

# **IPID4all Doctorate Research Exchange with Carl von Ossietzky University Oldenburg**

## **Feedback report**

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Rapid Control Prototyping for Networked Smart Grid  
Systems*

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### **Introduction**

Due to the large-scale integration of renewable energy sources (RES), problems like voltage limit violations or component overload arise in the current power distribution infrastructure. In order to counteract these effects and to be able to host a large share of RES generation units like photovoltaic and wind generation units, novel control systems need to be developed.

As the electric energy supply systems are critical infrastructure, the new control systems have to be developed, installed and operated in the field in such a way that they do not put system stability and operation at risk. Thus it is necessary to consider extensive and sophisticated evaluation measures in the development process. Besides this important evaluation requirement, the control system development process needs to provide quick turnaround and the ability to adapt to changing requirements.

### **Research Undertaken**

The previously described task of the creation of a new control system development process is an interdisciplinary task in the fields of electrical engineering, control design and computer science. Thus, the undertaken research was manifold: distribution grid simulation, coupled simulation of power and communication grids, control system engineering, and evaluation by controller-hardware-in-the-loop simulation.

An abstract and agile process for control system engineering has been derived from classical software & system design methods. The process then was applied to a concrete control system engineering task, which allowed for its evaluation. As a result control systems have been designed for three demo regions and were operated in the field for several months.

### **Personal Experience**

My personal experience according the research exchange is solely positive. Especially due to the interdisciplinary character of the problem at hand, it has been of great value for me as an electrical engineer to be part of a computer-science research team. Not only the very competent and highly motivated team around Prof. Dr. Sebastian Lehnhoff and himself, helped me to create great research work, but also the ability to work without much interruption several hundred kilometres away from home. Besides the successful finalization of my PhD thesis during the three months also a common publication has been created and a common research project tender has been submitted within the ERANet+ research programme.

### **Conclusions**

IPID4all research exchange has been of great value for me both in personal and professional manner. A strong and sustainable connection has been established between the German and Austrian research institutions OFFIS and AIT Energy. The duration of three months was a good choice as it allows getting to know the people, the country and to get work done without disrupting the

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connection to the home institute. Even though the funding through the IPID4all programme, I would not have been able to conduct the exchange without further support from my home institution AIT. I strongly recommend such research exchange activities to any researcher as it widens the horizon, helps to learn new skills, and creates an important network of researchers all around Europe and the world.

### Outlook

- PhD thesis completed: Faschang, Mario. "Rapid Control Prototyping for Networked Smart Grid Systems Based on an Agile Development Process", 2015.  
<http://www.ub.tuwien.ac.at/diss/AC12408070.pdf>  
Co-supervisor was Prof. Dr. Sebastian Lehnhoff from OFFIS Oldenburg
- Paper created and presented: "Requirements for Real-Time Hardware Integration into Cyber-Physical Energy System Simulation" <http://dx.doi.org/10.1109/MSCPES.2015.7115404>
- Further common research is planned and has been submitted together with SIEMENS Austria, KTH, Fraunhofer ISE and others as an ERANet+ proposal called "LarGo!" – Decision is pending and will be made in December 2016.
- The created PhD thesis has already been awarded three prizes  
[https://science.apa.at/rubrik/natur\\_und\\_technik/Dreifach\\_ausgezeichnete\\_Dissertation\\_am\\_AIT\\_Energy\\_Department/SCI\\_20161117\\_SCI39471352433059086](https://science.apa.at/rubrik/natur_und_technik/Dreifach_ausgezeichnete_Dissertation_am_AIT_Energy_Department/SCI_20161117_SCI39471352433059086)

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