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OPTIMUM CONTROL SYSTEM OF PMSM WITH FIELD WEAKENING BY VARIABLE VOLTAGE SUPPLY

To ensure a constant power mode in electric drive (ED) of vehicles and other mechanisms based on PMSM, there is necessarily to regulate the direct component of armature current i_d in the rotor axis frame *dq*, which weakens the machine field. Battery voltage in electric vehicle during operation may vary depending on the state of charge, temperature, wear and other factors. When using PMSM with the field weakening it is important to determine the point of transition from the first to the second zone, which depends on the supply voltage.

The modes of field weakening can be divided into four types: feed-forward control, feed-back control, hybrid control and control based on the theory of nonlinear systems. The system, which is developed in this paper, refers to the hybrid control type.

To determine the point of transition from the first to the second zone is generally used signal from the speed sensor or voltage sensor and the transition point to the second zone is determined on the basis of a mathematical model of PMSM. But this approach is sensitive to changes in the machine parameters. In this paper we proposed to use information about the states of the inverter keys to measure the voltage of PMSM. Oncoming of the relative width of control pulse of the voltage inverter to 1 means the inverter saturation and the need of moving into the second zone.

Control algorithm, based on this principle, works as follows. To reduce the ripple caused by PWM, the calculated relative value of the voltage signal is filtered. The maximum possible reference relative value of voltage $u_{\lim\_pu}$ is subtracted from it. Their difference u_{sig} is sending to an integrator and forming Δi_d, correcting the part of reference signal i_d^*.

The computer model of ED based on PMSM with the vector control system and field weakening by the developed algorithm was created in Matlab/Simulink. The maximum mechanical characteristics of ED were obtained and the dynamics of control system was investigated for the values of DC voltage $U_{DC} = 240, 290, 340$ V.