A Revolutionary Approach to Electromagnetic Suspension for Modern Vehicles

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ABSTRACT

Presently cars and machines use incompressible fluids as shock absorbers so as to soak up unforeseen shocks and vibrations that arise beneath motion. These shock absorbers offer damping result so changing K.E. of unforeseen shock into heat that is then dissipated. Our try is to style electromagnets so as to interchange these shock absorbers by mistreatment the conception of polarity. this method consists of 2 electromagnets and a 12V battery assembled in such how that a clearance is maintained between these 2 electromagnets by putting similar poles on a similar facet. Whenever there's a unforeseen shock (or) a vibration, this clearance between 2 magnetism plates provides damping result.

This project resulted in multiplied comfort for rider travel in cars and reduced annoying sounds in machines. It conjointly reduced the harm to the ground carried because of vibrations. what is more the extra advantage mistreatment this idea is clearance is varied by creating changes within the input voltage and therefore the variety of windings.

This paper offers motivations for a vigorous suspension that provides for each extra stability and maneuverability by performing arts active roll and pitch management throughout cornering and braking still as eliminating road irregularities, therefore increasing each vehicle and rider safety and drive comfort. Various technologies area unit compared to the planned magnetism suspension that uses a cannula static magnet (PM) mechanism along side a passive spring. primarily based upon on-road measurements and results from the literature, many specifications for the look of Associate in Nursing magnetism suspension area unit derived. The measured on-road movement of the passive suspension is reproduced by magnetism propulsion on 1 / 4 automotive setup proving the dynamic capabilities of Associate in Nursing magnetism suspension

Keywords: Active Suspension; Permanent Magnet; Tubular Actuator.

I. INTRODUCTION

Introduction

The sole purpose of this project is to improvise the prevailing mechanical system by exchange the current shock absorbers with electromagnets. the current shock absorbers incorporates incompressible fluid that converts the K.E. in to heat and dissipated. As all the elements are in grips with one another although it's damping sharp shocks, as a result of direct contact these vibrations are transferred. a number of the disadvantages of the current shock absorbers are:

1. Damage of the vehicle parts as a result of vibrations.
2. Failure of elements as a result of sharp shocks.
3. Discomfort for passengers as a result of vibrations.
4. Floor harm just in case of machines as a result of vibrations.

If we tend to analyze the drawbacks of the current shock absorbers, all the on top of issues is resolved by merely eliminating the contact between the wheels and chassis of the vehicle.

Therefore as a student of technology this project can expose Maine to the sector of planning and permits Maine to review the elaborate properties of electromagnets.

In this paper so as to lift the higher a part of the body from the lower one, electromagnets are used. These electro magnets are placed in such the way that similar poles are placed on identical aspect so the repel one another and because the moment in horizontal direction is strained it starts moving up lifting up the body of the vehicle.

Objectives

First associate degreed foremost style of mechanical a part of an magnet is a vital facet during this project, which might be near sensible applications. style ought to be versatile and a lot of economical in absorption of the vibrations.

Developing the powerful electromagnets consistent with the necessity of attraction that is employed to damp most quantity of vibrations is to be drained this project. to induce highest price of the magnetic strength variety

of case studies to be conducted by varied length, diameter, windings of magnet and additionally ever-changing the voltage and current that passes through the windings.

Finally structure are designed that ought to support the whole system. Structure ought to be a lot of versatile thus on face up to the load of system and external masses.

II. SUSPENSION SYSTEM

Suspension is that the system of tires, tire air, springs, shock absorbers and linkages that connects a vehicle to its wheels and permits relative motion between the 2. Suspension systems serve a twin purpose contributive to the vehicle's road holding/handling and braking permanently active safety and driving pleasure, and keeping vehicle occupants comfy and a ride quality moderately well isolated from road noise, bumps, vibrations, etc.

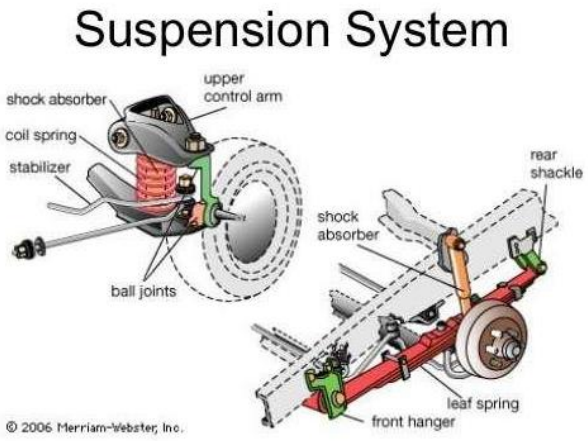

Fig 1: Suspension system. courtesy

These goals are usually at odds, therefore the standardization of suspensions involves finding the correct compromise. it's vital for the suspension to stay the road wheel to bear with the paved surface the maximum amount as potential, as a result of all the road or service acting on the vehicle do therefore through the contact patches of the tires. The suspension additionally protects the vehicle itself and any load or baggage from harm and wear. the planning of front and rear suspension of a automobile could also be totally different.

