AWESCO
Airborne Wind Energy
System Modelling, Control & Optimisation

Ampyx Power
airborne wind energy

UNI FREIBURG

PhD Fellowship on Launching and Landing Tethered Planes for Airborne Wind Energy

in Den Haag at the company AmpyxPower (Netherlands) and at the University of Freiburg (Germany)

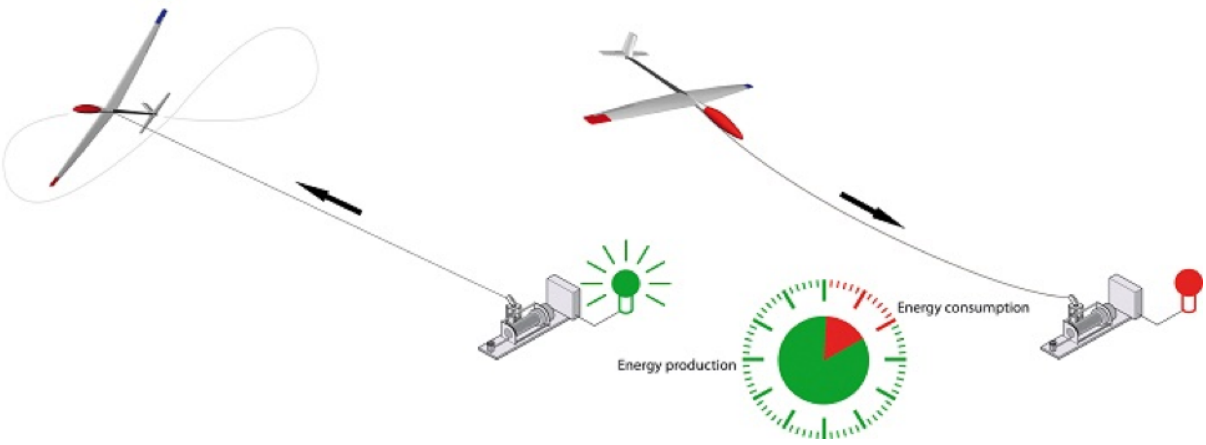
This PhD position on "Control of launching and landing the PowerPlane on a launch platform" is part of the Marie Curie Network "AWESCO - Airborne Wind Energy System Modelling, Control and Optimisation". AWESCO will recruit altogether 14 PhD fellows who are based in different countries but meet regularly during exchange visits, training events, workshops, and summer schools organized by AWESCO. The PhD fellow at AmpyxPower will work most of his/her time time at the company premises in Den Haag, but also spends about one year at the University of Freiburg (at the Systems Control and Optimization Laboratory headed by Prof. Dr. Moritz Diehl), which will award the PhD degree.

BACKGROUND

Ampyx Power is a start-up company developing a novel wind energy technology. Its product, the PowerPlane®, a tethered high-strength autonomously controlled glider, is projected to generate electricity at cost levels competitive with fossil fuels. The basic principle of power generation uses a "pumping cycle" that uses strong tether tension during roll-out to drive a generator at the ground, as illustrated below. Further system up-scaling shall allow electricity generation at costs well below any other generation technology. AmpyxPower with its a young team of 20 people offers an exciting working environment and has as its aim ground-breaking innovations for the world's energy sector.

One of the main challenges of the technology is to automatically and robustly launch and land the tethered airplane. AmpyxPower cooperates with the University of Freiburg on the automatic control and optimization of the PowerPlane, and the AWESCO PhD position shall assume a central position in this cooperation.

The control and optimization laboratory at the university of Freiburg focuses on methods and software for embedded model predictive control and optimization, and its members developed, among other, the open-source tools ACADO, CasADi, and qpOASES. One of its research lines is control and optimization of airborne wind energy systems, a topic on which it is supported by the European Research Council (ERC) with the project HIGHWIND that funds about 5 team members for five years.



PHD PROJECT

Aim of the AWESCO PhD position at AmpyxPower and Freiburg is to develop robust control methods for launching and landing of the 5.5 m wingspan PowerPlane, a tethered sailplane, developed by Ampyx Power. The student will go through all necessary steps for controller implementation, including modelling, controller design and testing. The student will develop detailed models of interaction between aircraft and launch mechanism, including subjects such as friction, short tether dynamics and elasticity to obtain a reliable simulation of the early launch stage, when the plane is close to the platform. The PhD student will use this model to search and optimize for robust trajectories to launch the PowerPlane without secondary propulsion. He/she will develop model predictive control schemes with sufficient robustness to fly these trajectories at strong winds.

Educational Objectives: The ESR will learn advanced control system design and control system implementation applied to the PowerPlane in particular for the start and landing phases.

