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COMPARATIVE ANALYSIS OF SUSPENSION AND DAMPING SYSTEMS: PNEUMATIC SUSPENSION, ADAPTIVE DAMPERS, ELECTRIC SUSPENSIONS

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Suspension and damping systems play a key role in the comfort, handling, and safety of a vehicle. The purpose of the suspension is to make driving smooth and keep the car from body roll (tilt) during acceleration, cornering and braking. In fact, the suspension elements accomplish several tasks. They increase comfort while driving which is achieved by damping vibrations, jolts and shocks; they stabilize the position of the car body during ride; minimize wheel stress; monitor the geometry of wheel position and movement. The study and comparative analysis of different types of suspension and damping systems make it possible to determine their advantages and disadvantages in various operating conditions in order to comply with specific requirements of the driver and the vehicle.

A pneumatic suspension uses compressed air to maintain the optimal level of a vehicle suspension. It consists of pneumatic springs that can be inflated or deflated to adjust the height of the vehicle and stiffness of the suspension. Advantages of this type suspension include provision of a smooth and comfortable vehicle motion, adjustable suspension stiffness as well as a possibility to change clearance. As far as its disadvantages are concerned, a more complex structure of pneumatic suspension requires additional maintenance, higher installation and repair costs. This type suspension can be applied in a variety of vehicle types: premium-class automobiles, trucks, buses, and specialized transport vehicles [1].

Adaptive dampers are a technology that enables a vehicle suspension to adapt to various road conditions and driving styles. Based on signals from the automobile sensors, adaptive shock absorbers can respond to road irregularities, turns and braking enhancing stability and safety of the vehicle. Strong points of adaptive dampers are primarily revealed in au-

tomatic adjustment of both stiffness and shock absorber stroke depending on road conditions and the driving style. Improved handling and stability seem just as beneficial. On the other hand, there are certain drawbacks such as the higher cost of adaptive dampers compared to regular dampers, and the risk of electronic malfunctions. Adaptive dampers are most commonly installed in high-end cars, sports cars, and commercial vehicles [2].

An electric suspension is a technology that uses electric drives to adjust the height of the vehicle suspension and the stiffness of the damping. This system enables quick and precise changes in suspension characteristics depending on road conditions and the driving style. Electric suspensions foster extra stiffness, thus improving comfort and stability on the road. They can also be integrated with other systems of automobile safety and control to optimize overall performance. The possibility of fast response to changes in road surface, ability to individually adjust each wheel, improved dynamics and handling are obvious strengths which make this technology a much-preferred choice for premium-class vehicles. However, it is also characterized by complexity of the electronic system, a possible risk of malfunction, expensiveness and high maintenance costs. Electric suspensions are especially practical in electric and hybrid vehicles, as well as in some sports and conceptual models [3].

In conclusion, a comparative analysis of the above-mentioned systems facilitates the choice of the best option for specific needs of the vehicle and the motorist. Thus, to increase comfort and stability on rough roads, the pneumatic suspension can be chosen, whilst adaptive dampers or electric suspensions can be preferred for a sporty driving style.

Reference

1. A. Ermakova, Ch. Zhdanovich Suspension System with Electronic Floor Control and Adjustable Shock Absorbers [Electronic resource] – Mode of access: https://rep.bntu.by/bitstream/handle/data/123539/ – Date of access: 21.03/2024.

2. Povarekho A. S., Rakhlei A. I., Plish V. N. Automobiles, Special machinery, and Equipment. Classic and Control Systems // BNTU, 2021 – 78p.

3. Savich E.L., Gurskiy A. S. Automobiles, Chassis // Higher school, 2020 – 319p.