

AWESCO — Work Package 4: Control Systems

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AWESCO kick-off week
Freiburg, Germany

Outline

- 1 Introduction
- 2 AWESCO Workshop at TUM
- 3 Work Package 4: Control Systems

Outline

- 1** Introduction
 - Technische Universität München (TUM)
 - Munich School of Engineering (MSE)
 - MSE Research group “Control of Renewable Energy Systems (CRES)”

Technische Universität München (TUM)

Main campuses

154 programs - 13 departments - 3 locations

Munich

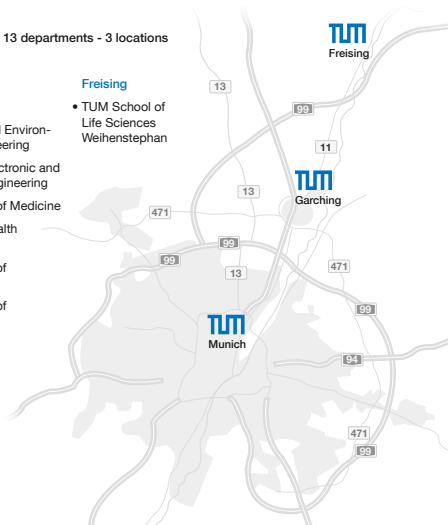
- Architecture
- Civil, Geo and Environmental Engineering
- Electrical, Electronic and Computer Engineering
- TUM School of Medicine
- Sport and Health Sciences
- TUM School of Education
- TUM School of Management

Freising

- TUM School of Life Sciences Weihenstephan

Garching

- Chemistry
- Informatics
- Mathematics
- Mechanical Engineering
- Physics



TUM science network

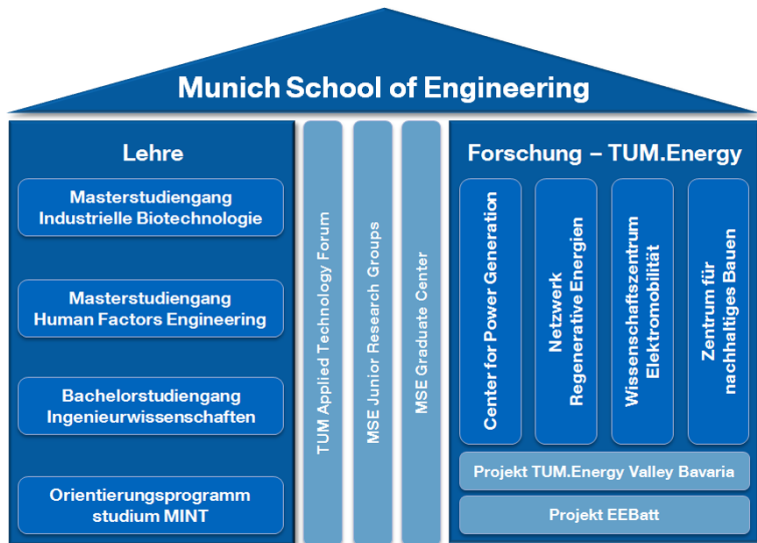
- Max Planck Institutes: Garching Martinsried Munich
- Helmholtz Zentrum München
- iwv Anwenderzentrum Augsburg
- Fraunhofer Institutes: Holzkirchen Freising

TUM locations

- Munich
- Garching
- Freising
- Iffeldorf
- Oberrach
- Straubing
- Wettzell
- Singapore: TUM Asia
- Beijing
- Brussels
- Cairo
- Mumbai
- São Paulo

Munich School of Engineering (MSE)

Integrative research center



Group “Control of renewable energy systems (CRES)”

Team



H. Eldeeb, M.Sc.
(CRES,09/2015)



C. Dirscherl, M.Sc.
(CRES,01/2014)



C. Hackl, Dr.-Ing.
(CRES,01/2014)



J. Kullick, M.Sc.
(CRES,10/2015)



K. Schechner, M.Sc.
(CRES,01/2014)



Z. Zhang, M.Sc.
(CRES/EAL,07/2015))

External PhD candidates



S. Krüner, M.Sc.
(SINNPower,11/2015)



A. Birda, M.Sc.
(BMW,04/2016)

... and collaborations with EAL (Prof. Kennel)



