Introduction and research foci of the TUM AWESCO partners

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Outline

1. Introduction of the TUM partners
2. Introduction Hisham Eldeeb
3. Introduction Florian Bauer
4. Open questions and future steps

Outline

1. Introduction of the TUM partners
   - EAL (Prof. Dr.-Ing. Ralph Kennel)
     - Overview
     - Renewable Energy Systems (RES) team
   - CRES (Dr.-Ing. Christoph Hackl)
     - Overview
     - Research foci
     - Interdisciplinarity
     - Contributions this far ...
     - Laboratory setups

Outline

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Institute for Electrical Drive Systems and Power Electronics (EAL)

R. Kennel, Prof. Dr.-Ing.
(Head of EAL; since 2008)

- 1984: Ph.D. at University of Kaiserslautern, Germany
- 1984–1997: Development of Industrial Servo Drives with Digital Control, Robert BOSCH GmbH, Erbach/Odw.
- 1997–1999: Advanced Development of Electrical Drives for Automotive Applications, Robert BOSCH GmbH, Buehlertal
- 1994–1999: Visiting Professor at the University of Newcastle upon Tyne, UK
- 1999–2008: Professor for Electrical Machines & Drives at Wuppertal University
- since 2008: Professor for Electrical Drive Systems & Power Electronics at Technische Universität München

Contact and more information

F. Bauer, M.Sc.
(Promoter of AWE@EAL)

- phone: (+49) (0)89 289 28452
- email: {ralph.kennel, florian.bauer}@tum.de
- WWW: `http://www.eal.ei.tum.de`
- > 40 PhD students and four research foci
  - Encoderless control of electrical drives
  - Modern control strategies for electrical drives
  - “Hardware-in-the-Loop” systems
  - Renewable energy systems

Outline

RES (Teamleader: Dr.-Ing. C. Hackl)

Current research topics

- **Energy efficiency and new topologies**
  - Reza Fotouhi
  - Daniel Miller
  - Felix Rojas
  - Markus Scherbaum
- **Wind energy systems**
  - Zhenbin James Zhang (CRES/EAL; DFG project starting in July 2015)
  - Mohamed Swify Abdelrahem
  - Christian Dirscherl (CRES)
  - Korbinian Schechner (CRES)
  - Florian Bauer
  - Hisham El Deeb (CRES/EAL; starting in Sept. 2015)
- **Photovoltaic energy systems**
  - Ayman Francess
  - Alizreza Davari (proposal in preparation)

Outline

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MSE research group (since January 2014) “Control of renewable energy systems (CRES)”


