# PROSPECTS FOR IMPROVING ELECTRONIC STABILITY CONTROL SYSTEMS OF VEHICLES

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Modern ESP systems include anti-lock braking system (ABS) and anti-slip regulation (ASR), which reduce slip of vehicle wheel contacts when braking and accelerating. As a result, the stability of a vehicle is increased. All ESP control algorithms are based on the well-known diagram showing the change of the adhesion coefficient of wheels (Fig. 1).

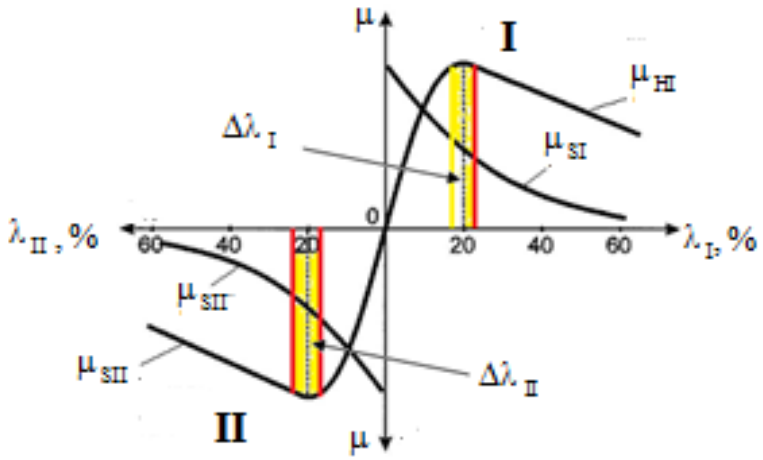


Fig. 1 – The change of adhesion coefficient of wheels depending on the relative partial slip ratio of the wheel contact $\lambda$: **I** is the change of the adhesion coefficient $\mu_I$ of the vehicle during braking; **II** is the change of the adhesion coefficient $\mu_{II}$ of the vehicle during acceleration; $\mu_H$ is the adhesion coefficient in the direction of movement of the vehicle; $\mu_S$ is the adhesion coefficient in the direction of movement of the vehicle, $\lambda$ – is the relative slip of the wheel contact, $\Delta\lambda_I, \Delta\lambda_{II}$ – are the threshold values of the relative slip of the wheel contact when braking and accelerating (control areas)

The relative slip of the wheel contacts $\lambda$, when braking and accelerating, is calculated in the information processing unit on the basis of measurements of the angular velocity of the wheel and the speed of the vehicle $\omega_i, V_i$ according to the formulas: $\lambda_I = \frac{V - \omega_i \cdot r_i}{V} \cdot 100\%$ – is the relative partial slip ratio of the wheel contact when braking; $\lambda_{II} = \frac{\omega_{iII} \cdot r_i - V_{II}}{V_{II}} \cdot 100\%$ – is the relative partial slip ratio of the wheel contact when braking, where $r_{i,I,II}, V_{i,I,II}, \omega_{i,I,II}$ – are the dynamic rolling radii of wheels, the vehicle speeds, the angular velocities of wheels. Thus, the algorithms are based on calculation and analysis of the kinematic parameters that are processed in the information processing unit (IPU). When identifying the specified threshold value $\lambda$,

the control of the actuating mechanisms (IM) is performed (Fig. 2). The disadvantages of the existing algorithms are as follows: 1 – insufficient grounds for the choice of threshold values $\Delta\lambda_I = \Delta\lambda_{II} \approx 18 = 20\%$; 2 – complexity of information processing due to the use of kinematic parameters $V, \omega_i$ in the algorithms (the speed V is determined approximately); 3 – the adhesion coefficient $\mu$ is measured in tenths; this can result in poor accuracy, which reduces the quality of control.

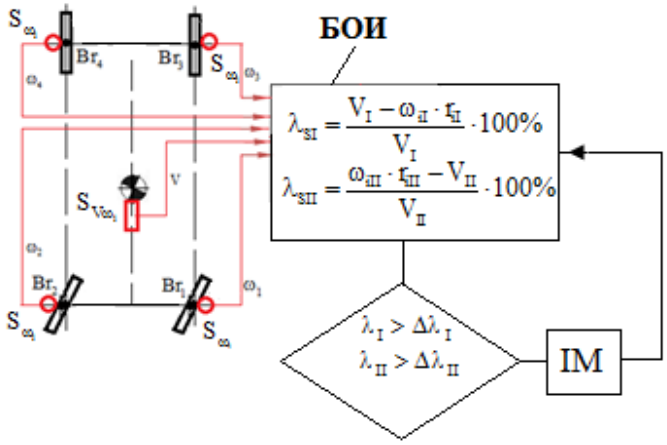


Fig. 2 – The algorithm of modern active safety systems of vehicles

We propose an algorithm based on measuring and analyzing the forces in the contact of the wheels with the road. The algorithm uses information about the lateral forces $S_i$ acting on the wheels (Fig. 3). The control of actuating mechanisms (AM) is performed at negative signs of derivatives of the lateral forces $\frac{dS_i}{dt} < 0$, which means that the slip of the contacts of the vehicle wheels occurs.

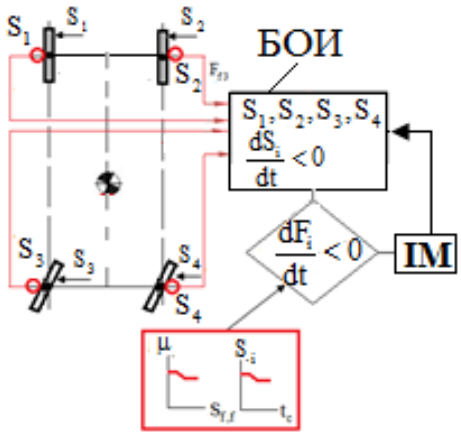


Fig. 3 – ESP Algorithm based on the analysis of forces

The tests have proved the effectiveness of the algorithms for controlling the movement of vehicles based on the analysis of forces.