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Power electronics + FPGA board for quadruped robot

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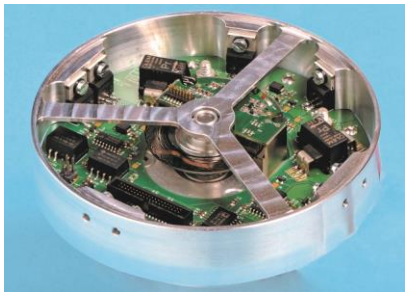
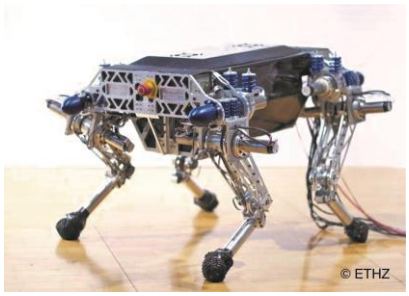
The Autonomous Systems Laboratory (ASL) from ETH Zurich has recently developed two walking robots, ALoF and StarlETH, to research quadruped locomotion. The target market is service robotics. As a result of successful testing of StarlETH, the ASL is developing a successor that is capable of sprinting. This form of locomotion places high demands on power electronics, control engineering, communication technology and mechanics. Whilst suitable motors are available there are no suitable motor controllers obtainable on the market and this paper describes the conception and development of a suitable motor controller which is to be used in the new robot development.
Several challenges could be overcome in the course of this project: A power electronics board was developed featuring a three phase inverter. Positional data could be correctly ascertained resulting in successful commutation and hence motor rotation. The necessary electronics could be deployed in a compact form factor which was balanced against the high power requirements of the motor. System on chip techniques could be successfully employed, in this case the Zynq platform from the FPGA manufacturer Xilinx was used with the current and position controllers implemented in the FPGA fabric. This significantly reduces the computation expense of the control functions and enables high loop bandwidths.
Based on a critical analysis of the functioning prototype, suggestions for a second prototype could be made.



The motor controller was developed in a compact form factor. The figure shows the power electronics and the optical positional sensor mounted inside the aluminum housing.



The figure shows the walking robot StarlETH from the Autonomous Systems Lab from ETH. This bachelor thesis comprises the development of a motor controller for a more powerful successor.