H. Eldeeb, M.Sc.
(CRES/EAL)


C. Dirscherl, M.Sc.
(CRES)


C. Hackl, Dr.-Ing.
(CRES/head of RES@EAL)


K. Schechner, M.Sc.
(CRES)

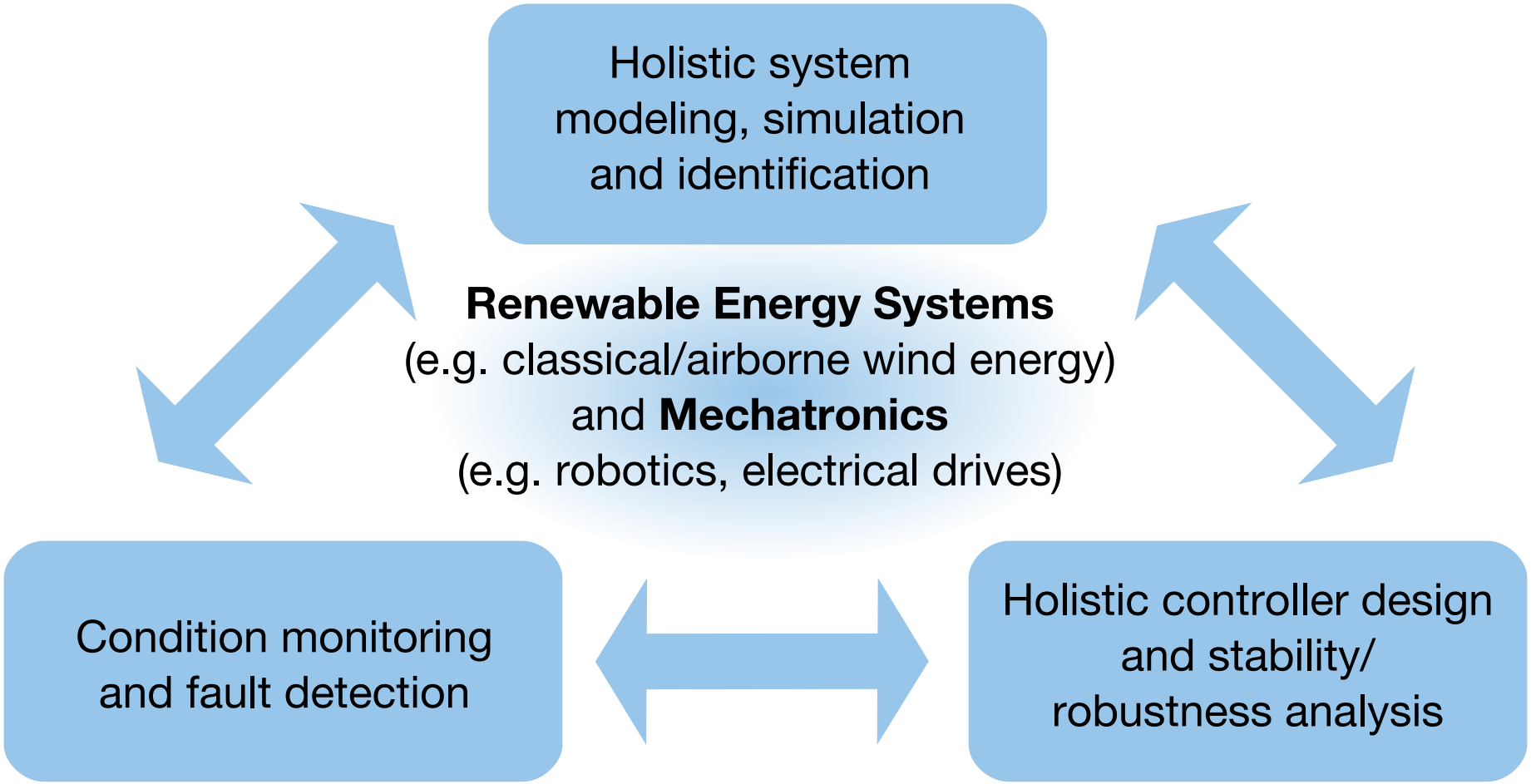

Z. Zhang, M.Sc.
(CRES/EAL)

Contact and more information

- phone: (+49) (0)89 289 16688
- email: christoph.hackl@tum.de
- WWW: `http://www.cres.mse.tum.de`
- Another CRES PhD candidate in October 2015 (geothermal energy systems)
- > 50 peer-reviewed publications and > 40 scientific talks

