UNIVERSITÄT PADERBORN
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FAKULTÄT FÜR
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Abstract of Dissertation:

Power supplies for High-Power Piezoelectric Multi-Mass Ultrasonic Motor

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The purpose of this dissertation is to investigate the technology of designing the power supply and its control for driving high power piezoelectric multi-mass ultrasonic motor.

The proposed LLCC-PWM inverter was developed to excite the high-power piezoelectric ultrasonic motors, where a LLCC-filter circuit is utilized and operated in PWM-controlled mode. Two-level and three-level harmonic elimination technologies are investigated in respect to power losses, total harmonics distortion, volume and weight of the filter circuit.

In order to eliminate selected harmonics (3^{rd}, 5^{th}, 7^{th} and 9^{th} harmonic) for prolonging the lifetime of the piezoelectric stacks, suitable switching angles of the PWM are calculated off-line. Other higher frequency harmonics will be sufficiently suppressed by the LLCC filter characteristics.

Control schemes are proposed for driving the MM-USM. For control design, an averaging model of the MM-USM driven by LLCC PWM inverter is studied and verified by simulation results at transient and steady state conditions. A feed-forward voltage controller is designed and implemented, based on a simplified inner loop transfer function. A FPGA is employed as controller by reason of its flexibility, fast and parallel processing characteristics.