



(Den Haag)



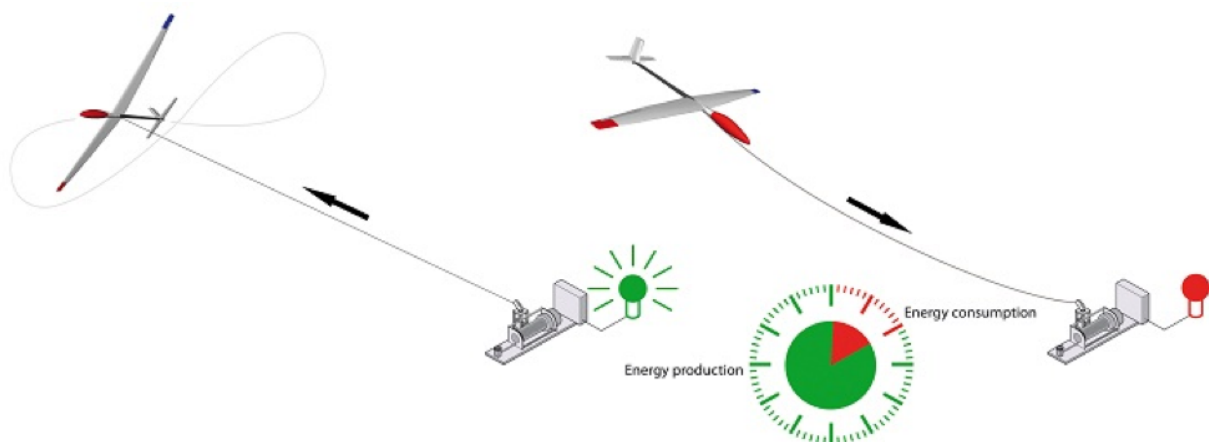
(Freiburg)

European PhD Fellowship on Flight Control for Airborne Wind Energy in Den Haag at the company AmpyxPower (Netherlands) and at the University of Freiburg (Germany)

This PhD position on "Embedded Model Predictive Control of a Tethered Aircraft for Airborne Wind Energy" is part of the Marie Curie Network "TEMPO - Training in Embedded Model Predictive Control and Optimization" (<http://www.itk.ntnu.no/projects/tempo/>). TEMPO recruits altogether 14 PhD fellows who are based in different countries but meet regularly during exchange visits, training events, workshops, and summer schools organized by TEMPO. The PhD fellow at AmpyxPower will work most of his/her time at the company premises in Den Haag, but also spends about one year at the University of Freiburg (at the Control and Optimization Laboratory headed by Prof. Dr. Moritz Diehl), which has strong airborne wind energy research activities and 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.



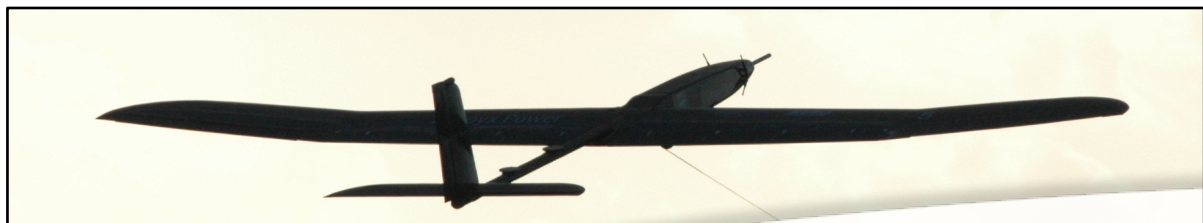
Further system up-scaling shall allow electricity generation at costs well below any other generation technology. AmpyxPower with its a young team of 20 people offers an exciting working environment and has as its aim ground-breaking innovations for the world's energy sector.

One of the main challenges of the technology is automatic control of the tethered airplane under varying weather conditions. Model Predictive Control (MPC) is a particularly promising control technology to achieve this aim. AmpyxPower cooperates with the University of Freiburg on this topic, and the TEMPO 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 TEMPO PhD position at AmpyxPower and Freiburg is to develop an embedded model predictive control (MPC) algorithm for the PowerPlane system. The research training objective of the fellow is to experience all stages of design and experimental testing of an MPC scheme for the prototype plane. The project starts by studying and improving an existing simulation model, including cable dynamics. The fellow will then practice in developing a lean and efficient nonlinear model suitable for optimization and control, and use this in searching for optimal open-loop trajectories for maximum power generation, for startup and for landing, and search for the best feasible launch procedures. Then, he/she will augment the control model by a disturbance model and study the setup of moving horizon estimation (MHE) and MPC for trajectory tracking. The MPC scheme is tested against the simulation model as hardware-in-the-loop, and an 8 hour experimental flight.



(Ampyx PowerPlane prototype in tethered flight)

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 TEMPO PhD researchers are planned at Ampyx Power. The duration of the project is three years, ideally starting in October 2014. The remuneration is generous and will be in line with the EC rules for Marie Curie grant holders (<http://cordis.europa.eu/fp7>). It consists of a salary augmented by a mobility allowance, resulting in a net monthly salary of about 2000-2400 Euro depending on family status. A fourth PhD year is possible and funding for it prereserved in the group of Prof. Diehl in Freiburg.

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).

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), and Robin Verscheuren (TEMPO PhD fellow focusing on “Code Generation for Embedded Nonlinear Model Predictive Control and Moving Horizon Estimation” starting on Oct.1, 2014).

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 (with CC to christine.paasch@imtek.uni-freiburg.de). Subject of your email should be: "TEMPO 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 July 30, 2014.

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

Please visit the <http://www.itk.ntnu.no/projects/tempo/> for more information about the project, its partners and eligibility criteria.



(PowerPlane prototype at Ampyx)



(team of Prof. Diehl)