

Budapest University of Technology and Economics
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Improvement of DC and switched reluctance servo drives' dynamic characteristics

Ph.D. thesis

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First of all this dissertation deals with position and speed control problems in electric servo drives as well as with high precision position measurement closely related to them. The mostly drive-specific part of it deals with optimal control of transistor SRM converters with reduced switching item number.

The dissertation shows a nonlinear control with changing gain for electric servo drives. This control provides positioning without overshoots as well as constant braking time even in cases of strongly changing moment of inertia and load. At constant-gain position control and zero load when moment of inertia falls to the half of its maximum value the braking time increases to 1.5 - 2 times larger although the maximum current limit would allow shorter braking time in such cases.

THESIS 1

To provide constant loop gain in speed control loop with changing parameters (moment of inertia and/or torque factor), parameter and signal adaptive model reference adaptive control was developed. The adaptive control can be applied in DC as well as switched reluctance servo drives.

Following from the structure of model reference parameter adaptive control developed to provide constant loop gain in speed control loop with changing gain (moment of inertia and/or torque factor) it makes easier to reach overshootless as well as fast speed changing compensation caused by jump in load. The algorithm even keeps its stability at fast changing, jump-like load torque.

Model reference signal adaptive control is advised to provide constant loop gain in speed control loop with changing parameters (moment of inertia and/or torque factor) exposed to significant load. The approaching block diagram of the adaptive control can be seen as extended version of the PF controller, so one of the adaptation factors (which is the free parameter of the

adaptive control) is given. Both model reference adaptive controls drawn up can be easily implemented, because the adaptation algorithms do not need angular acceleration measuring.

THESIS 2

Current control of the reduced switching item number SRM drives contain modified current reference signal. This method provides that torque ripple would not be significantly higher at a Miller-kind (n+1) transistor converter controlled n-phase drive - in other words a reduced switching item number SRM converter feed - than at independent current control in each phases carried out with 2n transistors.

THESIS 3

A new method can process the signals of analog (sinusoidal) incremental encoders used in high precision speed and position measuring without using hardware counter. Processing the sampled signals is satisfying even at that high speeds where there is no possibility to sample in each and every period.

This new result can be commonly put in words: angle change during sample time at limited slope sinusoidal signal can also be determined when more than one signal periods pass between two sampling. The conditions needed for such determination are that the angle inside a period should be determinable in the sampling moment, absolute value of the frequency changing rate should be smaller than half of sampling frequency square, and frequency at the beginning of the computation should be smaller than half of the sampling frequency. Thus the result can be seen as the Shannon sampling rule's extended version for a special case.

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