

Active Suspension Geometric Control System for Camber Angle

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ABSTRACT

This paper proposes a new active suspension geometry control mechanism for change in chamber angle rather than brake and driving torques controlling to improve the cornering performance. The safety in car design is important parameter. Therefore many efforts have been done to increase the vehicle stability especially in the turning. One of the most important factor affecting is to adjust the camber angle in the suspension system. By using camber angle reduces the cornering forces, reduces rubber abrasion improves acceleration and braking performance. Since increase or decrease in camber angle increase the vehicle stability the new camber angle mechanism is made available in a double wishbone type suspension. The dummy model is employed to establish control strategy for the camber angle mechanism. The worm and worm gear mechanism are used for control. For offsetting the position of upper wishbone crankshaft are used which gives the camber on tyre. Input are taken from stepper motor which is connected to worm. Programing is used as input of motor which is then provided to the worm gear and the required angle is obtained and as well as displays the angle of the camber. This mechanism is modelled in CATIA V5 software. These system effectively work on change in camber angle & increases stability of vehicle and reduces skidding of vehicle at will of driver instantaneously.

Keywords: Active suspension geometry, worm and worm wheel, cornering forces, camber angle, wishbones, etc.

1. INTRODUCTION

1.1 Camber angle: Camber angle is the angle made by the wheels of a vehicle; specifically, it is the angle between the vertical axis of the wheels used for steering and the vertical axis of the vehicle when viewed from the front or rear. It is used in the design of steering and suspension. If the top of the wheel is farther out than the bottom (that is, away from the axle), it is called positive camber; if the bottom of the wheel is farther out than the top, it is called negative camber [4]. This angle is caused to share the level of flat car tire pressure, that need to be uniform to reduce and inflection rubber. The advantage of camber is driving stability, because the level reliance increases and brings the centre of gravity lower. In this case, the radial tires can be used for side pressure into tire to be tolerated.

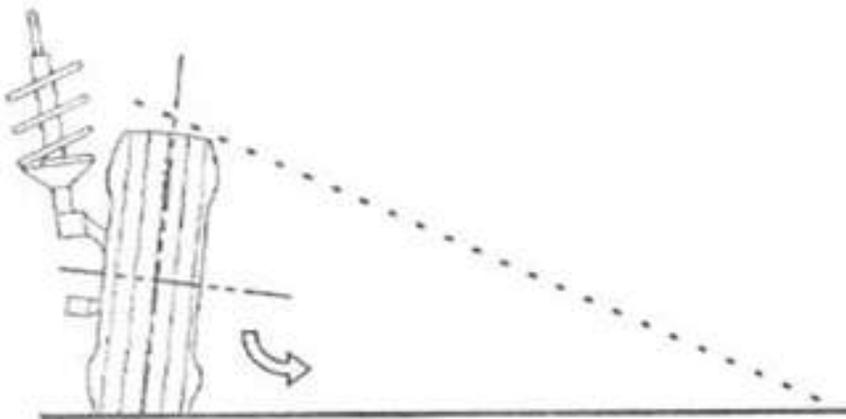


Fig-1: Camber angle

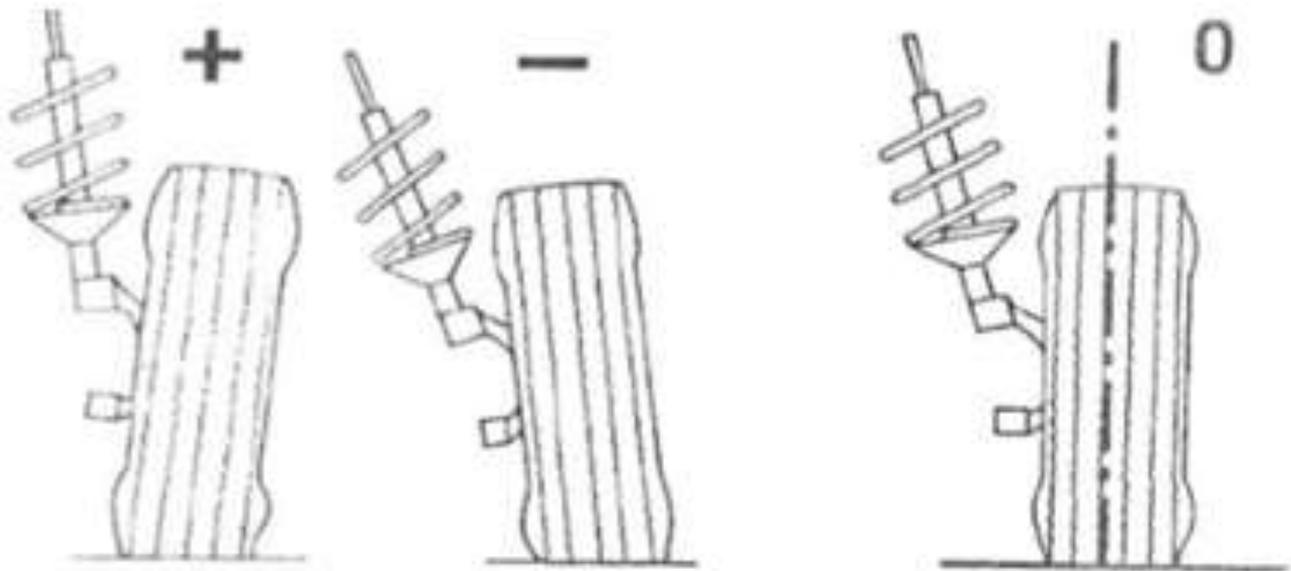


Fig-2: Positive camber Negative camber Zero camber

1.2 Necessities/Need/Importance:

1. The advantage of camber is driving stability, because the level reliance increases and brings the centre of gravity lower.
2. At the time of turning camber angle play very important role, turn the vehicle easily as well as resist the skidding of vehicle.
3. The camber angle has influences on the tires ability to generate lateral forces. A cambered rolling pneumatic wheel produces a lateral force in the direction of the tilt. This force is referred to as Camber thrust when it occurs at zero slip angles.

