Ozan Keysan

Curriculum Vitae

May 2014

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Degrees Awarded

2013	PhD	Electrical Engineering, University of Edinburgh, UK Dissertation Title: *Superconducting Generators for Large Offshore Wind Turbines*
2008	MSc	Electrical-Electronics Engineering, Middle East Technical University, Turkey Thesis Title: *A Non-Invasive Speed and Position Sensor for Induction Machines Using External Search Coils*
2005	BSc	Electrical-Electronics Engineering, Middle East Technical University (METU), Turkey

Career Since Graduation

2011–Present	Research Associate	Institute for Energy Systems, University of Edinburgh
2010–2012	Design Consultant	NGenTec, Edinburgh
2009–2010	Research Associate	Institute for Energy Systems, University of Edinburgh
2005-2009	Research Assistant	Middle East Technical University, Turkey

Major Research Interests

Research Impact & Achievements

My research output has resulted in high research impact in terms of consultancies and knowledge exchange activities. Within last five years, I published six journal papers (one included in RAE), two invited book contributions, 15 refereed conference papers (two won the best paper/poster award) and filed one patent.

The superconducting machine design I developed in my PhD project got very positive feedbacks and resulted in three invited talks from Institute of Physics, UK Magnetics Society and Superconducting for Energy. Also I got the Young Researcher Award for my work in EUCAS and ICSM conferences. Furthermore, the prototype I developed improved the links between UoE and General Electric Energy and Power Conversion and led to transfer of an extensive superconducting lab to UoE. The lab is expected to be used by other institutes as well, and has the potential to become the base for many research grant applications.

I worked with different renewable companies across UK, which helped to develop network between industry and university. I am currently working as the main researcher in an EU FP7 project work package, which brought £320k to UoE. I represented UoE in general project assemblies and work package meetings.

I designed several machines and power take-off systems varying from 5 kW to 5 MW, all in forms of consultancies and research partnerships, bringing research grants to IES. The details of these works are provided in the next section.

Research Interests

My main area of interest is in the design and development of electrical machines. In particular, I am working on novel machine topologies such as superconducting machines and direct-drive permanent-magnet machines, including linear generators. I also worked in reliability assessment and control systems of renewable energy devices.

- **Superconducting Machines**: I designed a novel generator topology that surpasses all the existing superconducting machine designs in terms of modularity, reliability and significant cost benefits by utilising only 10% of the SC tape compared to other designs. The topology has chance to be implemented as the world's first superconducting wind turbine. There are many research opportunities in this area that I can contribute with my research experience. SC transmission lines and fault current limiters can be excellent applications for future HVDC systems, which is one of the IES' strategic research areas. I am also planning to work on SC magnetic gearboxes, which will be the world's first with unmatched torque density capabilities.
- **Direct-Drive Permanent Magnet Generators**: I have been working in this area since 2009. I developed design and optimization tools for C-Gen generator, which was the main idea behind NGenTec (a spin-out company from IES). UoE has licensed my design tools to NGenTec, and they have been used in other consultancy projects. I designed 25 kW and 1 MW generators, both of them are manufactured and tested successfully. I designed a 50 kW linear generator for the Carbon Trust Project, which led to best paper award in ICEM-2010 and 20 citations.
- **Power Electronics and Electric Machine Drives**: I completed my Masters on control of AC motors. I developed a novel method that led to an international patent, two journal papers and many conference papers. I have designed a motor drive controller board, which is still being used in METU. I am currently involved in a project on HVDC subsea transmission system with NAREC. The concept reduces the number of power electronic components,and hence the overall cost. I am also involved in control of electric machines in the MARINA project, in which I compared different power aggregation techniques for combined wind and wave energy systems.
- **Reliability and Condition Monitoring**: The reliability for renewable energy systems are critical, hence almost all the projects I have involved has reliability as the main concept. I believe there is much work to do to cope with harsh operating conditions of renewable energy devices. My PhD topic introduced a fault-tolerant, modular generator topology, which can minimise down-times in a wind turbine. I have also analysed the failure modes of combined wind and wave energy plaftorms for the MARINA Project. One of my MSc students developed an electric machine fault-detection app for smart phones, which has been downloaded 500 times less than in six months.

