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Summary of doctoral dissertaion

Subject: Analysis and synthesis of suspension kinematics and steering of car wheels.

The suspension mechanism plays an important role in the car. Passive safety is extremely important because it is impossible to ensure active safety in all driving conditions. However, active safety can always be improved. Improvements in active safety can be made, inter alia, by changing the suspension structure. Almost every vehicle has a suspension of a different structure with different parameters adapted to the purpose of the vehicle, even if the kinematic schemes are the same. Nowadays, kinematic schemes and their constructions meet many stringent requirements, though they are not perfect. Vehicles, mainly due to the cost of their production and operation, have a limited size. This is the reason why the suspension of a vehicle should take up as little space as possible. It can be seen that creating a car suspension requires a lot of compromises and if one feature is improved, it is at the expense of worsening another.

The paper proposes the conversion of spherical kinematic pairs into pairs with less mobility. The ball joint is a combination of three degrees of ease (three perpendicular axes of rotation intersecting at one point). The articulation can be replaced by three joints with one degree of ease. Replacing each ball joint with three joints of one degree of ease (rotational or sliding) one can obtain a mechanism which mathematical description contains more independent parameters than a ball joint, and thus more possibilities. The computational problem of solutions of such systems is the necessity of using numerical methods, eg subsequent approximations or optimization.

MacPherson strut is analysed in the paper. The analysis showed a change in the turning angles and inclination of the wheels as a result of the change in the length of the shock absorber as a result of the movement of the suspension. Changes in the value of these angles are undesirable. Later, in the steering system of the new solution, the linking of the rods by ball joints was replaced by rotary connections. This way, an improvement in the suspension operation was achieved, i.e. a reduction in the change of steering angles and wheel inclination resulting from a change in the length of the shock absorber. In the further part of the work, solutions were analyzed in which spherical joints were replaced with rotary and cylindrical joints. This way, suspension mechanism was obtained in which the change of steering angles and wheel inclination resulting from changing the length of the shock absorber were completely eliminated.

The result of the paper are three new solutions for car front suspension systems, two of which have been patented (patent applications No. P.423574 and P.423575). – applications were filed on November 24th, 2017.

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