IGERT Trip Report: Germany (and beyond), Summer 2014

Goals
My primary goal for this trip was to gain exposure to the research being conducted in the intersection of the “Internet of things” and energy efficiency. Broadly speaking, my academic research objective is to use data mining, computing, and the Internet of things to enable people to reduce their energy and other resource consumption. While I have a current research focus on automating residential thermostat management in order to meet a pre-determined cost budget, my advisor and I plan to expand this topic within the realm of pervasive computing for energy efficiency. Exposure to similar research being done by other academic researchers is key to determining how to expand our own research.

Another important goal for the trip was to get feedback on my thermostat management research, from other researchers working in similar and different areas. Feedback from researchers with a smart grid focus is valuable for understanding my research’s impact within the context of broader smart grid research, while feedback from researchers with a software and computer science focus is valuable for the technical aspects of my approach.

Technical Experience Overview
The first conference I attended was the Cleantech Group Europe Forum in Stockholm, Sweden. This conference was a gathering of industry leaders in smart grid and cleantech: startup CEOs, corporate executives, and venture capital investors. I participated as a volunteer, to help offset the cost of attending; volunteering provided an added benefit of spending time with and getting to know other volunteers, most of whom are also graduate students pursuing cleantech interests. The conference mainly featured sessions discussing trends, from a commercial point of view, in cleantech sectors, such as innovation in materials used for industrial processes, for-profit approaches to tackling environmental issues in developing countries, and the “digital oilfield”. These sessions, along with ones in which startups pitched their companies to investors, proved to be helpful in increasing my understanding of commercial opportunities and needs in cleantech, so that my academic research remains relevant in terms of its motivations and goals. I also was able to informally discuss my own research during networking breaks with various attendees and received encouragement that my topic and approach are both relevant and innovative. A personal bonus to this trip was an evening reception at Stockholm’s City Hall, where the Nobel Prize banquet is held each year. It was very inspiring to spend time in a place that has welcomed such accomplished people for over a hundred years!
View of City Hall
The second conference I attended was the International Conference on Future Energy Systems, also known as e-Energy, in Cambridge, United Kingdom. With its very specific focus on computing and communication for smart energy systems, this conference was the most beneficial part of my trip. I participated as an attendee and learned about many different research approaches to energy systems that other software engineers and computer scientists are taking: enabling temperature “zoning” within houses, forecasting residential electricity demand, automating appliance usage during brownouts in developing countries, and detecting behaviors based on smart meters and smart phones. While these research topics are different from mine, they are in a similar vein and provide me with context, inspiration, and possibly collaboration opportunities. I made contacts with other students whose research very closely aligns with mine, which is something I had not found before this trip. In the months since the conference, I have been in touch with them, sharing research articles and having discussions on our research.

The third conference I attended was TUM’s International Graduate School of Science and Engineering (IGSSE) Forum, along with the other IGERT students in Germany. While this Forum wasn’t focused specifically on smart grid, many of the TUM students who participated are focused on energy systems. We spent a good amount of time with these students, discussing the differences in buildings and their energy use in the United States and Germany – specifically, Austin and Munich. It was interesting and valuable to hear about the differences and similarities in the buildings themselves, as well as how people interact with them.
One main difference is heating and cooling: in Munich residential buildings, heated floors are common while central heating/cooling systems are not. At this conference, we also learned of the joint TUM-UT solar decathlon team and the work that the TUM side of the team is doing toward the project. I was not previously aware of this partnership or the team, and I loved hearing about it. Since returning from Munich, I have joined the solar decathlon group and hope to contribute to any software that is needed.

The IGERT students at the IGSSE reception, held at the Raitenhaslach Monastery
All of the IGSSE participants, outside the Forum venue in Burghausen

The final conference I attended was the European Control Conference, in Strasbourg, France. I participated as an attendee at this conference. Unfortunately, this conference turned out to be very focused on theory and minimal attention was given to application, and as such, the conference was less beneficial to me than the others. I had hoped to learn more about control, especially as it pertains to smart grid, but the majority of the conference was too theoretically advanced for me to gain a good understanding.

Overall, the conferences I attended served to help me get a better understanding of the broader contexts for my research – both with their application in the “real world” and with other research in software engineering as applied to energy systems. While it’s possible to seek out this context through literature reviews, it’s immensely more helpful to get it through hearing presentations, seeing live demos, and talking with the researchers themselves.

Interactions with TUM
I had two main ways of interacting with TUM. One was the IGSSE Forum, as discussed above. The other was a meeting with the Energy Informatics group, which focuses on using models and analytics to solve energy-related problems. At this meeting, I presented my research and got very valuable, technical, specific feedback on ways to improve it. In addition to specific recommendations for machine learning approaches to try and ways to adjust my existing approach, I also learned of significant differences between residential heating and cooling systems in the US and in Germany; notably, the lack of central heating and cooling systems in homes in Germany. Such systems are central to my research, and so recognizing where it is and is not applicable is important. One of the students in this research group also presented at the e-Energy conference in
Cambridge, so I got to learn more about his research on forecasting residential electricity demand there.

**Sightseeing Highlights**
By far the best personal aspect of this trip was the opportunity to explore the nearby Alps. I took every chance I could to hike around the region, and at the same time I developed my friendships with the other IGERT students and some TUM students I had met at the IGSSE Forum. Spending time in the outdoors is very important to my personal mental well-being, and I couldn’t ask for a better setting than the Alps.

Erin Keys and I started off our sightseeing with a trip to Salzburg, Austria, where we attempted to hike to the top of the Untersberg Mountain. Unfortunately we got a bit lost on the way and had to return to the base of the mountain before reaching its peak, but we took a cable car up a different part of the mountain and got wonderful views anyway:

On our train ride to Salzburg, we made a brief stop in a lake town, where we noticed that Aldi, a popular grocery chain, has covered many of its stores with solar panels:
After Salzburg, Erin and I headed to the beautiful Berchtesgaden National Park: