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### REVIEW PAPER ON MAGIC BODY CONTROL SUSPENSION

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#### Abstract

In the present days riding comfort is an important need, riding comfort and the handling capabilities of vehicle are mainly determined by the suspension system. The objective of designing magic body control suspension system is to improve the riding quality without adjusting the handling characteristics. A magic body control suspension increase the level of comfort simultaneously improving driving dynamics. It is a predictive suspension system. MBC always ensures a balance level is set in all driving condition. The best avoid sprung mass vibration on uneven road surface. The important part of the system is complex control logic, using data from 13 sensors monitoring the movement of vehicle body, calculates the commands for the hydraulic servo system to adjust the suspension for each wheel, by varying the parameters accordingly, the characteristics of vehicle dynamics and ride comfort can be adapted to suit different track.

**Index Terms:** *Magic Body Control, Suspension, Sensors, Hydraulic servo system, sprung mass vibration, MBC.*

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#### 1. INTRODUCTION

In today's world race is happening among the automotive business thus result out extremely developed models. Better performance and control riding and handling in automobile at ones is quite difficult task in order to achieve high comfort and control during riding. As you drive the vehicle on track countless forces act on your car. Dips and Bumps caused the wheels to move up and down and therefore vertical movement of body take place. Turning the car makes body to lean to one side. Braking caused body to push forward and most of the time this all happen at once. Most car even those with adjustable suspension can only react to all these by resisting them. Magic Body Control is design to do something more. MBC actively fight back. MBC is a network of advance components. Five sensors constantly measured each type of body motion side to side, front to rear, and vertical. At each wheel a strut consist of a spring a shock absorber and active hydraulic cylinder that can rapidly move up and down. A sensor in each cylinder monitors it's position .Two micro-computer and high-pressure hydraulic pump complete the system as it detect each motion .MBC can change the length of each strut as little as 10 milliseconds this generates a counter force to compensate for the forces acting on the car with every movement MBC quickly takes action at each wheel to help keep the whole car level so handling is flatter safer and sportier while the rides stays incredibly smooth superior control ,best comfort that does not compromise it takes action.

##### 1.1 Literature Review

Siddhant Halno [1] give review includes important information about conventional suspension system and some recent suspension system.

Pranit M. Patil, Vijay R. Patil and Ganesh N. Rakate [2] tries to give an idea about the previous researches & their finding about study of passive and active suspension system parameters by considering quarter car model.

Nouby M. Ghazaly and Ahmad O. Moaaz [3] described the main concept that use an active suspension to reduce the vibration energy of the vehicle body induced by the road excitation, while keeping the vehicle stability within an acceptable limit.

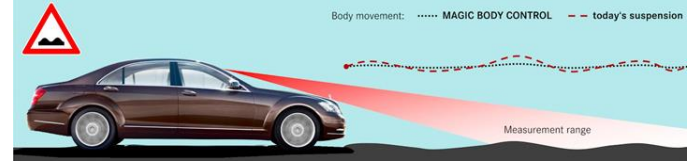
#### 2. WORKING OF MAGIC BODY CONTROL

The MAGIC BODY CONTROL (MBC) suspension system is combination of Active Body Control (ABC) and the ROAD SURFACE SCAN (RBS) function. Active Body Control is used to explain hydraulic active suspension that enables management of the vehicle body motions .The ROAD SURFACE SCAN function are provided by a stereo camera fitted behind the windscreen, which scans the road up to 15 meters ahead of the vehicle with a precision of three millimeter or better. It defines exact road profile and three dimensional images to electronic control unit. Because ROAD SURFACE SCAN is camera-based, it can work throughout the day and night, if visibility is good, the road structure is suitable and even at speeds of up to 130 km/h. Based on the camera pictures and driving status information, the electronic control unit constantly calculates the best control strategy for overcoming unevenness such as prolonged bumps. The vehicle can therefore adjust the length of each individual wheel to according to electronic control unit and increase or reduce the load on the wheel by means of an active hydraulic servo mechanism. The suspension will adjust according to a given situation within fractions of a

