Flight Control Laboratory (FCL)
Kick-off meeting

Tommaso Sartor & Jochem De Schutter

University of Freiburg

tommaso.sartor@imtek.uni-freiburg.de
jochem.de.shutter@gmail.com

April 26, 2018

Overview

1. Presentation
   - Motivation
   - Organizational
2. Projects
   - Rotary Kite experimental Setup
   - Carousel, Half wing setup
3. Project Discussion

What is the FCL?

Objectives

- Hands-on experience in control and/or estimation
- Working with a real and/or simulated aerial system
- YOU shall learn something / gain further insights
- A documented and *working* (*running*) project (demo)

You working crazy hours and getting frustrated is certainly NOT our goal!

Examples from previous Year 2017

Figure: Learned odometry model

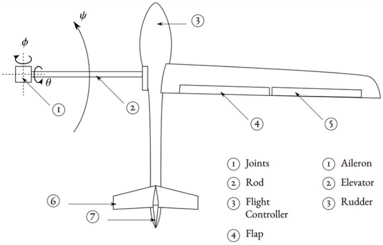


Figure: Learned State Estimator

Examples from previous Year 2016

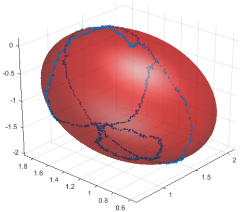


Figure: Magnetometer Calibration

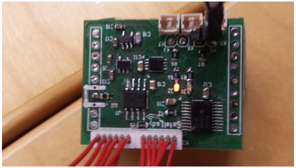


Figure: PCB development for a gps module

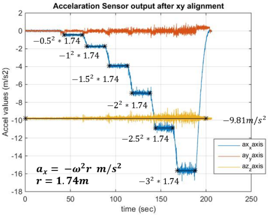


Figure: Accelerometer Calibration

Time-line

Deadlines and mandatory meetings:

- **Kick-off meeting** April 25, 2018
- **Project Proposal Presentation** (two weeks after Kick-off)
- **Mid-term Presentation** (first week of June)
- **Final Presentation** (last week of July) *graded!*
- **Final Report** *submission deadline* August 7th, 2018, 23:59

- **Weekly Report** *every* Monday, 23:59

Project Proposal Presentation

Project Proposal Presentation:

- 5-10 min each
- Present your Project:
    - Define goals
    - Identify approach(es)
    - Come up with detailed time line (plan for mistakes and detours!)
- make slides

Afterwards:
(individual) discussion of project, approaches and time line

Mid-term Presentation

Mid-term Presentation (1st week of June):

- work accomplished so far (including problems and taken approaches)
- current state
- planned work
- (updated) time line for remaining time
- NOT graded!

See this as a grand rehearsal for the final presentation.

Final Presentation

Final Presentation (last week of July):

- final state of your project
- Demo
- problems encountered, approaches taken
- Prof. Diehl will be there!
- 20% of your grade

Final Report

General:

- Article in the SYSCOP wiki!
- *about* 1000 - 2000 words (quality over quantity)
- 60% of the grade

Contents:

- Explanatory graphics
- Problems, tried Approaches, lessons learned, ...
- Point to code and Examples / Tutorial

Keep in mind while writing:
Other people will read (parts of) it when they want to use or build up on your work

Weekly Report & Meetings

What goes into the weekly report (deadline Monday 23:59)?

- Work accomplished in previous week, including problems and state of lab
- Plans for the next week
- point to commits you have made if any
- Mail or markdown document in your repository
- Structured text like bullet points or tables are a plus

Questions, Problems, want to try your presentation, . . . ?

→ Send an email and ask for a meeting!

Grading

Grading based on three components:

- 20% your final presentation
- 20% code and documentation
- 60% lab report (Wiki article)

Legal notice

Please note:

- Plagiarism or copyright violations will be rewarded with a 5.0 (you fail)
- Cite correctly! Wrong citations or missing citations are plagiarism.
- Indicate your source for any piece of intellectual property that is not yours (code, image, text), otherwise this is also plagiarism.
- Before you the intellectual property of somebody else make sure you have the right to do so, and that you are not violating any copyrights.

