TECHNISCHE UNIVERSITÄT
BERGAKADEMIE FREIBERG
Die Ressourcenuniversität. Seit 1765.

MSELab

Embedded UDV Velocity Estimation

Type of Thesis: Master Thesis

Suitable for: Angewandte Informatik, Angewandte Mathematik, Engineering, Robotik

Motivation & Background:
How is the Earth's magnetic field created? The DRESDYN precession experiment at Helmholtz-Zentrum Dresden-Rossendorf tries to answer this question with a unique experiment: A vessel filled with 4 tons of liquid sodium and rotated with precession just like the earth. What are the flow structures inside the sodium that create a magnetic field?
Simulations can only partially answer this question so we need to measure it - with ultrasound! We already built a custom hardware platform that can capture the relevant signals for measuring flow velocities via UDV (Ultrasound-Doppler-Velocimetry) but processing still takes place afterwards on a PC. Now we need to move this to a microcontroller.

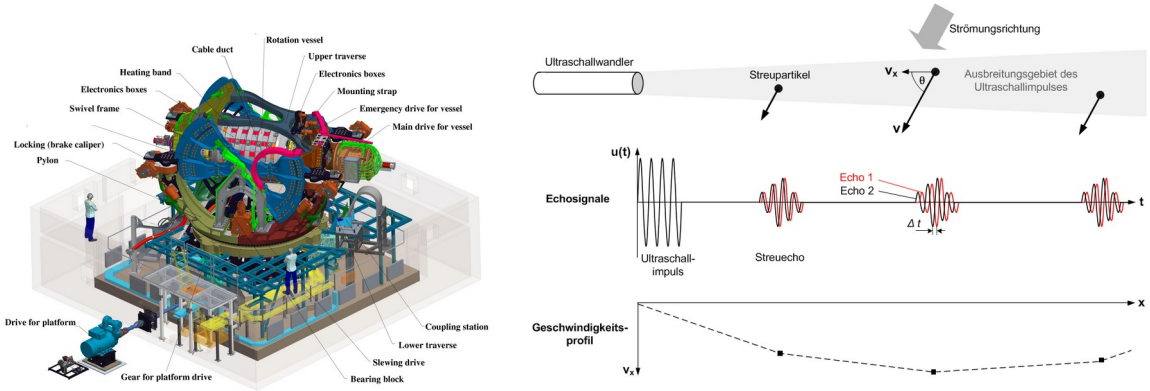

Figure: ***DRESDYN Precession Experiment / UDV Principle***

Goals & Objectives:
Port the Loupas 2D Velocity Estimator including required preprocessing steps from python to embedded C within the resource constraints of the target microcontroller platform.

Milestones:
- Understand UDV principle, the basic operation of estimation algorithms and the working principle of the CMSIS DSP library
- Port existing python code to CMSIS-DSP python wrapper and verify against testbench
- Identify parameters to tune resource usage against estimation uncertainty
- Port implementation to CMSIS-DSP C code and embed it into existing firmware
- Verify functionality in a simple experiment

Character of the work:
30% Python Programming, 30% Embedded C Programming, 20% System Design, 10% Math, 10% Experimental Work

Supervision & Workflow:
- Regular **bi-weekly meetings** where the student presents status and progress and need for support is identified. Additional meetings can be scheduled if required

- Additionally, the supervisor is **reachable via Element Messenger** for support on smaller technical questions
- Students are encouraged to give a **mid-term presentation** as a preparation for the final presentation of the thesis. This is an opportunity to discuss the results with a broader audience and get important feedback on the current state of the work.

Required Skills: Python, Git, C (basic skills)

Supervisor: Dipl.-Ing. Lennart Schierling