F. Bauer, M.Sc.
(EAL)



M. Abdelrahem,
M.Sc. (EAL)

Group “Control of renewable energy systems (CRES)”

Fields of research

Classical wind turbine systems



Focus: Efficiency and reliability

Airborne wind energy systems



Focus: Fault-tolerant control

Small-scale wind turbines



Focus: Use of RSMs (≤ 50 kW)

Wave converters (with SINN Power GmbH)



Focus: Energy efficiency and robust control

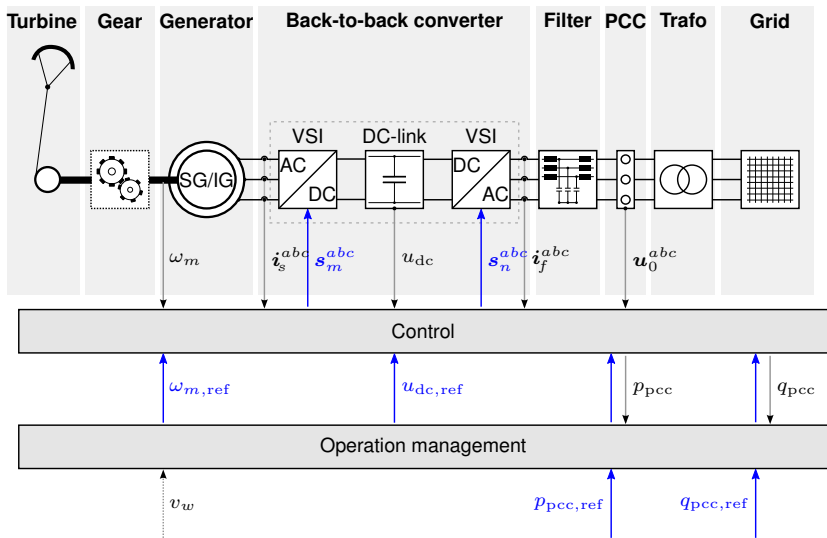
Geothermal power systems



Focus: Fault-tolerant control

Group “Control of renewable energy systems (CRES)”

Our point of view: **Electrical** components of e.g. airborne wind energy systems



Outline

2 AWESCO Workshop at TUM

AWESCO Workshop at TUM

Check: <https://www.cres.mse.tum.de/index.php?id=awescoworkshop>



AWESCO H2020 Innovative Training Network Workshop: ACADO/CasADi Training (ALU) and Electrical Drives Course (TUM)

Facts

- When: 4th – 8th April 2016
- Where: Technische Universität München (TUM), Garching near München, Germany
(see http://portal.mytum.de/campus/roomfinder/getBuildingMap?mapid=80&b_id=5507 for directions)
- Who:
 - Interested AWESCO ESRs and / or
 - Interested external PhD students (workshop fee: 150 € includes coffee/snacks and lunch)
 - Maximum number of participants: 30
- Registration/Application:
 - Deadline: 1st March 2016
 - Please send your application to Christoph Hackl (christoph.hackl@tum.de)
 - External PhD students: Please also attach CV & supervisor's recommendation letter

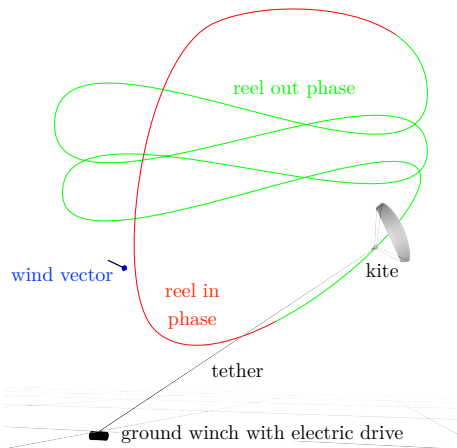
Outline

3 Work Package 4: Control Systems

- Research Objectives
- Multidisciplinary problem
- 8 Milestones
- Tasks and talks