Suggested methodologies

Team work:

- We suggest to work in group of two people

Software:

- The usage of `git` is highly encouraged
- You will create a repository on gitlab.syscop.de server
- Linux is preferred over Windows
- Python/Jupyter is preferred over Matlab

Formalism:

- Quaternions are preferred over Euler angles

Organizational Questions?

Project Overview

Projects:

- Rotary Kite experimental setup
- Half wing carousel

Airborne Wind Energy - background

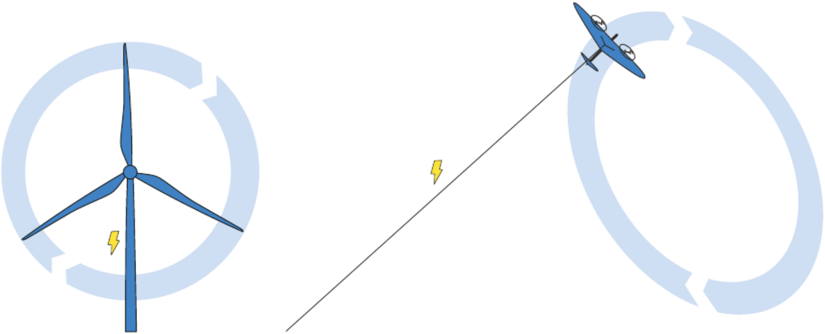


Figure: Comparison between conventional wind turbines, Illustration by R. Paelinck.

Airborne Wind Energy - background

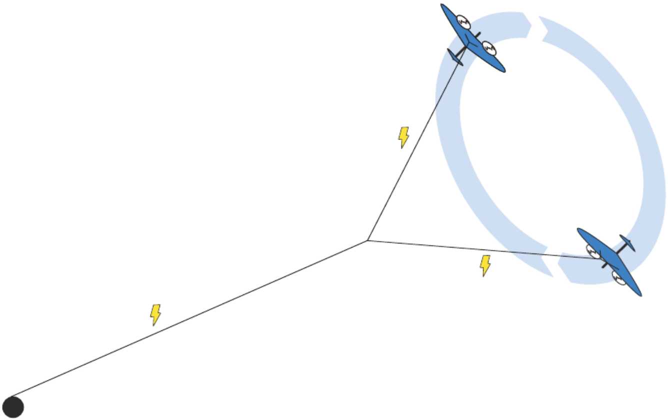


Figure: Dual-kite system, Illustration by R. Paelinck.

Airborne Wind Energy - background

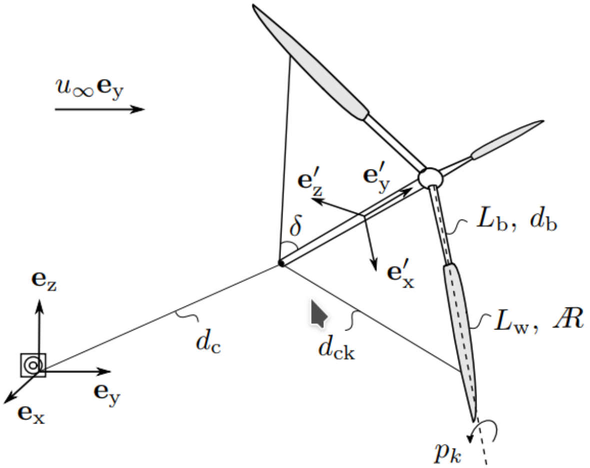


Figure: Conceptual schema of Rotorkite Airborne Wind Energy System (RAWES), Illustration by J. De Shutter.