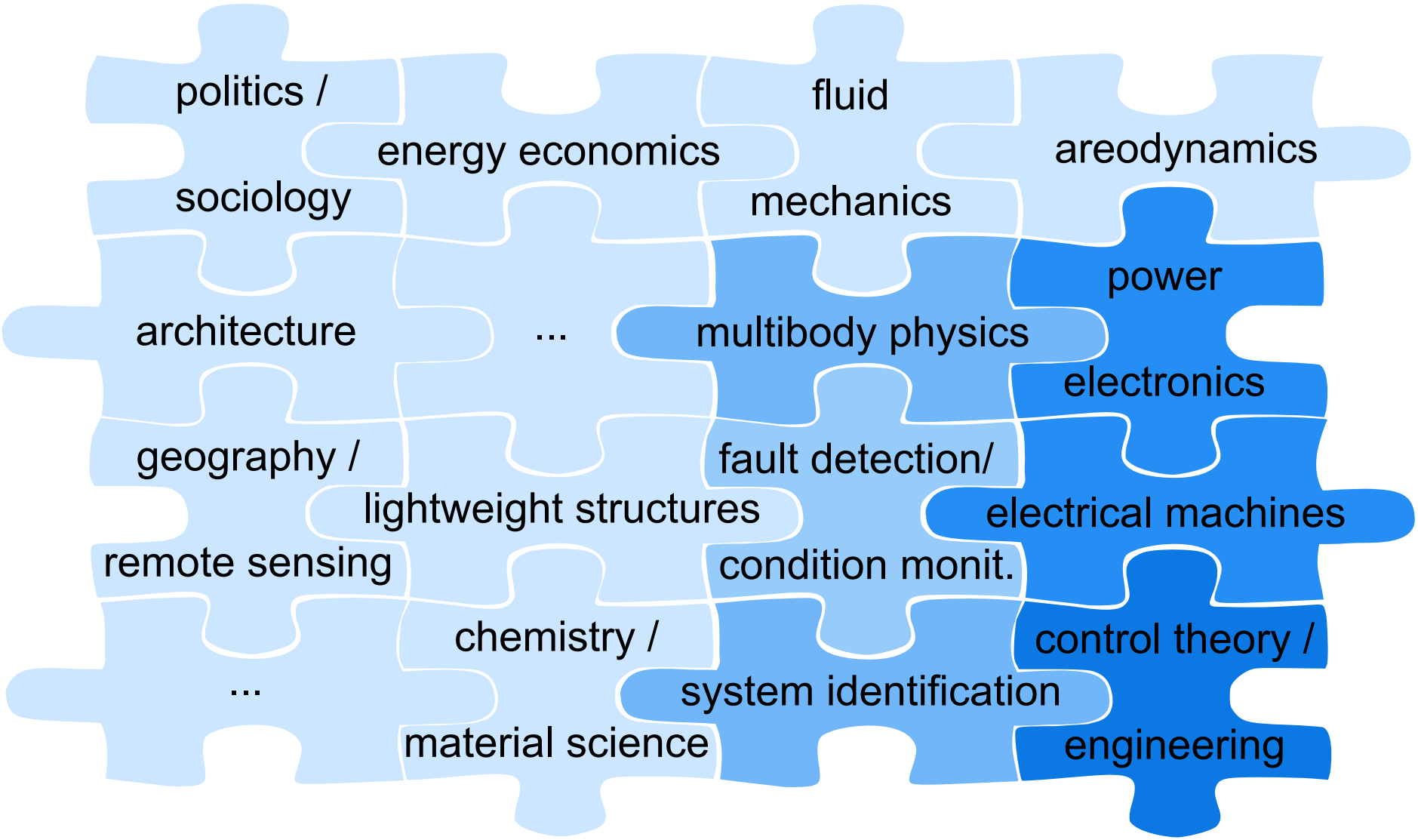
Outline

CRES research foci



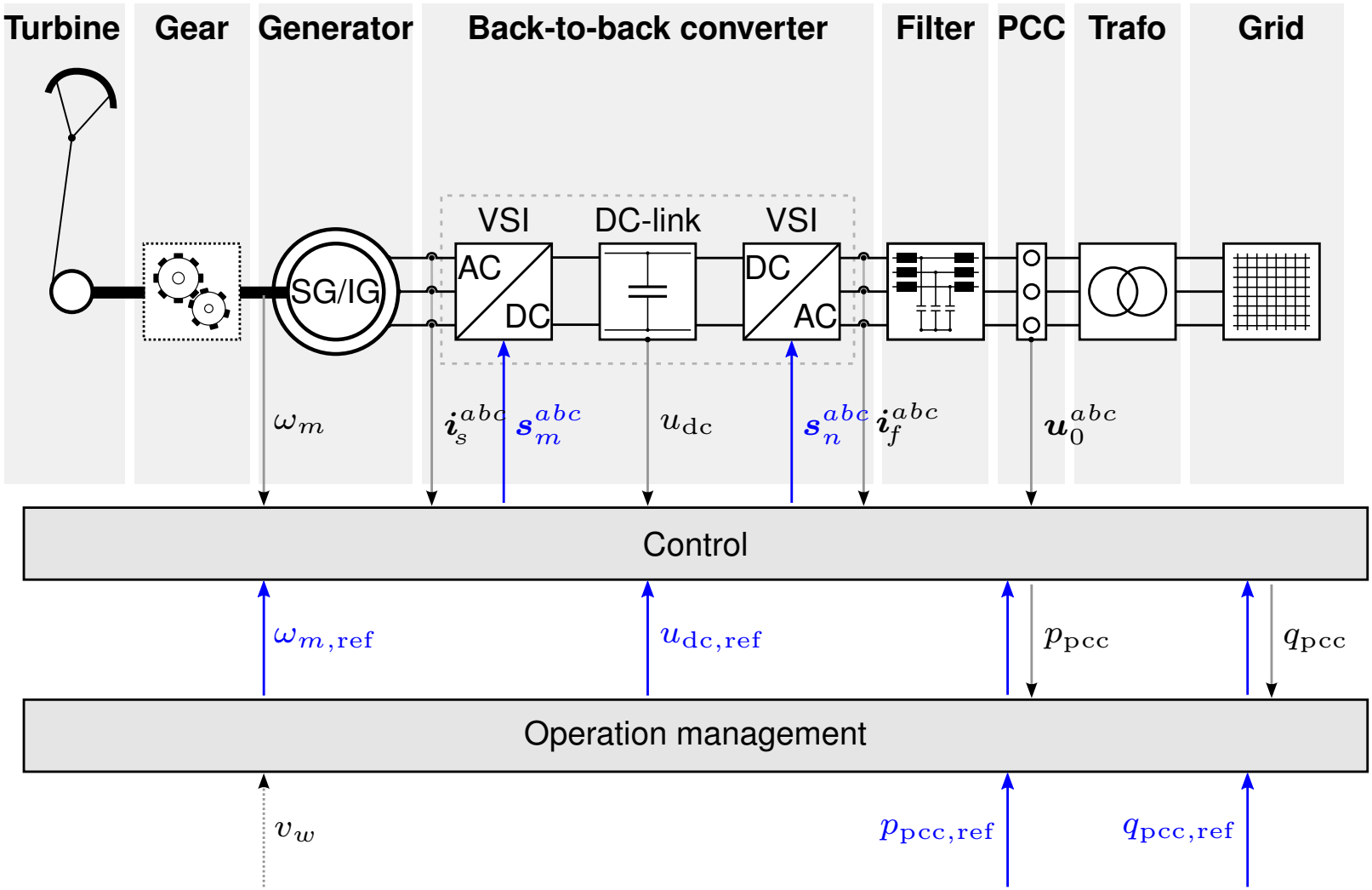
Outline

(Energy-)Research = Interdisciplinarity



Our point of view on airborne wind energy

Electrical sub-system



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CRES research contributions

Renewable energy systems:

- Chapter on “Modeling and control of modern wind turbine systems”: [1]
- Model predictive control of PMSG and grid connection: [2–5], [6][1]
- Sensorless control of PMSG and DFIG: [2, 7]
- Parameter estimation of DFIG (Extended Kalman Filter): [8]
- State-feedback control with observer for LCL filters: [9]
- Sensorless control of grid connection (Virtual Flux): [10]
- DC-link control: [4, 11], [12]
- Model-free generator speed control of wind turbine systems: rigid [13], elastic [14]
- Model-based *and* model-free current control of RSM: [15] and [16]
- Non-ideal torque control in wind turbine systems: Causes and impacts [17]
- Dynamic power flow in WTS with DFIG [18]

Mechatronics:

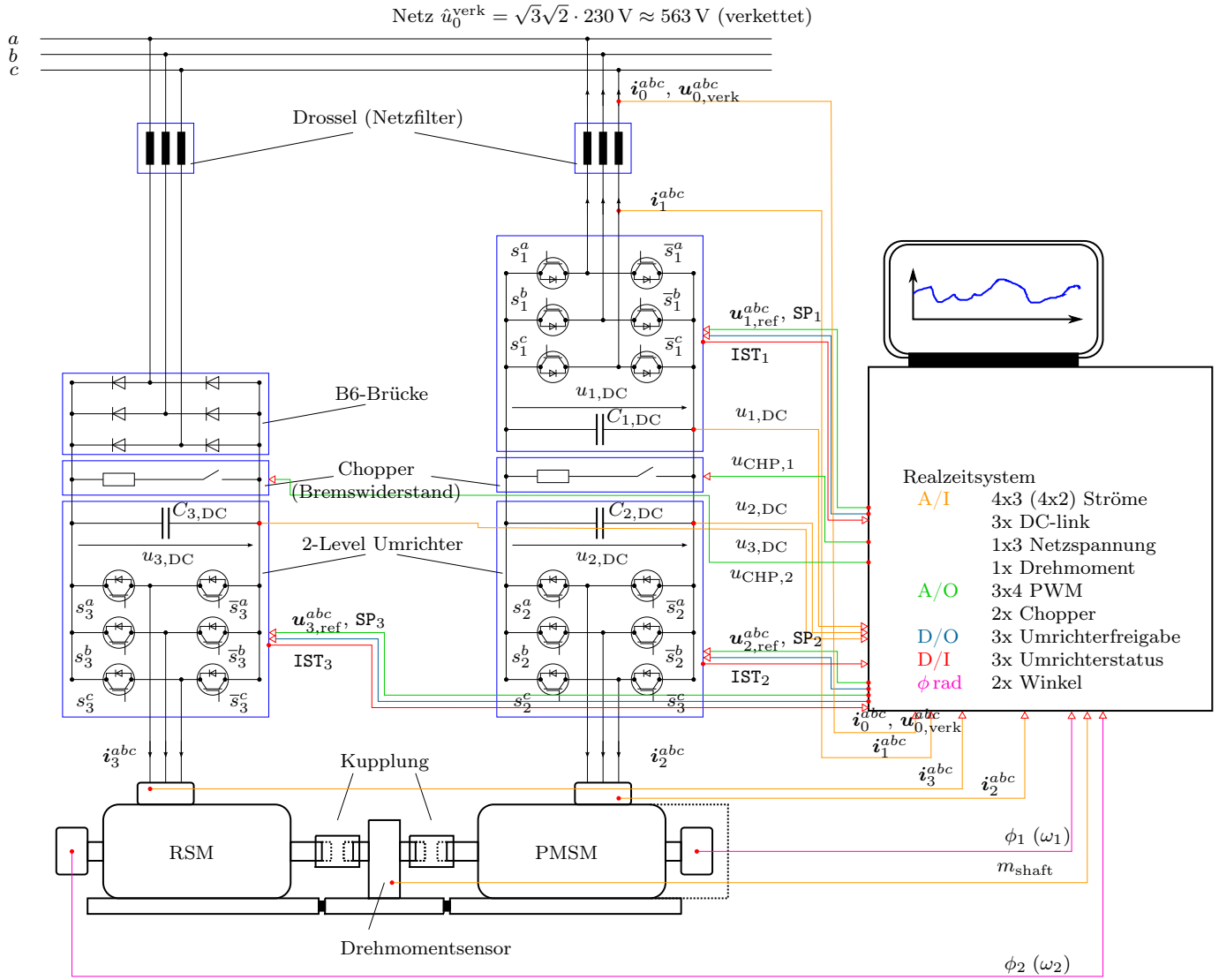
- Chapter on dynamic friction modelling: [19]
- Model-free position and speed control of electrical drives and robots: [20–27]
- Monograph on non-identifier based adaptive control in mechatronics [28]