Work Package 4: Control Systems

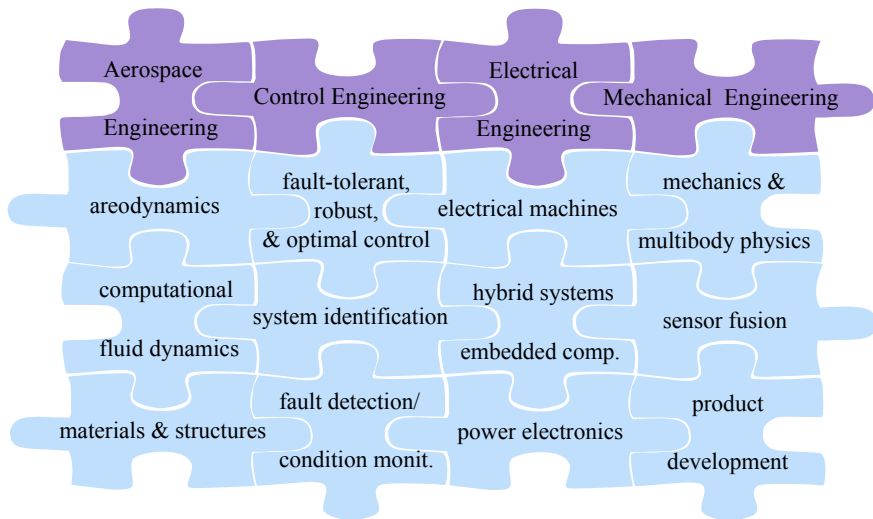
Research Objectives



- **robust** and **fault-tolerant low-level** and **high-level** control algorithms to achieve a **reliable** and **safe operation** of the AWE system
- **computationally efficient** and **fast enough** algorithms to handle the relevant dynamics of an AWE system
- Control methodologies **will be tested** on the in-house prototype and also on a large scale setup with **complimentary secondments** in industry and academia.

Work Package 4: Control Systems

Multidisciplinary problem



Work Package 4: Control Systems

8 Milestones (as in Grant Agreement)

MS19	Electrical drive simulation models and controllers including fault handling developed	WP4	5 - TUM	24	
MS20	Controllers tested on hardware set-up	WP4	5 - TUM	36	
MS21	Modelling and simulation of AWE system completed	WP4	7 - AMPYX POWER BV	24	
MS22	Automatic launch and recovery of rigid wing	WP4	7 - AMPYX POWER BV	36	
MS23	Control strategy designed and tested on prototype	WP4	1 - TU Delft	24	
MS24	Automatic launch and recovery of flexible kites	WP4	1 - TU Delft	36	
Milestone number ¹⁸	Milestone title	WP number ⁹	Lead beneficiary	Due Date (in months) ¹⁷	Means of verification
MS25	Open-source software produced	WP4	1 - TU Delft	24	Formally responsible for this milestone is TU Delft, implementation is done by ETHZ.
MS26	Validated control strategies on experimental set-up	WP4	1 - TU Delft	36	Formally responsible for this milestone is TU Delft, implementation is done by ETHZ.

Work Package 4: Control Systems

Tasks and corresponding talks

- Task 4.1: Robust and Fault-Tolerant Low-Level Control of the Electrical Drive System (ESR7, TUM)
Hisham Eldeeb, “Robust Fault-tolerant Control for the Electrical Drive of Airborne Wind Energy Systems”
- Task 4.2: Control of launching and landing the PowerPlane on a launch platform (ESR9, Ampyx)
Jonas Koenemann, “Modeling Dynamics of the Ampyx AWE System for Launching and Landing Optimization”
- Task 4.3: Robust Automatic Operation of Inflatable Tethered Wings for Power Generation (ESR2, TUD)
Eva Ahbe, “Airborne Wind Energy at ETH Zurich”
- Task 4.4: Modelling and Periodic Control of Dynamically Uncertain Airfoils (ESR13, ETHZ)
Sebastian Rapp, “Robust Automatic Operation of Inflatable Tethered Wings for Power Generation”