Rotary Kite Experimental setup

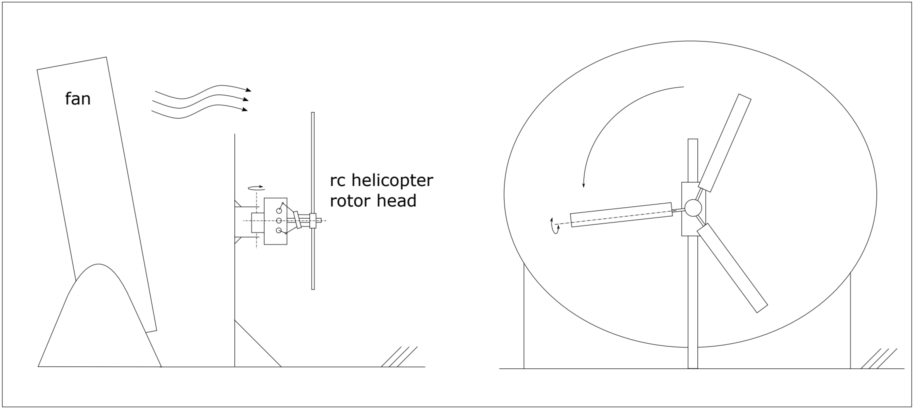


Figure: RAWES experimental setup, Illustration by T. Sartor

RAWES experimental setup - Main concepts

Figure: RC helicopter

Figure: Conventional Wind turbine

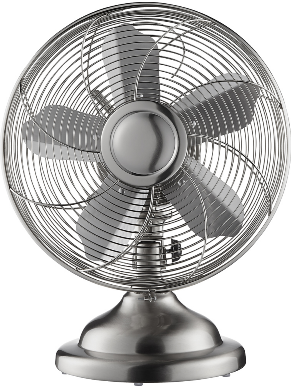


Figure: Artificial airflow

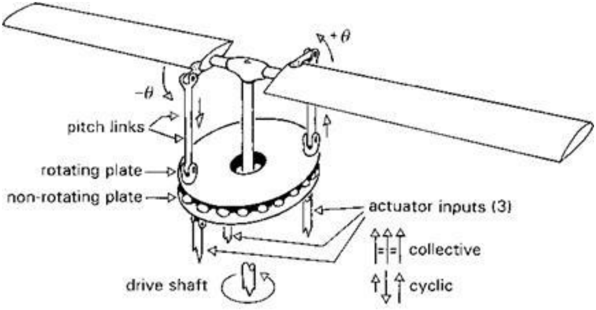


Figure: Collective and cyclic pitch

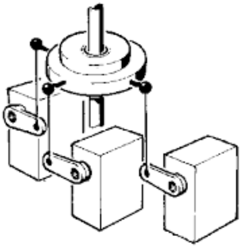
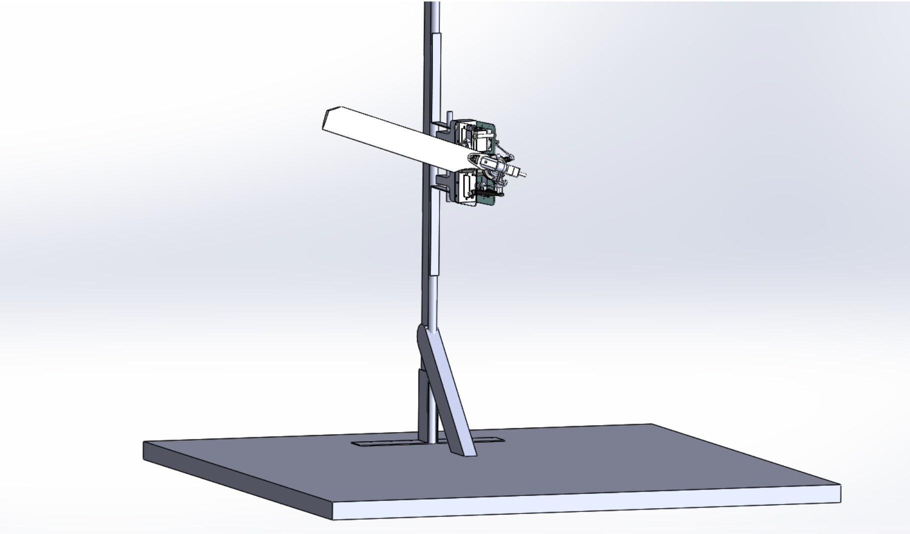
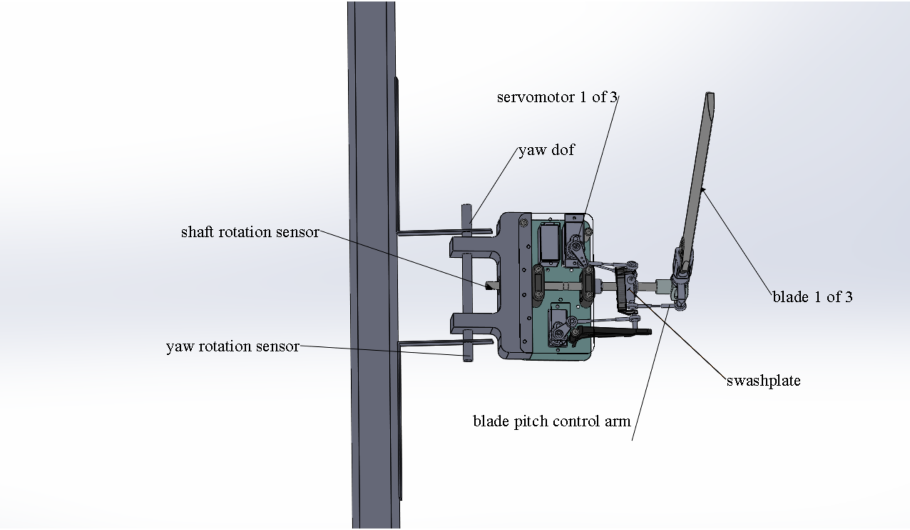