second, and body movement can be reduced considerably. This results in a great level of ride comfort and handling. In the Magic Body Control system, the four spring struts are equipped with hydraulic cylinders to adjust the force in each spring strut individually. This means that the system can almost completely made for lifting, rolling and pitching of the body. The electronic control unit receives data on the current driving situation from various acceleration sensors and then compares these data with those from the pressure sensors in the spring struts and the level sensors on the control arms. The system then computes the control signals for the servo-hydraulic valves at the front and rear axle to ensure precisely metered oil flows. Once oil flows into the plunger cylinders, this modifies the tracing point of the steel springs integrated into the spring struts, generating the necessary force to counteract the body movements. Thanks to a constantly available hydraulic pressure of up to 200 bars, MBC is able to stabilize the body within fractions of a second. A digital interface connects the control unit and the sensors, while the fast Flex Ray bus connects the control unit and the vehicle electronics.

servo mechanism and shock absorbers. The main function of ECU are calculates the current driving status, independent controlling of shock absorbers, selecting damping characteristics.

**3.2 Stereo camera**



**Fig.3 Stereo camera**

Stereo camera acts as the eyes of the MBC system. The stereo camera is situated in the wind screen it continually monitor the road surface ahead 15 meter and reports to the ECU in the form of electronic signal this process is called road surface scan. The stereo camera is infrared camera and besides these road surface scan process another technologies like intelligent drive system and parking assistance also uses these camera.

**3.3 Sensors**

There is different type of sensors used in magic body control system. Each sensor senses each quantity continuously and reported to the ECU at the interval of 10 milliseconds. The main sensors used in magic body control are.

1. Acceleration sensors
2. Pressure sensors
3. Vehicle height sensors

**3.3.1 Acceleration Sensors**

To achieve optimum dampening for every driving condition, the control unit must recognize the relationship of the body movement to that of the axle components. The movement of the body is measured by three acceleration sensors called longitudinal acceleration sensors, lateral acceleration sensors, vertical acceleration sensors. The longitudinal acceleration sensor reports acceleration and deceleration to the ECU by these data the ECU can calculate the time taken to reach the road undulation and also ECU provide best control strategy reduce the bounding action during acceleration and deceleration. The lateral acceleration sensors detects transverse or side to side movements and vertical acceleration sensors detect lifting motion and pitch and roll of the body these are three in numbers and located at different positions of vehicle.

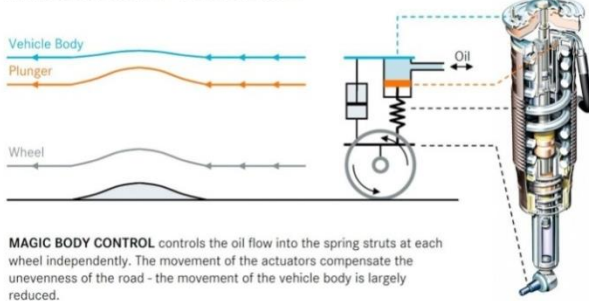
**3.3.2 Pressure Sensor**

The pressure sensor measures the pressure of the front and rear axle strut assembly also it senses the pressure developed in the servo mechanism and hydraulic pipe lines and these data were reported to ECU. By measuring the pressure in the hydraulic pipe line it is easy to detect ant leakage, block in the pipe line.

**3.3.3 Vehicle height sensor**

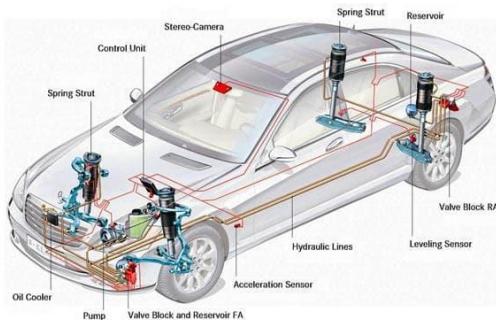
Vehicle height sensors are rotary Hall Effect sensors that enable the computer to more accurately measure ride

