Master Thesis Informatik/ESE/MST/MSE/SSE

# Cyclic Pitch Control of a Roto-Kite

Airborne Wind Energy (AWE) is a novel way to harvest wind power by flying devices. AWE can harvest winds in higher altitudes than conventional wind turbines and promises to become a major source of renewable energy in the future energy system. One possible AWE approach is based on roto-kites with torque transmission via tensegrity structures, as pursued by the Spanish company someAWE Labs S.L. (see also https://www.youtube.com/watch?v=p8Hfj7L7d_w). This company is located in Alicante and offers an industrial master thesis in close cooperation with the team of Prof. Moritz Diehl from the Systems Control and Optimization Laboratory of the University of Freiburg, who will be the academic supervisor. A major task for the automatic flight of roto-kites is the control of the position of the device on the sky, which can be achieved via cyclic pitch control of the blades, somewhat similar, but not exacly, to helicopter control. In a previous ESE master thesis, an automatic way to compensate the rotation of a roto-kite based on measurements from an inertial measurement unit (IMU) was realized both in theory and experiment (https://www.syscop.de/event/master-thesis-presentation-rotation-compensation-rotary-kite-systems).

**Master topic:** The proposed master thesis shall build on the previous work in Freiburg and Alicante and realize an embedded control system for cyclic pitch control of a roto-kite consisting of a rotation compensation mechanism (as realized in the previous master thesis) and three individual pitch motors (one for each blade). The task of the embedded controller is to accept three inputs from a human-controlled remote control (RC) system (average collective pitch, cyclic pitch amplitude, and cyclic pitch phase) and to translate these to individual pitch motor commands, in order to be able to steer a real roto-kite device by RC-control on the sky.

**Your skills**: Prior knowledge in systems and control as well as C programming skills are necessary, and experience with Arduino systems could be a useful starting point. Most important is the willingness to make a real-world embedded control system including sensors and actuators work.

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