

# Report on 2015 International Electric Machines and Drives Conference (IEMDC-2015)

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**Figure 1. A view of Coeur d'Alène, Idaho, U.S.A**

This report gives an account of my experiences during the International Electric Machines and Drives Conference (IEMDC), 2015. I was supported by a UK-Magnetic Society student conference bursary, which helped to cover some of my travel costs to the conference.

The IEMDC conference has been held every two years since 1997, in order to establish one of the major events in the field of electric machines and drives. IEMDC-2015 was held in the beautiful setting of Coeur d'Alène, Idaho, U.S.A, between the 10<sup>th</sup> and 13<sup>th</sup> of May. The conference was attended by almost 350 delegates from all around the world. The main topics that were discussed during the poster and oral presentations, and the tutorials during the conference were:

1. Rotating electrical machines,
2. Special machines, sensors and actuators,
3. Electrical drives,
4. Machine design and related problems,
5. Condition monitoring, fault detection, noise and vibration,
6. Embedded applications and “smart” solutions, and
7. Grid connected or emergency applications.

## **10<sup>th</sup> May, 2015 - Day One of the Conference**

On the first day of the conference the IEMDC committee organised three specialist tutorial sessions on popular topics from the research fields of electric machines and drives. The three tutorial sessions were:

1. *Design and Analysis of Permanent Magnet Machines Including High-Speed Operation*, which was presented by Bulent Sarlioglu from the University of Wisconsin and Thomas Wu from the University of Central Florida.
2. *Design and Development of Low Speed 10 MW+ Superconducting Wind Turbine Generators*, which was presented by Nenad Mijatovic from the Technical University of Denmark and Bogi Bech Jensen from the University of the Faroe Islands, and
3. *Thermal Analysis of Electric Motors with Complex Duty Cycles* by Dave Staton from Motor Design Ltd.

The tutorials lasted for approximately four hours and aimed at providing a comprehensive high-level introduction into these topics. I personally attended the second tutorial session, since my PhD research topic is associated with wind turbine technologies. The tutorial started with a comparison of existing wind turbine technologies and was followed with an explanation of their suitability for large size turbine structures. The sessions finished with a discussion of superconducting topologies for building a more efficient wind turbine electric generator. It was interesting to learn where the technology is projected to go and the present limitations.

### **11<sup>th</sup> May, 2015 - Day Two of the Conference**

On the second day of the conference, the “Author’s Breakfast” welcomed all the authors who were going to give presentations that day. This was the day of my oral presentation so I attended the author’s breakfast. The author’s breakfast provided an opportunity to meet with the session chairman and other presenters who were giving presentation in the same session. It was the first time that many people experienced this type of socialising event at a conference and the general impression about this experience was a positive one.

Two plenary sessions took place during the conference. The first plenary session was titled *Growing Role of Electrical Machines and Drives* and was presented by Ayman M. El-Refaie who is one of the principle engineers from General Electric’s (GE) Global Research Centre. He talked about the importance of magnet and lamination materials in machine design in order to provide high strength, low core losses and better efficiency. He also discussed their research object, which is to develop new materials to obtain higher performance characteristics from specially designed machines for high-speed and high-temperature operation. The latest technological development in drive technologies and the reasons why silicon carbide (SiC) switches are presently of research interest, as well as having important roles in future converter design were also presented. Lastly multiphase drives and their usage were also mentioned.

This was the second conference I attended but the first time I had the opportunity to present my own research to people who are experts in their fields. The aim of my PhD research project is to investigate the development of novel controller loop embedded condition monitoring techniques for wind turbine drives. This involves the development of novel harmonic drive model as well as design and build a 30 kW variable speed laboratory test-rig.

I presented my research work in the afternoon in the *Design and Related Problems* technical session. The title of my presentation was: *Modelling of Induction Machine Time and Space Harmonic Effects in the SIMULINK Environment*.

**Figure 2. The first page of my presentation**

My presentation discussed the implementation procedure of a high fidelity induction machine dynamic model, which was developed to enable the analysis of time and space harmonic effects for machine operation with or without electrical asymmetry in the SIMULINK environment. The model architecture was presented, which utilised the coupling impedance approach. The performance of the model in frequency domain analysis of harmonic effects from the machine signals was validated with experiments conducted on two industrial Wound rotor induction motor (WRIM) laboratory test rigs at The University of Manchester and presented results showed good agreement. Lastly, the ability of the model to represent additional time and space harmonic effects based on supply unbalance, rotor electrical asymmetry, etc., which were validated in the laboratory, were also presented.

My presentation lasted fifteen minutes and there was five minutes for questions at the end. There were almost 80 delegates in the audience. It was so special for me because it was the first time I have published a paper and presented my work in front of a significant amount of people. After the session presentations, had finished I met with several people who are working on similar topics. They were interested in what I was researching and wanted to keep in touch and consequently, we exchanged contact details. This was therefore a great opportunity to network. I met with a manager from Bosch, which is the one of the big German companies working on machines and drives design and manufacture, and I learnt that they are also using very similar techniques to model machines as me. It was important for me to discuss the advantages and disadvantages of these very similar modelling techniques and I found this informative and helpful for my future research work plan.

