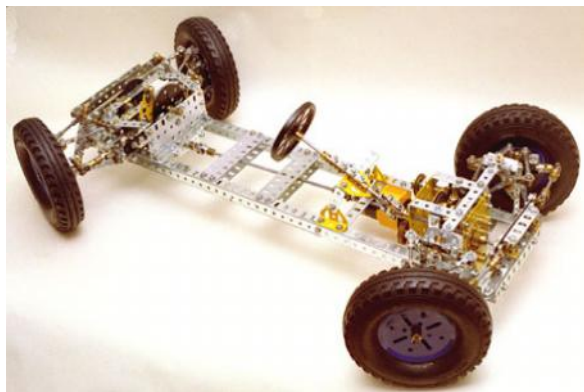
The direction of steering the rear wheels relative to the front wheels depends on the operating conditions. At low-speed wheel movement is pronounced, so that rear wheels are steered in the opposite direction to that of front wheels. This also simplifies the positioning of the car in situations such as parking in a confined space. Since the rear wheels are

<sup>1</sup> Department of Mechanical Engineering, Pad. Dr. D.Y. Patil Institute of Engg.and Technology, Pimpri, Pune 411018, Maharashtra State, India.

made to follow the path on the road taken by the front wheels, the rear of a 4WS car does not turn in the normal way. Therefore the risk of hitting an obstacle is greatly reduced.

At high speed, when steering adjustments are subtle, the front wheels and rear wheels turn in the same direction (Jack Erjavee, 2009). As a result, the car moves in a crab-like manner rather than in a curved path. This action is advantageous to the car while changing lanes on a high-speed road. The elimination of the centrifugal effect and, in consequence the reduction of body roll and cornering force on the tyre, improves the stability of the car so that control becomes easier and safer. In a 4WS system, the control of drive angle at front and rear wheels is most essential.

Figure 1: A Model of Four Wheel Steering System



The four wheels have fully independent steering and need to turn in an unconventional direction to ensure that the vehicle turns around on its own axis. Such a system requires precise calculation from a servo motor with real-time feedback to make certain that all three steering modes function perfectly. The only major problem posed by this layout is that a conventional rack-and-pinion steering with

Figure 2: Jeep Hurricane



pitman arms would not be suitable for this mode, since the two front wheels are steered in opposite directions. The Hurricane jeep is having the four wheels Steering System (Thomas Birch, 1987). Steer-by-wire systems would work fine, however, since independent control can be achieved.

### PHASES OF QUADRA STEERING SYSTEM

In this type of steering system, we can steer a front wheel, as well as the rear wheel of the vehicles simultaneously. This steering mainly includes two types of steering:

Front wheels and rear wheels are steered in the same direction and are parallel to each other. This type of system is very useful during lane changing. Front wheels are steered in the direction opposite to that of the rear wheel. This steering system reduces the space required by the vehicle during turning as compared to that of the two wheel steering system.

Quadra Steer is the system that gives full size vehicles greater ease or maneuverability while driving or tugging trailer at low speed,

and improves stability, handling and control at higher speed. The present “Four Wheel Steering” works mechanically with help of linkages. The system utilizes a manual manipulator to control and direct the articulation (left and right turning) of rear wheels.

The system operates in three phases: Negative, Neutral and Positive.

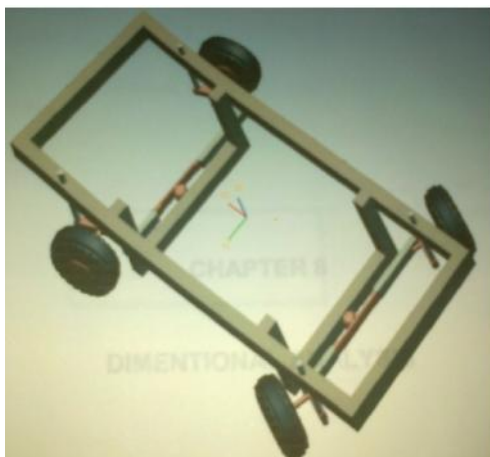
At lower speeds, rear wheel turns in opposite direction from the front wheel. This is negative phase. At moderate speed, the rear wheel remains straight or neutral.

At higher speed, the rear wheel are in the positive phase turning in the same direction as the front wheels.

