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Experimental Study on Wheel Alignment System of Light Vehicles

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ABSTRACT
The wheel alignment system of the light vehicles is investigated experimentally. The different wheel alignment adjustment technique is used to perform the real time wheel alignment of the vehicle. In order to enhance the automobile performance a regular examination and adjustment of wheel alignment angles are needed by means of wheel alignment system. Computerized and computer vision based automobile wheel alignment measuring system is presented in this paper. The experiment analysis shows that the wheel alignment of vehicle became misalignment when the running distance range is approximately 4000 km to 5000 km. The investigation results suggest that the regular checking of wheel alignment by advanced technologies are significantly improved the life of tire, tire safety, and vehicle handling satisfaction.

Keywords: Wheel alignment, Alignment machine and sensor, Light vehicles

1. Introduction

With the advancement of automotive technology, the travelling speed of automobile is vastly increased, but the influence of automobile stability and travelling safety are decreased. The wheel is important component of the automobile which has direct relation with vehicle stability and safety [1,2]. The recent researches show the most of the accident may occurred due to the wheels are not correctly fitting, wheel alignment is not proper setting and steering function system is not proper work. It also find that the vehicle fuel efficiency is decreasing with increasing the tire wear.

Now a day's modern passenger vehicle has used different wheel alignments technique for safety purpose such as toe, camber, steering axle inclination (SAI) and caster which are most influencing parameters in automobile wheel alignment system. Currently, many wheel alignment technique has been developed to enhance the tire life and reduction of tire wear of the vehicle. Also it can be ensure the vehicle wheels properly contributed to run straight and right way. Automobile wheel alignment active safety systems are caster, camber and toe alignment can be easily measured by using IR sensor [3]. In this technique a computerized wheel alignment machine is used to measure proper wheel alignment of heavy and light vehicles [3-6]. The system used simple circuit and it was low cost and high resolution and also reliability [4]. Recent years the machine vision process was extensively used for easy and proper way to know the characteristic angles [7]. The wireless process has used to easy data transfer system which is better than the traditional system [8]. However, it should be noted that the tire safety and stability and also driver satisfaction are related to the tire quality, tire material and proper size [5]. In the present study the wheel alignment system of light vehicles is investigated experimentally.

2. Experimental Procedure

Wheel alignment consists of adjusting the angles of the wheels, so that they are perpendicular to the ground and parallel to each other. The steering system is related function such as caster, camber, toe-in and toe- out, kingpin inclination and turning radius check. Experimental analysis includes pre-checking of wheel alignment by manual checking with all wheel alignment related parts. Then the vehicle is aligned by using computerized wheel alignment machine. Fig.1 show the experimental setup for wheel alignment system of light vehicle. Computer vision-based system used in this experiment and utilize the images captured by video camera and the images are processed algorithm to obtain main wheel angles. The sensor connecting boards have to be mounted on the wheels before applying the system as the vehicle wheel balances on the platform. The vehicle is lifted park on alignment bay and set on turning table firstly. The four sensors are mounting on four wheels disk on front and rear axle. The vehicle lifted up with the help of air pressure jack.

Fig.1 Experimental setup.

The commercial computer software for wheel alignment system has now been used to measure the caster angles and this angle was adjusted by open end wrench and memorized with logging steering wheel. Caster is the tilting of the uppermost point of the steering axis either forward or backward (when viewed from the side of the

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vehicle). A forward tilt is positive (+) and a backward tilt is negative (-). Then the camber angles is adjusted by losing and tightened of the tie rod and push rod function with steering system. Camber is the tilting of the wheels from the vertical when viewed from the front of the vehicle. When the wheel tilt outward at the top, the camber is positive (+). When the wheel tilt inward at the top, the camber is negative (-). The amount of tilt is measured in degrees from the vertical. Similarly, toe-in and toe-out are adjusted. Toe is a measurement of how much the front and/or rear wheels are turned in or out from a straight-ahead position. When the wheels are turned in, toe is positive (+). When the wheels are turned out, toe is negative (-). The actual amount of toe is normally only a fraction of a degree. Each step of measurement the data were store in memory drive.
In the present study a TOYOTA PREMIO vehicle was considered to analysis the wheel alignment system. For analysis three different mileage 91052 km, 96923 km and 106402 km has been taken.

3. Wheel alignment analysis results

Please Table 1 shows the experimental data reading for TOYOTA PREMIO -1650cc light vehicle. Three different mileages 91052 km, 96923 km and 106402 km are consider to be measured the wheel alignment geometry. Sample wheel alignment of active safety system functions such as caster, camber, Toe and king pin angles checking data are shown in Fig.2. The reading data can be analyzed for wheel alignment after every 5000 km or 4 months which one comes earlier. Analysis results show that the vehicle wheel alignment became misalignment when the running distance range is approximately 4000 km to 5000 km. As shown in Table 1 the wheel misalignment is increased as the running distance increased. Noted that the wheel alignment in proper time can improve the safety of the suspension system parts and also reduce the tire wear and increases of mileage of the vehicle. The routine checking of wheel alignment of the vehicle can also enhance the average life of vehicle. Wheel alignment service is one of the most important considerations to vehicle maintenance, find out how to prolong the life of tire investment. Analysis results suggest that after proper wheel alignment the TOYOTA PREMIO vehicle mileage for front axle tire can give approximately 30000 km life and rear axle tire give 35000 km life. Regular maintain this routine checking resulted even tire life can increase to up to approximately 5000 km. Another data shows vehicle mileage becomes 35000 km tire life for front tire and 40000 km of tire life for rear tire. Therefore, it is recommended that the wheel alignment need to be checked after every an 4000 km to 5000 km running distance as a part of vehicle preventive maintenance program.

Fig.2 Front axle readings [9].

Table 1 The wheel alignment summary data for TOYOTA PREMIO -1650cc light vehicle.

Vehicle distance	Drive	91052 km	96923 km	106402 km
Caster	L	+00° 10'	+00°08'	+00°08'
	R	+1°38'	+02° 08'	+01° 07'
Camber	L	+00°10'	+00° 16'	+00° 02'
	R	-00°11'	-00° 26'	-00° 32'
Toe	L	+0.3 mm	+0.6 mm	+6.1 mm
	R	+0.4 mm	+2.4 mm	+8.1 mm
King pin angle	L	+01° 54'	+00° 51'	+02° 00'
	R	+10° 26'	+11° 25'	+07° 55'

* L = Left; R = Right

4. Conclusion

This study led to the evaluation of tire of the wheel alignment system. The results clearly indicate the advantages of applying the wheel alignment process. Based on the observations and the experimental results obtained, the following conclusions are made.
1) It was found that the wheel alignment in proper time can contributed to the tire life increase and reduction of the tire wear and increases of mileage of the vehicle.
2) The regular maintain routine wise wheel alignment can increase fuel performance and also enhance the average life of vehicle.
3) The proper wheel alignment of the light vehicle can improve the effective safety of the suspension parts in vehicle.
4) It is recommended that the wheel alignment need to be checked after an every 4000 km to 5000 km running distance as a part of the vehicle preventive maintenance program to increase the tire life of vehicle.

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