I also met with several Turkish professors after my presentation, who are working at different universities around the world. They told me how they were impressed with my English and also presentation, which helped my self-confidence. They also gave me lots of career advice, as they had started their career path in a similar way to me. My PhD is sponsored by the Turkish Ministry of Education, and I am required to be an academic in Turkey after finishing my PhD. Therefore, it was very useful and beneficial for me to meet with Turkish professors and establish several contacts before I return to Turkey.

## 12<sup>th</sup> May, 2015 - Day Three of the Conference

The second plenary session was presented by Normann Fisher from Schweitzer Engineering Laboratories. He talked about condition monitoring and fault detection of rotating electric machines and drives used in different environments. This session was related to my PhD research topic, since I am working on wind turbine fault analysis. Therefore, I had a chance to see how important it is to detect failures in machines and drive systems, and also the real implementation of fault diagnosis techniques. The plenary sessions were useful in helping to understand the role of industrial companies in the development of existing practices through various research projects and applications, as well as the collaboration of manufacturing companies and universities to bring ideas to life, and to produce novel implementations and commercial products.

I attended a number of technical sessions including *Condition Monitoring, Fault Detection, Noise and Vibration, Rotating Electrical Machines* and *Electrical Drives*. These sessions were all related to my PhD topic and therefore, of particular interest to me. The condition monitoring and fault diagnosis sessions took my highest interest, as it was useful for me to understand other condition monitoring techniques not only for wind turbine applications but also for other machine applications used to detect various machine failures. One particular presentation titled: *Diagnosis of Stator Short-Circuit Faults in Series and Parallel Winding Connections of Closed-Loop Controlled PMSMs* from Marquette University was presented by Jiangbiao He. In the presentation the effectiveness of diagnosing stator winding short-circuits faults in series and parallel winding connections of PMSMs were compared with a permanent magnet synchronous machine (PMSM), which showed a lot of similarities.

Poster presentations were also held on the third and fourth days of the conference after the lunch breaks. My colleague Kavul Tshiloz also from The University of Manchester was presenting his poster titled *Real-Time Sensorless Speed Estimation in Wound Rotor Induction Machines using a Dichotomous Search Algorithm* on the third day. I generally found the poster session beneficial, even sometimes more than some technical sessions, since it was easier to pick up relevant topics to my area and go and talk to people about their work. I also believe that because the poster presentations were held in a more informal environment, it was easier for people to ask questions and discuss topics into greater depth and therefore, gain a greater understanding or appreciation for the research and its findings.

## **13<sup>th</sup> May, 2015 - Day Four of the Conference**

I attended an oral session related to rotating electrical machines. The first presentation of the session was given by Hamid Toliyat, who is one of the well-known professors in machine design and its applications. He compared permanent-magnet (PM) and magnet-less generators for direct-drive wind turbine applications. This was an interesting presentation, since the presenter discussed the economic aspect of PM material on the wind turbine final cost and also the performance, weight and cost comparison of a 3 MW direct-drive switched reluctance generator with a 3 MW direct-drive permanent-magnet generator for wind turbine applications was proposed. Another presentation presented by Cornelia Stuebig, was about electromagnetic design of a lightweight 10 MW permanent-magnet synchronous generator for wind turbine applications. The presenter stated that a completely new structural design was implemented to reduce the weight of the machine, in order for a higher power output. The generator length was held less than 1/30 of the diameter and tooth-wound coil windings were used to further reduce the weight.

The conference also provided me with the opportunity to interact with exhibitors between sessions from various sectors of the industry. They introduced their company's products, services, and solutions to attendees. I was personally interested in a company called LeCroy, since I have been using their scopes and current and voltage probes during my experiments in the laboratory. The company representative demonstrated the latest model of their scopes; however, I had the chance to discuss how to improve the functionality of the scope which I am presently using in my test-rig in the laboratory at The University of Manchester.

## **Conclusions**

An aspect of why these international conferences are held around the world is to build a network among colleagues, academics, and companies' representatives. I met with many students and engineers from around the world, established good friendships and also exchanged ideas. Therefore, the conference not only helped to improve my research work but also to gain opportunities for working in various areas in different countries. I also met with one of the most famous professor in the field of condition monitoring and fault detection, which is closely aligned with my PhD research topic. This was Professor Gerard-Andre Capolino from The University of Picardie who was one of the general co-chairs of the conference. It was an extraordinary experience for me to meet with a person whose papers I

have been reading during my PhD. He offered me several good recommendations and also invited me to his laboratory in France, which I hope to accept and visit before the end of my PhD.

To conclude, the conference was very beneficial for me. I learn about the latest developments in the fields of machines and drives, and more specifically condition monitoring. This furthered my knowledge of the existing literature and I also learnt how researchers are using different techniques to solve the same issues as I am presently researching. I also gained lots of interesting ideas to improve my research work further. I feel that I am a more informed PhD research student after attending this conference and I would therefore like to thank the UK-Magnetics Society for giving me such a great opportunity to participate in IEMDC-2015. I would also like to thank the Turkish Government, who has sponsored my PhD and Dr Sinisa Durovic for guiding my research at The University of Manchester.