[1] submitted/under review/in preparation

Outline

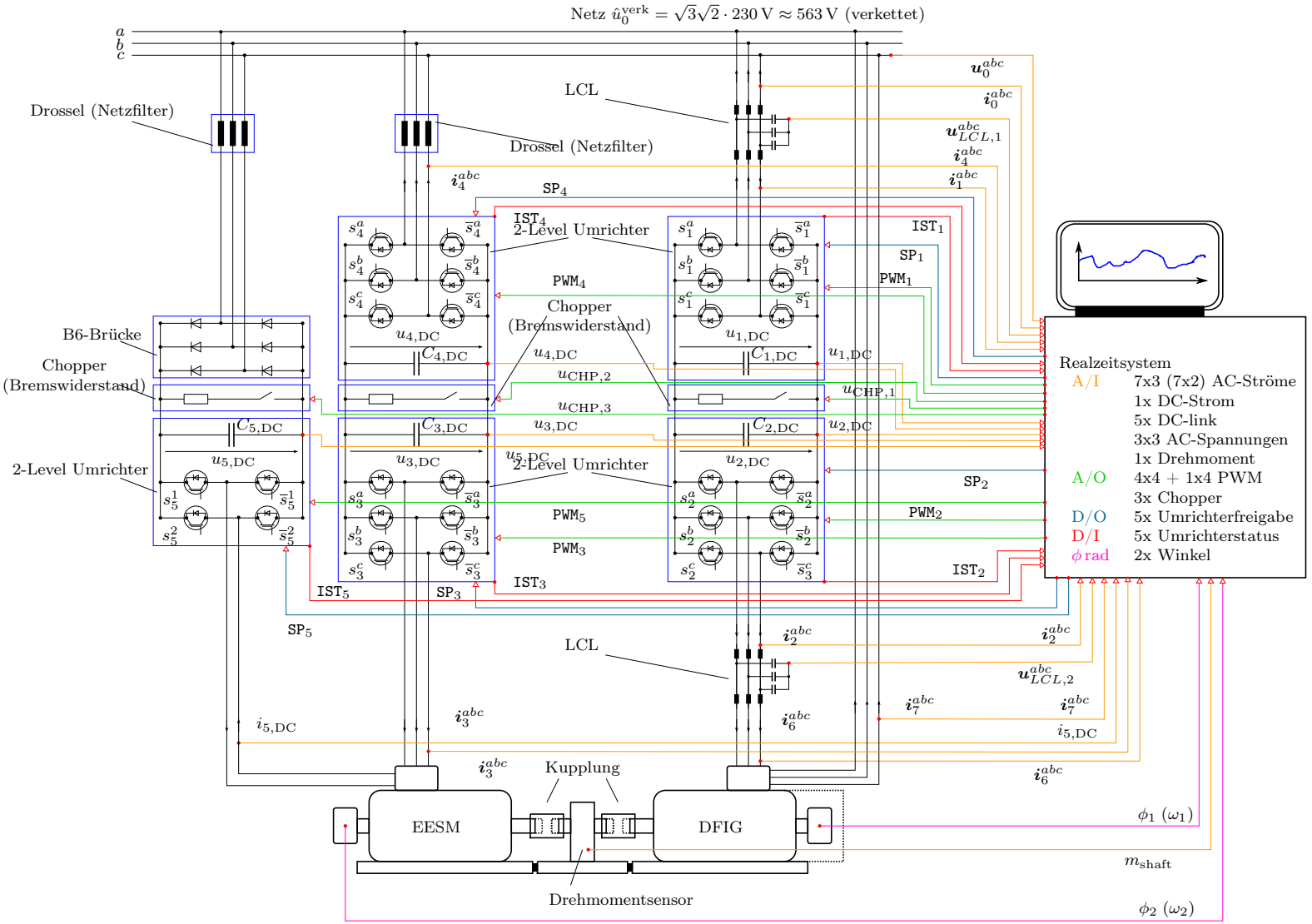
Laboratory setups

Setup 1: Reluctance synchronous machine and permanent-magnet synchronous machine



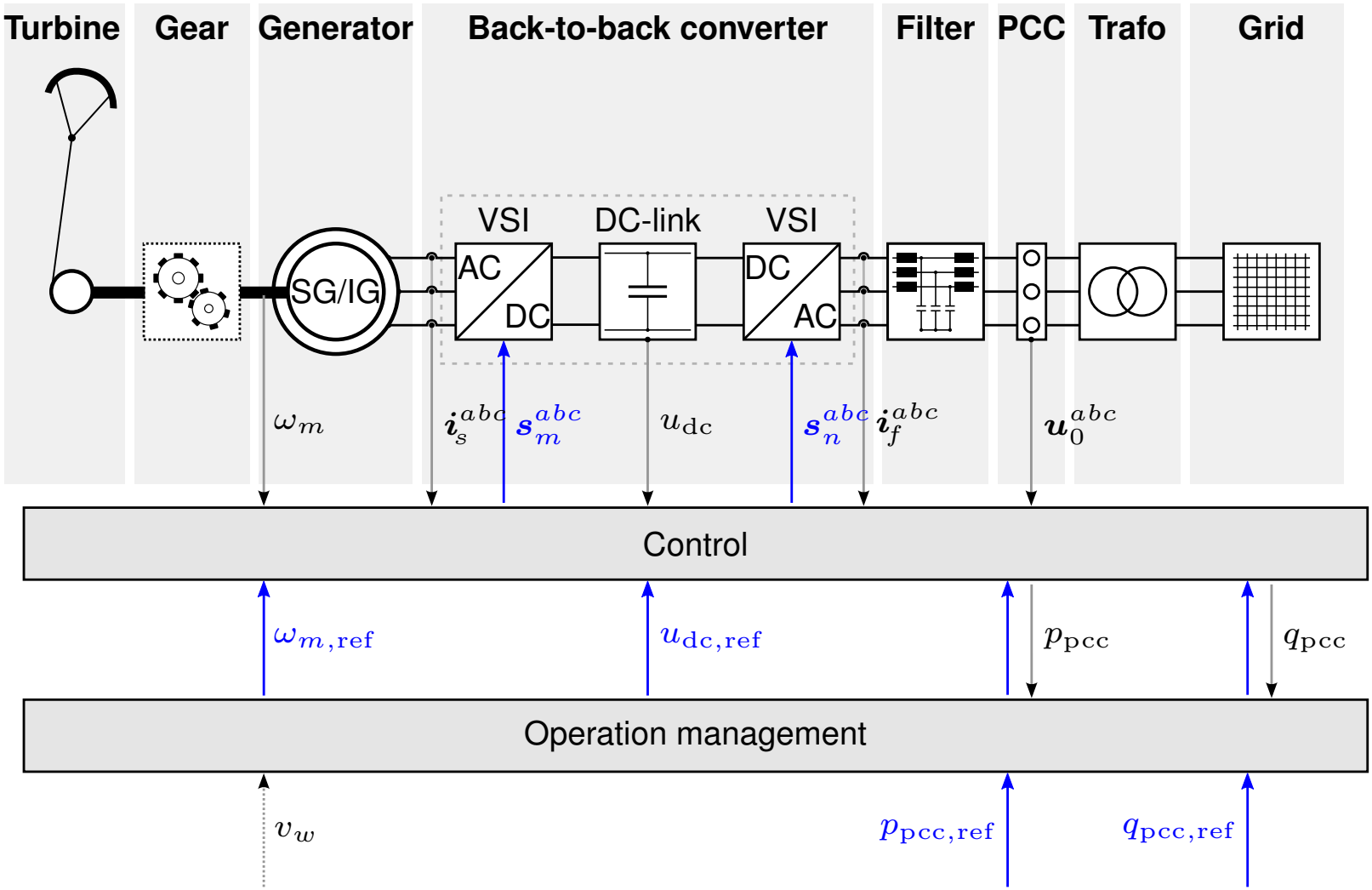
Laboratory setups

Setup 2: Electrically-excited synchronous machine and doubly-fed induction machine



Laboratory setups

Setup 3: Airborne wind energy (to be specified)



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Open questions

- real parameters ?
  - masses / inertias
  - electrical parameters (resistance, inductance, trafo, . . .)
  - filters (also between converter and generator?)
  - specifications (e.g., required dynamics, efficiency,. . .)
- real world difficulties / problems? Where could we contribute?
  - HiL system ?
  - “non-ideal” torque control (no torque sensor) = losses in energy capture
  - switching frequencies / “optimal pulse pattern”
  - new topologies / multi-level inverters
  - modeling and parameter estimation/identification
- general interests?
  - condition monitoring / fault detection (for which components)
  - reluctance synchronous machine
  - topics for secondment (brain storming)

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