Advanced electro-mechanical and electronic systems are progressively put in to influence the dynamic performance of the vehicle, as an example antilock braking systems (ABS), electronic break force distribution (EBD), electronic stability program (ESP), etc. These systems are put in to boost vehicle handling and traveler safety, since this becomes AN ever increasing demand for the automotive trade particularly once cars tend to become smaller (SMART), incorporate the next center of gravity (SUV) and reduced footprint. for example, the transportation analysis board [1], rumored that fifty one take advantage of the intense automobile accidents are caused by change.

Another trend within the automotive trade is that the ‘more electrical car’, as an example the Toyota Prius. These hybrid vehicles mix the potency of an electrical motor along with an inside combustion engine. thanks to the world increase in oil costs and also the importance of
environmental property, the ‘full electrical car’ is additionally gaining attention. Recently, a Dutch energy company, Essent [2], launched an advert electric automobile along with electric automobile Europe. These cars have a very totally different weight distribution since the combustion engine is replaced by an electrical motor along with electric battery pack of around four hundred weight unit. As such, the best electrical drivetrain potency is reached once utterly incorporated within the wheel [3, 4]. However, as a result, the unsprung mass of the vehicle will increase that may be a disadvantage relating to traveler comfort and handling.

These trends clearly show the necessity of active suspension to be incorporated into vehicles. These systems afford bigger suspension articulation once driving beneath low yaw circumstances (driving comparatively straight) to soak up road irregularities and have a way additional rigid response once the automobile is driven through turns that improves vehicle dynamics.

III. ACTIVE SUSPENSIONS

A. Hydraulic Systems

Due to the high force density, easy style, maturity of technology, and industrial accessibility of the varied elements, hydraulic systems are normally employed in body management systems. All industrial body management systems use fluid mechanics to produce the active mechanical system to enhance vehicle roll behavior and ride management, wherever the most blessings of the mechanism are as follows:

1) very high force density;
2) ease of control;
3) ease of design;
4) commercial availability of the various parts;
5) reliability;
6) commercial maturity.

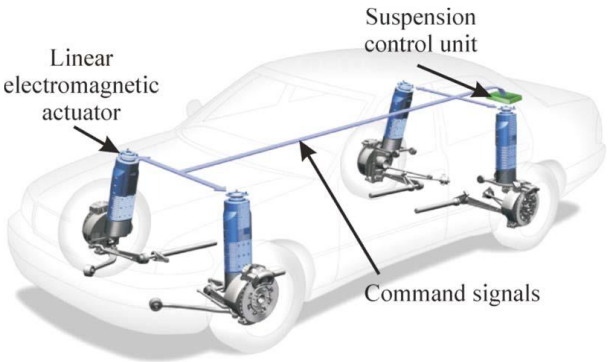

Fig. 2. Bose suspension system [11].

The main disadvantages of the mechanism are as follows:

1) thought of inefficient owing to the desired incessantly controlled system;
2) comparatively high system time constant (pressure loss and versatile hoses);
3) Environmental pollution owing to hose leaks and ruptures, wherever hydraulic fluids are toxic;
4) Mass and uncontrollable house necessities of the full system, together with offer system, even supposing it in the main contributes to the sprung mass.

Hydraulic systems already evidenced their potential in industrial systems with relevancy active roll management (ARC) since the information measure demand is extremely tiny (order of hertz); but, regarding reduction of road vibrations, the performance of the mechanism is shy.

B. Electromagnetic Systems

An magnetic force mechanical system may counter the disadvantages of a mechanism thanks to the comparatively high information measure (tens of hertz), and there's no would like for continuous power, simple management, and absence of fluids. Linear motion may be achieved by an electrical rotary motor with a ball screw or different transducers to remodel motility to linear translation.

However, the mechanism needed to form this conversion introduces vital complications to the system. These complications embrace backlash and multiplied mass of the moving half thanks to connecting transducers or gears that convert motility to linear motion (enabling active suspension). a lot of necessary, they conjointly introduce infinite inertia, and so, a series suspension, e.g., wherever magnetic force feat is described by a rotary motor connected to a ball screw bearing, is desirable. These direct-drive magnetic force systems square measure a lot of suited to a parallel suspension, wherever the inertia of the mechanism is reduced.

IV. RESEULT AND DISCUSSION

Compared with hydraulic actuators, the most blessings of magnetic force actuators are as follows:

1) enlarged efficiency;
2) improved dynamic behavior;
3) stability improvement;
4) correct force control;
5) twin operation of the mechanism.

The disadvantages are as follows:

1) enlarged volume of the suspension, since the force density of the active a part of fluid mechanics is beyond for
1) electromagnetic deed, i.e., system mass and volume
2) could be less;
3) comparatively high current for a 12- to 14-V system;
4) typical styles that require excitation to supply endless force;
5) higher system prices.

