

IPID4all Doctorate Research Exchange with Oldenburg university

Feedback report

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Voltage and frequency control of renewable energy
integrated microgrid

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Introduction

I had a great experience during my research exchange stay at the DLR Institute of Networked Energy Systems, University of Oldenburg. It was nice to share knowledge with researchers working here and get to know their interesting work.

Research Undertaken

Microgrid (MG) has been a promising approach to accommodate the distributed generators (DG) in the vicinity of the consumers, which helps to use local energy sources (i.e. solar, wind, biomass) without solely relying on fossil fuels. The basic concept of a MG is to aggregate and integrate different DGs, distributed energy storage systems (ESS), and loads that can be operated in a controlled, coordinated way either while connected to the main power grid or while islanded. Renewable energy source (RES) based generators are usually preferred to be used as DG, but it may be inevitable to also have some small-scale fossil fuel based generators.

If multiple DGs exist, they can share the total load using several techniques. Droop control is the commonly used one for this purpose and helps the DGs to share the active and reactive power of the loads without any communication technologies amongst them. This concept has been expanded to converter-based DGs (i.e., the most common form of RES-based DGs) of the MG. The appropriate sharing of active and reactive power amongst DGs is crucial for the stability of the MG by keeping voltage and frequency within prescribed range, and it can improve some crucial parameters of MG, which includes the operational cost, sustainability of operation process and supply reliability. On top of that, the integration of load and renewable energy forecasting can be helpful to handle any potential voltage and frequency issue. In cooperation with Dr Thomas Schmidt, the forecasting expert at DLR Institute of Networked Energy Systems, the opportunities and scope of using forecasting to optimize the operation of the MG was elaborately investigated. In this regards, the research undertaken were-

- Analysing the power dispatch algorithms of different DGs in an MG
- Improving the optimization process for more cost effective and sustainable MG operation.
- Investigating the effectiveness of predicting RES output and load to improve the control mechanism of frequency and voltage of MG
- Developing a prediction based control mechanism to share load between the DGs to reduce the frequency and voltage violation as well as cost effective operation of MG.

Personal Experience

Researchers around the world have the opportunity through the IPID4all doctoral research programme to explore the research excellences that Germany showcases and to work with the best research groups in German universities. Working with the researchers from the *DLR Institute of Networked Energy Systems* was a great opportunity for me. Their expertise in renewable energy research field and interest in application-oriented research provided an excellent basis for developing and expanding my proficiency that helped me to acquire more knowledge to accomplish some objectives of my doctoral research. In particular, the knowledge sharing sessions with- Babak Ravanbakh on the reactive power concept, Philipp Böttcher on open source projects, Sofia Pinheiro Melo on the primary frequency control, Dorothee Peters on simulation software were very

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interesting. I would also like to mention Dr Karsten von Maydell and Dr Wided Medjroubi for their support during my stay at DLR.

On the other hand staying in Oldenburg was also a learning experience for me where I struggled with the language for first few days and eventually learned the ways to deal with the day to day things. However, getting the chance to familiarise with German people and their native culture and tradition was a big achievement for me. This exchange programme opportunity opened the window of vast horizon to me to witness the rich European culture, history and their heritage as well. I availed the opportunity to travel to some ancient sites in Germany and surrounding countries to witness the tremendous history and evolution of human civilisation and the natural beauty of the country. Therefore, I acknowledge the support from DAAD with funds from BMBF, the University of Oldenburg and DLR Institute of Networked Energy Systems for allowing me to take part in the exchange programme.

Conclusion

This sort of research exchange programme is beneficial for both the home and host research group. It helps to exchange the research practices and enhances the knowledge base. It is also advantageous for personal development, to learn about diverse culture and people.

Outlook

- Collaborative publication is planned in reputed journal.
- Enhance collaboration between Murdoch University School of Engineering and Information Technology and DLR Institute of Networked Energy Systems.

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