Figure: Swashplate actuators

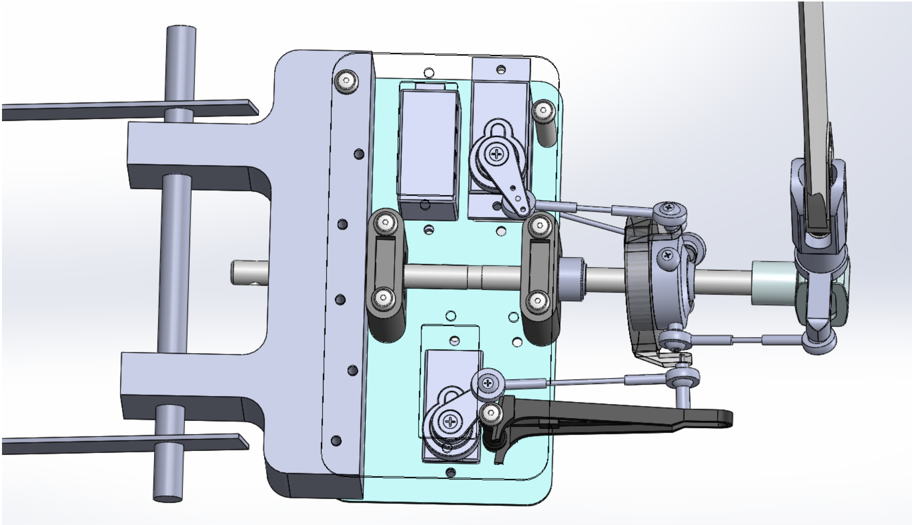
Rotary Kite Experimental setup - Current stage



Rotary Kite Experimental setup - Main components



Rotary Kite Experimental setup - Zoom-in



Project 1: Rotor kite - Control yaw angle

- Connect hall effect rotation sensor with MCU
- Design sensor mounting solution
- Formulate a model of the system
- Control task: Yaw angle tracking
- Run experiments (simulations)
- Collect data

Project 2: Rotor kite - Torque free along rotation axis

- Design a mechanical patch to current design to add additional degree of freedom
- Add torque actuation on rotor-head axis to counteract bearing friction
- Measure and model bearing friction
- Add rotation sensor to measure rotorhead sub-assembly (RHS) rotation with the respect to the frame
- Control task: Minimize net torque force transmitted from frame to RHS
- Run experiments (simulations)
- Collect data

Project 3: Rotor kite - Additional upgrades

- Add pitch DOF (force sensor)
- Choose a control strategy
- Control task: compensate gravity (maximize pulling force)
- Run experiments (simulations)
- Collect data

Project Discussion