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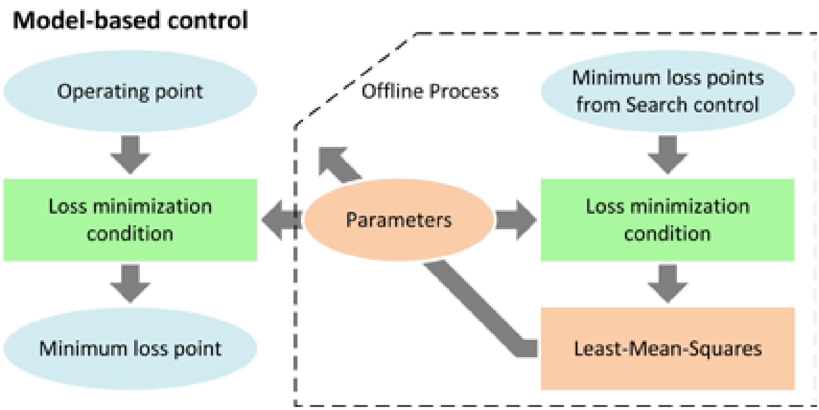
Loss minimization control of three-phase motors



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LOSS MINIMIZATION CONTROL OF THREE-PHASE MOTORS

Nguyễn, Chí Dũng

der Fakultät der Elektrotechnik und Informationstechnik der
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Abstract

Nowadays, three-phase motors are very widely used in many types of applications, such as in the industry, the commercial, residential, agricultural and transportation sectors. Simultaneously, efforts to reduce losses of these motors have also been performed. The content of this thesis is to contribute in these efforts by developing optimization control strategies based on the field oriented control method.

In practice, reducing losses of three-phase motors by optimization control strategies is a complex task because it is difficult to determine exactly motor parameters and, moreover, some motor parameters can be varied due to the magnetic saturation effect. In this dissertation, new optimization control strategies based on the combination of the model-based control technique and the search control technique are suggested for induction motors, permanent magnet synchronous motors and synchronous reluctance motors. These strategies focus on establishing the loss minimization condition from the loss model and then combining with optimal results obtained from a search control strategy to determine unknown parameters of this condition. This idea comes from the fact that search control strategies can find true minimum loss points that satisfy the loss minimization condition and, therefore, these points can be exploited as training data to estimate unknown parameters of the loss minimization condition. In this way, the proposed optimization control strategies can be performed without knowledge of motor parameters. The experimental and simulated results confirm the validity of both the proposed optimization control strategies and the parameter estimation method.

Also, this thesis presents a new approach based on the hybrid control technique to minimize copper losses of the externally excited synchronous motor. First, from the motor model optimal values of current components are defined as an explicit solution. Then, by combining with a search control algorithm, the explicit solution is able to avoid variation of motor inductances due to the magnetic saturation. The advantages of this hybrid control strategy are that it requires no extra hardware and can be easily performed with only knowledge of the ratio between stator- and excitation resistances, which is not seriously affected by variations of the motor temperature. The simulation results show improved performances compared to the original case.

Contents