**MAGIC BODY CONTROL**



**Fig-1: Working on Magic Body Control suspension**

**3. MAGIC BODY CONTROL COMPONENT**



**Fig-2: Schematic Representation of MBC Suspension**

**3.1 Electronic control unit**

The electronic control unit is the central element of the system. In the suspension system ECU controls the whole system. It processes the relevant messages from the other unit on the vehicle and discrete input signals. It receives inputs from different sensors. Stereo camera placed on wind screen and driving mode selection unit. The results are the signals that actuate the hydraulic

height as well as to compensate for the road variation. This prevents the vehicle from bottoming out when crossing over railway track or similar road irregularities. These are four in number and located in each wheels to measures the vehicles height at every condition.

### 3.4 Reservoir

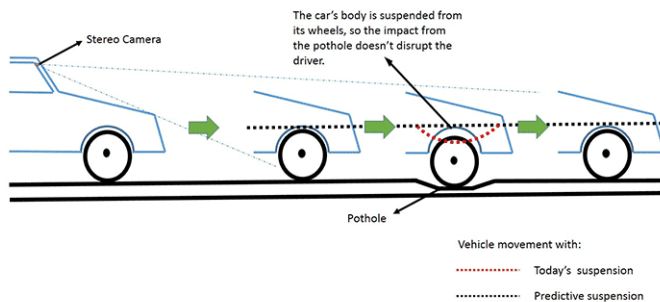
The reservoir is used to store the oil and it supplies to the hydraulic servo mechanism as per the command of the ECU, The reservoir is situated at the rear side of the vehicle.

### 3.5 Hydraulic Servo Mechanism

It is a mechanism that uses automatic feedback and hydraulics to connect the performance of a machine. In magic control system the ECU directs the servo mechanism on how to correct the car's positioning.

### 3.6 Shock Absorber

Shock absorber is used to absorb shock impulses formed during different road shocks Magic body control suspension system uses a electronically controlled shock absorbers that feature variable shock dampening the degree of is controlled by the computer based on input from the different sensors .ECU and stereo camera dampening.



**Fig.4 Magic Body Control suspension working**

## 4. MERITS

### • Stability of all time

Since MBC is a computer controlled this system ensures stability of vehicles at all time regardless the road condition

### • High level of ride comfort

By the combination of active suspension system and stereo camera the rides comfort is increased

### • Speed –dependent lowering of vehicle

Magic body control system provides speed dependent lowering of body which impress aerodynamic and handling stability is improved by the car's low centre of gravity.

### • Minimize pitching, rolling and bouncing action

When vehicle takes the turn it have a tendency to roll about longitudinal axis pitching is occurred during braking or acceleration .It is the rocking action of vehicles about transverse axis .Bouncing is occurred while the vehicle taking humps .These effects are reduced by the independent control of shocks absorbed through ECU servo mechanism and sensors.

### • Less time of operation

The total operation time for adaptive air suspension is less than 20 milliseconds.

## 5. DEMERITS

### • High Cost

The cost of the magic body control is comparatively high because it contains ECU, sensors, stereo camera.

### • Maintenance became difficult and costlier

Specialized technician and equipments are requires for maintenance. Faculty maintenance lead to dangerous situations

### • Requires super quick micro computers

As the time of operation isles than 20 milliseconds super quick micro computers are unavoidable component of MBC which in turn increases the overall cost.

### • Space requirements

The space requirements for the magic body control is quite large, as it uses different type of sensors, electronic control unit and other components

## 6. CONCLUSION

Magic body control that it is a Mercedes-Benz created a revolutionary change in suspension system which takes off all the drawbacks of the conventional suspension system. Since all luxurious cars having higher cost for their brands and services hence for customer satisfaction these vehicles must provide optimum comfort and impressive driving dynamics .For achieving these goals MBC uses a perfect combination of each component and provides best suited damping characteristics for each wheels .Thus from this paper it has been clear that the development of magic body control suspension system has made it possible the vehicle with optimum comfort MBC makes vehicles handling is flatter ,safer and sportier while the rides stays incredibly smooth superior control ,best comfort that does not compromise

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