2. Design of system:

The mechanism designed for the change in camber angle instantaneously at the drivers will according to the requirement is done by using various components like,

- 1) Worm and worm wheel gear drive.
- 2) Stepper motor.
- 3) Crankshaft.
- 4) LCD Display.
- 5) Keyboard.
- 6) I2C converter.
- 7) Arduino microcontroller.

Above mentioned components are used to achieve the results. The worm and worm wheel drive is used because, this drive gives high reduction ratio in the speeds but the most important is that this drive don't allow the reverse motion i.e. self-locking, it locks in reverse(from gear to worm) preventing the tyre to move the gear and hence change in the camber angle. This drive maintains the camber angle and hence the stability of the vehicle is maintained.

Arduino is programed for the function so that if a input of angle manually given to the motor will rotate the motor shaft by a particular amount so that it will make a displacement that will give a camber angle to the tyre.

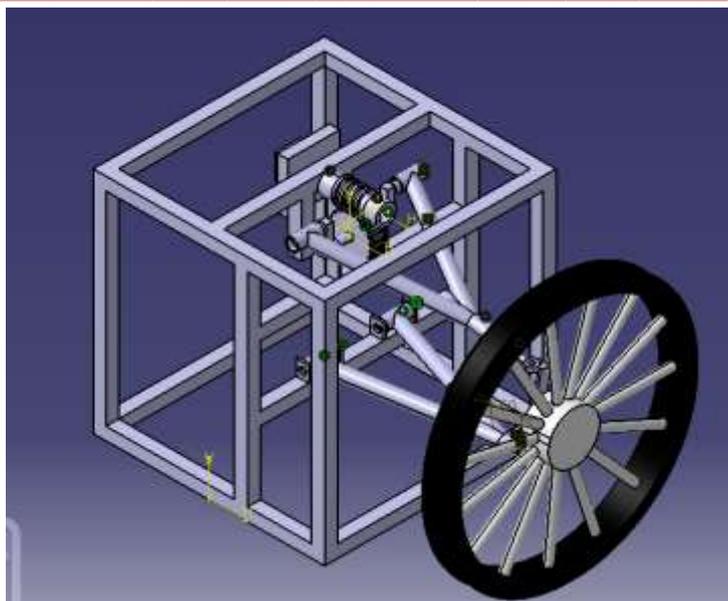


Fig-3: CAD model of the system developed.

2.1 Design of crankshaft:

The design of crankshaft was done considering the maximum camber angle required to achieve. The maximum camber angle that was to be achieved was assumed 10° . So according to the angle the crank radius was designed and the diameter was designed.

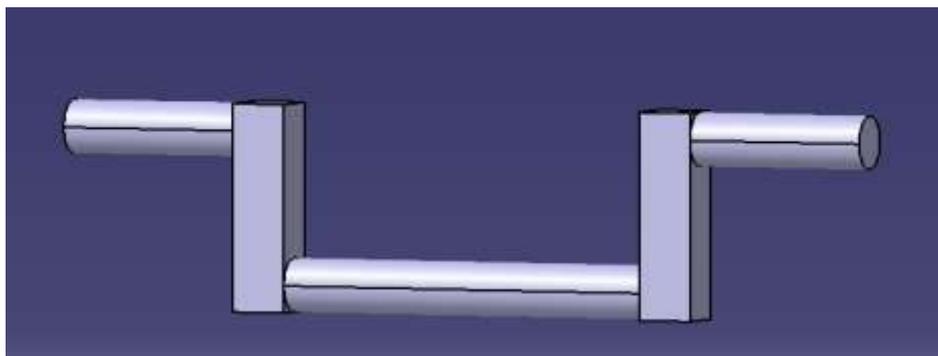


Fig-4: CAD model of crankshaft.

The radius of the crankshaft was estimated according to the wishbone geometry.

The amount of displacement of upper wishbone was measured for which the tyre gives a camber angle of 10° .

This analysis was done in CATIA.

Similarly worm and its gear is designed with considering cornering forces. And other supporting features like mounting and bushes are designed, the lower wishbone is untouched and system only effects and works using upper wishbone.



Fig-5: Actual working model.



Fig-6: Actual mechanism.

3.Results:

The working model was manufactured and tested. The camber angle of 10^0 is achieved and is measured with the help of a camber gauge. The mechanism proved to have a high degree of compactness and hence it allows it to be accommodated in a vehicle because of the worm wheel drive used. The arrangement of display and the keyboard will be in the driver cockpit and he can change the angle and have benefit of it.

4. CONCLUSION:

From the testing and working model of the concept, it can be concluded that the concept is validated and can be used in practical applications like in racing car where the performance is the most important thing and the camber angle that is fixed while the designing process, can be changed now with the help of this system. An angle as high as 10^0 is achieved with this system. The biggest advantage of this system is that we can change the camber angle while running the vehicle in no time by just pressing few buttons on the keyboard provided in the dashboard. This go possible because of the use of worm and worm wheel drive which makes this active suspension geometry system unique.

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