



# FPGA-Based Control System Design for Servo Drives for a Robotic Hand

## Master's Thesis

In the realm of robotics, the precision and agility of servo drive control systems are indispensable for enabling intricate motion and manipulation tasks. Leveraging Field-Programmable Gate Array (FPGA) technology holds immense potential for enhancing the capabilities of servo drives, offering real-time control and flexibility. This thesis proposal aims to explore the design and implementation of an FPGA-based control system specifically tailored for servo drives in robotic hands. By integrating advanced control algorithms, sensor feedback mechanisms, and efficient hardware design, this research seeks to contribute novel insights to the field of robotic control systems. The proposed investigation holds promise for advancing the state-of-the-art in robotic manipulation, with implications for various industrial and research applications.

### Experience:

- Theoretical experiences in robotics, mechatronics and electrical engineering
- Proficiency in FPGA development, including familiarity with FPGA architectures, programming languages such as Verilog or VHDL
- Understanding of embedded systems concepts, including real-time processing, interfacing with peripherals, and low-level programming for hardware control.
- Strong foundation in control theory, including PID control, state-space representation, and system identification techniques.

### Tasks:

- Requirement Analysis and System Design
- Implement the control algorithms using HDL such as Verilog or VHDL, ensuring real-time performance and resource efficiency.
- Design communication interfaces to facilitate interaction between the FPGA-based control system and external devices or higher-level control systems.
- Integrate all hardware and software components of the FPGA-based control system, including sensors, actuators, control algorithms, and communication interfaces.
- Conduct comprehensive system testing to verify functionality, performance, and reliability under various operating conditions.

The work is being carried out at the German Aerospace Center in Wessling.

Begin: at the earliest possible date  
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Please include a brief motivation, a description of previous projects, and a current resume.



Fig. 1: Awiwi Hand