#### Negative Phase

In this drive the axles both the front and the rear move in opposite direction relative to each other. This drive is mainly used during parking of the vehicle. As both the axle move in different directions the radius of curvature while turning reduces (Tim Gilles, 2014). This means the vehicle will require less space for parking and

Figure 3: Negative Phase

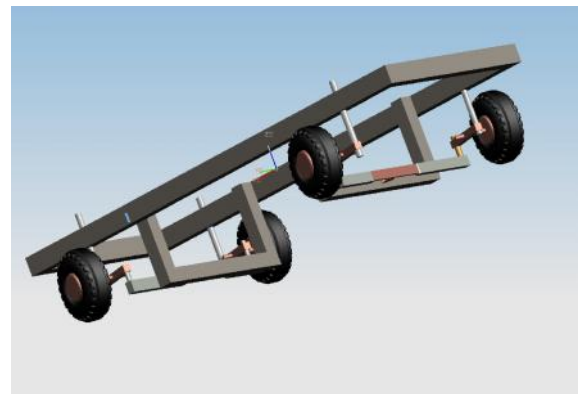


this will be helpful in places where traffic and parking is a major problem.

#### Neutral Phase

In this drive only the front axle moves either in clockwise or anticlockwise direction and the rear wheel being unmoved. This is the drive that we see in day to day life in all the four wheelers (<http://www.howstuffworks.com>). It is generally used at moderate speed.

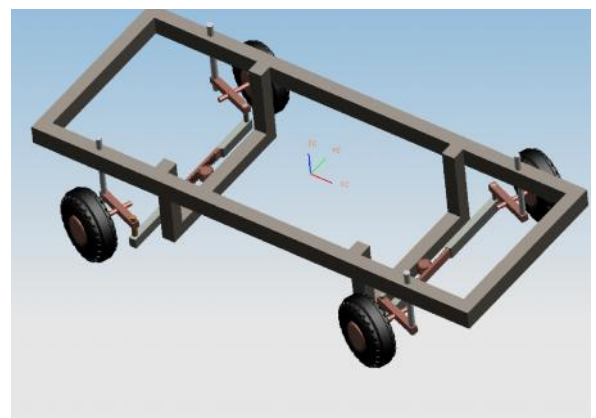
Figure 4: Neutral Phase



#### Positive Phase

As the name suggest, in this drive both the axle viz. front and rear move in same direction relative to the each other. This motion of both

Figure 5: Positive Phase

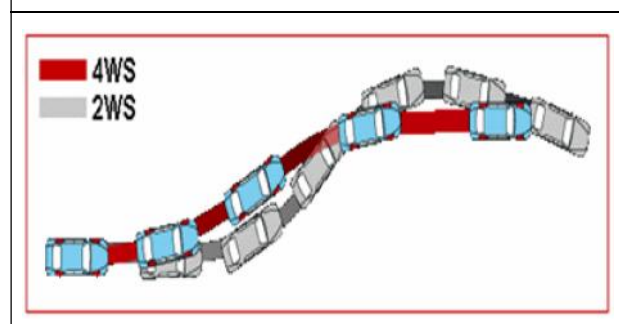


the front and the rear axle helps Quadra steering system enabled vehicle to change the lane during highway driving ([http://trucks.about.com/cs/4ws/a/4wheel\\_steering.htm](http://trucks.about.com/cs/4ws/a/4wheel_steering.htm)). It is generally applied at higher speed.

## COMPARED OF 4WS SYSTEM WITH 2WS CONVENTIONAL SYSTEM

- Car more efficient and stable on cornering.
- Improved steering responsiveness and precision (<http://www.projecttopics.info/Mechanical/Mechanical-Four-Wheels-Steering.php>).
- High speed straight line stability.
- Notable improvement in rapid, easier, safer lane changing maneuvers.
- Smaller turning radius and tight space maneuverability at low speed.
- Relative Wheel Angles and their Control.
- Risk of hitting an obstacle is greatly reduced.

Figure 6: Comparison of the Avoidance Manoeuvre with a Vehicle with 2WS Conventional Steering



## FUTURE ASPECTS

An innovative feature of this steering linkage design is its ability to drive all four 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.

The advanced system of “Four wheel steering” will work electronically with the help of microprocessors.

The system will utilize an onboard computer to control and direct the turning left and right of the rear wheels.

## CONCLUSION

Thus, the four wheel steering system has got cornering capability, steering response, straight-line stability, lane changing and low speed maneuverability. Even though it is advantageous over the conventional two wheel steering system, four wheel steering is a complex and expensive. Currently the cost of a vehicle with four wheel steering is more than that of the conventional two wheel steering of vehicle. Four wheel steering is growing in popularity and it is likely to come in more and more new vehicles. As the system become more common place, the cost of four wheel steering system will drop down. 🌀

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