

# Introduction to HIGHWIND Scientific Advisory Board Meeting

Moritz Diehl



Leuven, May 24, 2012



# Overview

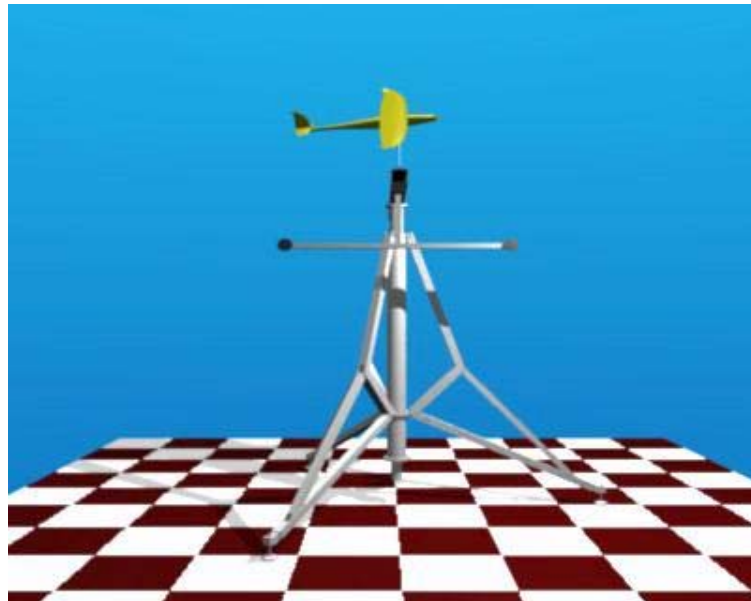
- HIGHWIND Project in a Nutshell
- Scientific Advisory Board (SAB)
- Overview of the Day

# European Research Council Project, 2011-2016



## Simulation, Optimization, and Control of High Altitude Wind Power Generators

**Aim:** Guide the development of high altitude wind power, focus on *modeling, optimization, and control*, plus small scale experiments.



ERC  
**HIGHWIND**  
SIMULATION, OPTIMIZATION & CONTROL OF  
HIGH-ALTITUDE WIND POWER GENERATORS

# Two Major Questions of Airborne Wind Energy

- How to start and land ?
- How to control automatically ?

# Four Work Packages of HIGHWIND

- WP1 - Mathematical Modeling of Airfoil and Tether
- WP2 - Optimal Control and Stability Optimization
- WP3 - Embedded Control
- WP4 - Small Scale Experiments

# Current ERC HIGHWIND Team



Prof. Moritz Diehl  
principal investigator



Prof. Jan Swevers  
control systems



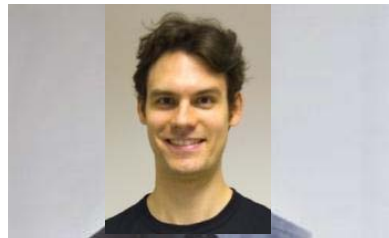
Prof. Dirk Vandepitte  
mechanical design



Prof. Johan Meyers  
CFD simulations



Dr. Sébastien Gros  
coordinator, simulation



Dr. Andrew Wagner  
vision & hardware



Dr. Julia Sternberg  
stability optimization



Dr. Hammad Ahmad  
power & communication



Kurt Geebelen  
control experiments



Mario Zanon  
predictive control



Milan Vukov  
embedded optimization



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# HIGHWIND SAB Members

- Stephan Brabeck, CTO of SkySails, Germany. SkySails is a leading company on ship propulsion with towing kites with interest in electricity generation
- Damon Vander Lind, Chief Engineer of makani power, a leading company in airborne wind energy (in place of Corwin Hardham) (talk today)
- Prof. Dr. Florian Holzapfel, Head of the Institute of Flight System Dynamics, TU Munich, one of Europe's leading groups on flight dynamics and UAV control (talk today)
- Dr. Chris Spruce, senior specialist at VESTAS, one of the world's leading wind power companies



# Aims of Scientific Advisory Board (SAB) Meeting

## Aims

- critically evaluate the performance of the HIGHWIND team
- give advice for improvements
- recommend synergies and contacts

## Questions to SAB

- what are the strengths, what are the weaknesses of the team ?
  - what opportunities and what risks do you see for the project ?
- (+ long list of detailed questions in internal report)

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# Program This Morning

- 09:00 Introduction (Moritz Diehl)
- 09:15 Progress on simulation side (Sébastien Gros)
- 09:35 Fast solvers for embedded optimization (Moritz Diehl & Milan Vukov)
- 09:55 Progress on experimental side (Andrew Wagner)
- 10:15 Demo of the Highwind carousel (Hahmad Ahmad & Kurt Geebelen)
  
- 10:45 *Coffee break*
  
- 11:15 Short poster presentations
- 11:30 Poster session
  
- 12:30 *Sandwich lunch in Machinezaal*

# Program This Afternoon

- 13:30 Airborne Wind Energy based on Dual Airfoils (Mario Zanon)
- 13:50 Open loop stability optimization (Julia Sternberg)
- 14:10 Optimization research at KU Leuven (Moritz Diehl)
- 14:20 Control of Mechatronic Systems in the Unit PMA (Jan Swevers)
- 14:30 Turbulent Wind Flow in Large Wind Parks (Johan Meyers)
- 14:50 Concluding remarks & final discussion
- 15:00 *End of Public Workshop and Good Bye Coffee*

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