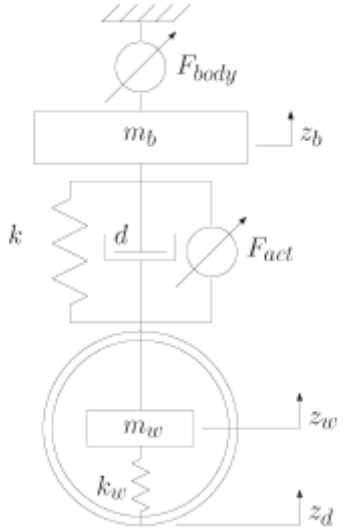

Fig. 3. Quarter car model, including body disturbances and active suspension.

Table I: nominal parameters of the quarter car model

Parameter	Value	Description
k	30 kN/m	Passive spring stiffness
k_w	160 kN/m	Tire stiffness
d	1200 Ns/m	Passive damping constant
m_b	450 kg	Quarter sprung mass
m_w	40 kg	Unsprung mass

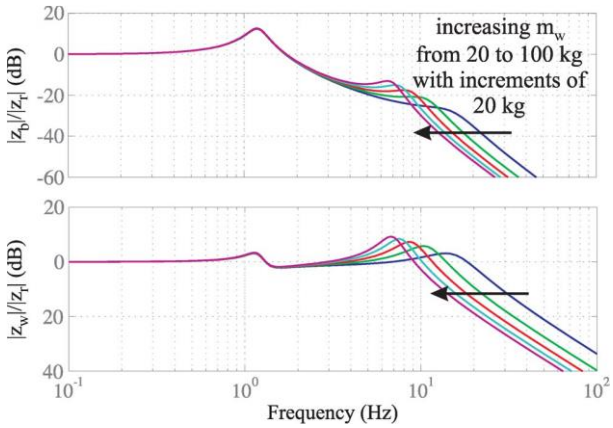

Fig. 4. Bode diagrams of the sprung and unsprung mass responses to roaddisturbances for increasing unsprung mass.

Due to the amendment in vehicle ideas to the additional electric automobile, the mechanical system becomes ever additional vital attributable to changes within the sprung and unsprung plenty. Active magnetism suspension systems will maintain the specified stability and luxury attributable to the flexibility of adaptation in correspondence with the state of the vehicle. Specifications area unit drawn from on- and cross-country measurements on a passive mechanical system, and it are often terminated that, for ARC, a peak force of four kN and an RMS force of two kN (duty cycle of 100%) area unit necessary for the front actuators. what is more, the required peak damping power is around a pair of kW; but, the RMS damping power is barely sixteen W throughout traditional town driving. the most certain and rebound strokes area unit eighty and fifty eight

millimeter, severally. The on-road measurements, that area unit mimicked on 1 / 4 automobile setup by suggests that of magnetism feat, an honest following response, and measure of the frequency response of the hollow mechanism, prove the dynamic performance of the magnetism mechanical system.

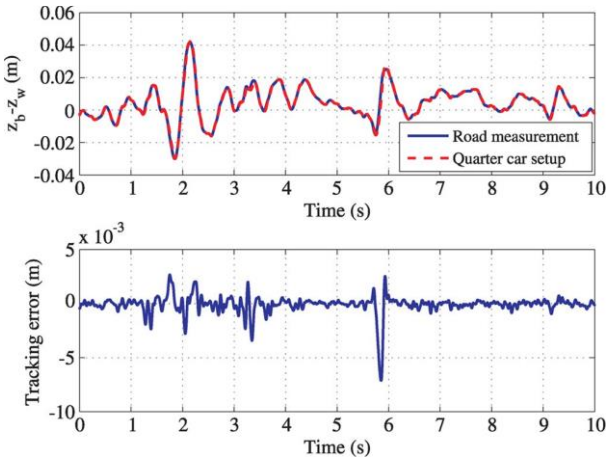

Fig. 5. Time interval of the on-road measurements and off-road electromagneticactuation on the quarter car test setup.

V. CONCLUSIONS

Due to the amendment in vehicle ideas to the a lot of auto, the mechanical system becomes ever a lot of necessary owing to changes within the sprung and unsprung lots. Active magnetic force suspension systems will maintain the desired stability and luxury owing to the power of adaptation in correspondence with the state of the vehicle. Specifications area unit drawn from on-road and cross-country measurements on a passive mechanical system, associate degreed it will be complete that for active roll management a peak force of four kN and an RMS force of 700 N area unit necessary for the front actuators. what is more, the required peak damping power is around a pair of kW, but the RMS damping power is just sixteen W throughout traditional town driving. magnetic force feat, and a awfully smart following response proves the dynamic performance of the magnetic force mechanical system.

The maximum certain and rebound stroke area unit eighty and fifty eight millimeter, severally. The on-road measurements area unit mimicked on 1 / 4 automotive setup by means that of magnetic force feat, and a awfully smart following response proves the dynamic performance of the magnetic force mechanical system

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