› EC-Motors

adcos

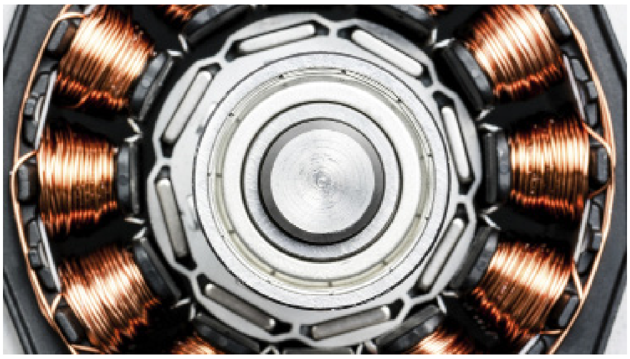
Software and hardware at the highest level

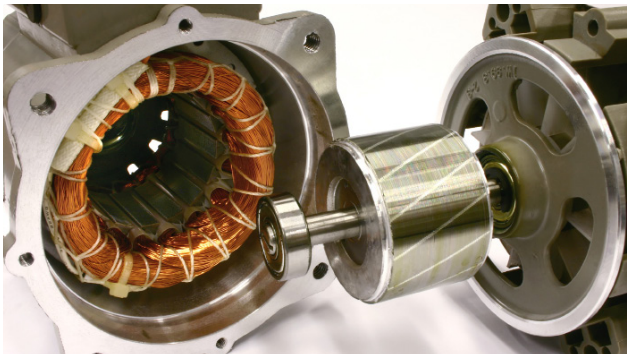
› Energy-efficient control of electronically commutated motors

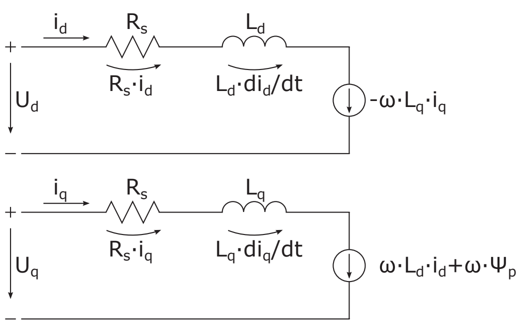
Today's market make increasingly higher demands on the energy efficiency of electronically commutated motors. Besides the motor design itself, the used control algorithms have a significant influence on motor behavior and efficiency. In this field, a focus of our R&D activities is the development of control algorithms for high-dynamic and energy-efficient operation of 3-phase electronically commutated synchronous and asynchronous motors.

Motor Types

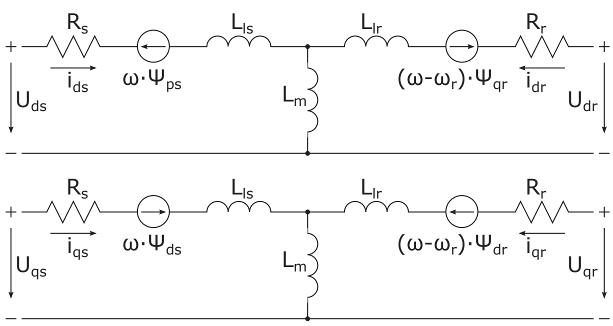
There are many different types and designs of electric motors. The focus of our R&D activities is on permanent-magnet synchronous motors with surface magnets (SPMSM) and interior magnets (IPMSM), as well as on asynchronous motors with squirrel-cage rotor (ASM). We test our algorithms primarily with low voltage motors in the range of 12V to 48V in automotive applications. The results of development are also applicable to other applications with higher voltage classes.







Physical equivalent model PMSM



Physical equivalent model ASM

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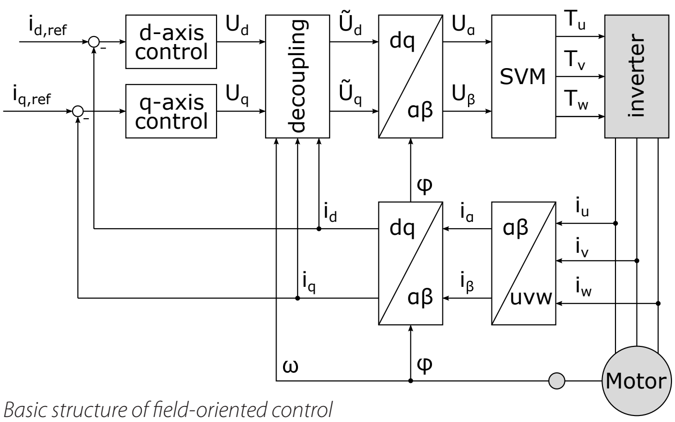
Control Algorithms

In developing our control algorithms, we combine model-based methods of modern control theory with proven traditional approaches. The development is carried out strictly model-based with detailed simulation models for the motors and power stages in MATLAB/Simulink. Thus, the algorithms are validated and optimized through simulations before they are integrated on the ECU by automatic code generation and tested with the real motor.

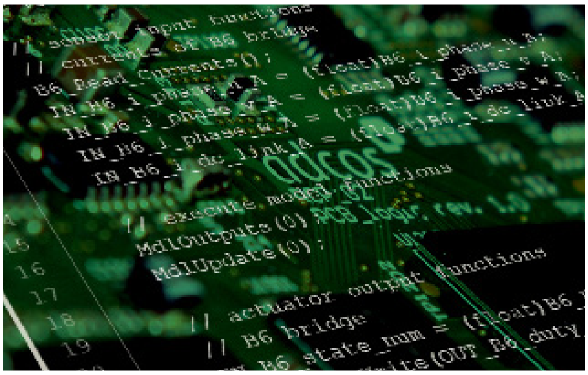
Currently we apply amongst others the following control algorithms:

- Classical commutation methods (Block, Sine)
- Field-oriented methods (FOC, DTC) with classical PI-controllers as well as discrete compensation controllers (Deadbeat-control)
- Sensorless field-oriented methods based on Kalman-Filters and Sliding Mode Observers

Our algorithms are characterized by high efficiency and guarantee a robust and highly dynamic control behavior in both constant torque and field weakening range.



Basic structure of field-oriented control



Test and Validation

For testing and continuous further development of our algorithms, we use our own developed rapid control prototyping ECU's. These ECU's are equipped with a standard automotive microcontroller and an integrated power stage for controlling motors up to a performance class of 2 kW. We also conduct system tests on in-house and on customer-specific engine test benches with standardized testing programs.

Production Code Implementation

The production code implementation of our model-based developed algorithms occurs with dSPACE TargetLink by automatic code generation. So that we can integrate our software quickly on different platforms such as AUTOSAR (usually as Complex Device Driver) or proprietary embedded software.

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