Timeline and Secondments: In the first year, tethered plane modelling and NMPC control theory will be studied. To improve this, a six month secondment in Freiburg will take place to get acquainted with modelling, simulation and control of start-up. Also an 1 month secondment at ETH Zurich will take place to get familiar with control system methodologies. The third year is focussed on the implementation of an advanced controller and on writing the thesis.

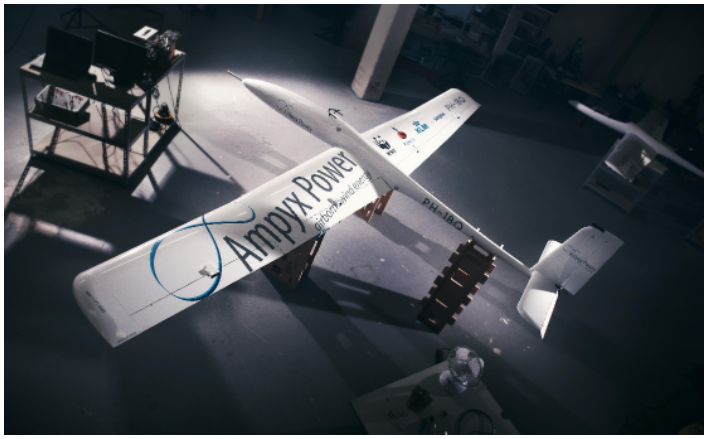
The Marie Curie Initial Training Network is set up as an international project. The fellow will attend a large number of workshops abroad, conferences and trainings with both technical and nontechnical subjects. A 6 month internship to the university of Freiburg is included at the beginning of the work to familiarize the fellow with the MPC software developed under supervision of Prof. Moritz Diehl; a close connection to the academic team is ensured via regular participation at group events in Freiburg. Several internships of fellow AWESCO PhD researchers are planned at Ampyx Power. The duration of the project is three years, ideally starting in June 2015. The remuneration is generous, depends on family status, and will be in line with the EC rules for Marie Curie grant holders.

The PhD will be supervised by several world leading experts in optimization-based flight control and shall prepare the candidate for a high-level career in advanced control engineering in industry or in academia.

SUPERVISORS AND MAIN CONTACTS

AmpyxPower: Sören Sieberling (control team manager and daily PhD supervisor), Dr. Paul Williams (guidance and control expert), Shadi Ghanchi (UAV control expert), and Dr. Richard Ruiterkamp (CEO of AmpyxPower), Giovanni Licitra (starting PhD student on “Embedded Model Predictive Control of a Tethered Aircraft for Airborne Wind Energy”, jointly between AmpyxPower and Univ. Freiburg).

University of Freiburg: Prof. Dr. Moritz Diehl (head of control and optimization laboratory and main PhD supervisor), Greg Horn (senior PhD student working on aircraft modelling and optimization software for airborne wind energy), Mario Zanon (senior PhD student working on Nonlinear Model Predictive Control formulations), Robin Verscheuren (PhD student focusing on “Code Generation for Embedded Nonlinear Model Predictive Control and Moving Horizon Estimation”).



CANDIDATE PROFILE

An ideal candidate has a master degree in aerospace or control engineering, with a strong background in physical modelling and control of flying systems, an interest in programming (Matlab, C/C++) as well as a desire to contribute to the success of real-world control experiments. Proficiency in English is a requirement. The position adheres to the European policy of balanced ethnicity, age and gender.Both men and women are encouraged to apply.

APPLICATION

To apply, send an email to diehl@imtek.uni-freiburg.de and soeren@ampyxpower.com (with CC to christine.paasch@imtek.uni-freiburg.de). Subject of your email should be: "AWESCO Ampyx PhD Application". Please include:

a) an academic CV and a PDF of your diplomas and transcript of course work and grades
b) statement of research interests and career goals
c) sample of technical writing
d) list of at least two referees: names, phone numbers, and email addresses
e) proof of proficiency in English (e.g. language test results from TOEFL, IELTS, CAE, or CPE)

Please send your application before February 15, 2015.

MARIE CURIE ELIGIBILITY CRITERIA IN SHORT

To be eligible, you need to be an "early stage researcher" i.e. simultaneously fulfill the following criteria at the time of recruitment:

a) Nationality: you may be of any nationality.
b) Mobility: you must not have resided or carried out your main activity (work, studies, etc...) in Germany for more than 12 months in the 3 years immediately prior to your recruitment under the AWESCO project.
c) Qualifications and research experience: you must be in the first 4 years of your research career after the master degree was awarded.

For more information, please visit the following webpages:

http://www.ampyxpower.com

http://www.imtek.de/laboratories/systemtheorie

http://www.awesco.eu