Research Experience & Projects

2014	NAREC	(WP Budget:£30k). Design of next generation HVDC network for the offshore renewable energy industry. I am desigining a high-frequency high-power transformer that can be coupled to the HVDC transmission line. The proposed system has fewer power electronics and cost advantages over existing AC and DC systems. (WP Budget:£30k)
2011–2014	EU FP7 Project	(WP Budget:£320k). MARINA Platform Project is a 3 year EU FP7 project with 17 industrial and academic partners, which aims to design combined wave and wind energy platforms. I am the main researcher in WP7, and I have led and presented UoE in work package meetings and general assemblies, which helped me to have contacts across Europe and build my presentation skills. I developed a design tool for sizing and efficiency calculation for wind and wave power take-off systems and the tools was shared with the research community as an open source tool. (WP Budget:£300k)
2013	United Arab Emirates Uni.	Design of a 5 kW permanent-magnet linear generator test rig.
2013	General Electric	A project to validate the superconducting generator topology that I developed during my PhD. General Electric agreed to loan the superconducting coil, vacuum chamber and other test equipments to UoE for the cryogenic experiments.
2011	NGenTec	Consultany for a medium-speed generator design. Electromagnetic optimization a 5 MW, 300 rpm permanent-magnet generator has been completed.
2010	NGenTec	(Company funded £2M). Design and optimization of a 1 MW, 12 rpm direct-drive generator for a wind turbine. The machine has been manufactured and successfully tested.
2010	SMART R&D Grant	(Budget:£93k). Design and testing of a 25 kW axial flux permanent-magnet generator. The experimental results have been used to evaluate the thermal performance of the generator and the cooling system.
2010	Hayward Tyler	RenewNet project. Feasibility analysis of a submerged and flooded permanent-magnet generator. Thermal performance of the flooded generator was investigated as well as the corrosion mechanisms and fluid drag losses.
2009–2010	NPower Project	(Budget:£78k). The feasibility analysis of direct-drive PM generators for two wave energy converters (Aquamarine,AWS Ocean Power) and two tidal energy converters (Marine Current Turbines, Scotrenewables) were investigated. An analytical and optimization tool was developed, and licensed by University of Edinburgh for further use.
2005–2008	METU	A novel method to estimate the rotor speed and position of an induction motor using the fringing flux out of the rotor cage was developed. An international patent was awarded to this work.

Teaching Experience

Since I got BSc degree in 2005, I have taught in different courses. I was a research and teaching assistant in METU, which is the highest-ranked university in Turkey, for four years. I tutored in 3rd year and 4th year undergraduate machines and power electronics courses. I was the laboratory coordinator and main point of contact for over 200 students. My personal teaching performance evaluations within the department were consistently in the top five.
In UoE, I supervised 2nd year Power Engineering and 3rd year Power Generation Labs and gave lectures on IDCORE programme in the last two years. I am confident and passionate on teaching and e-learning and I can take responsibility on power electronics, power systems and machines courses as supervising. I supervised two MSc and two MEng students so far, and assisting in a few PhD projects within the group.

School of Engineering, University of Edinburgh

Laboratory Supervision:

- Power Engineering Lab (2nd year): This course introduces students to the techniques and equipment used in the generation, transmission, distribution and utilisation of electrical power. I have supervised in this lab since 2012.
- Power Generation Lab (3rd year): The lab aims to give the students experience in working with rotating machines and power electronic equipment and synchronization to the grid. I have supervised in this lab since 2012.

Lectures:

- The Industrial Doctoral Centre for Offshore Renewable Energy (four-year EngD programme), "Introduction to Superconductivity and Superconducting Generators".

Supervision:

- Dauriuz Olczak, “Structural Design of a High Temperature Superconducting Generator ”, MEng Thesis, 2012.
- Patryk Radyjowski, “Designing a Cooling System for a Superconductive Coil”, MEng Thesis, 2013.
- Mario Recio Lara, “Development of a mobile phone application to detect speed and faults of electrical machines”, MSc Thesis, 2013.
- Marzia Akbari, “Comparison and control of power take-off systems for combined wind/wave energy platforms”, MSc Thesis, 2013.

Middle East Technical University

Laboratory Supervision:

- 3rd year Electromechanical Energy Conversion I-II (EE361, EE362).
- 4th year Static Power Conversion (EE463).
- Laboratory coordinator (4 semesters).

Honours & Awards

2013	Staff Scholarship, University of Edinburgh.
2012	Young Researcher Support, International Conference on Superconductivity and Magnetism, ICSM.
2012-2013	PhD Overseas Fee Waiver and Stipend, University of Edinburgh.
2011	Young Researcher Award and Travel Grant, European Conference on Applied Superconductivity, EUCAS.
2011	IEEE Membership and Travel Grant, IEEE Power Electronics Society.
2011	Best Poster Award, IEEE International Electric Machines and Drives Conference, IEMDC.
2010	Best Paper Award, IEEE International Conference on Electrical Machines, ICEM.
2010-2012	PhD Scholarship on Renewable Energy, Hopewell Holdings, Hong Kong.
2005–2007	TUBITAK Graduate Fellowship.
2005	Ranked 2nd in the Academic Personnel and Graduate Education Exam (ALES).
2005	Finalist in the METU Entrepreneurship Competition (Yeni İşler Yeni Fikirler).
2001–2005	Dean's high honour list (3 times), Dean's honour list (3 times).

Invited Presentations & Lectures

- Superconducting for Energy Conference, Pasteum, Italy, 2014.
- Current Research in Large-Scale Applications of Superconductivity, Institute of Physics, London, 2013.
- Superconducting Machines, UK Magnetics Society, University of Oxford, 2012.
- Future Reliable Renewable Energy Conversion Systems, 4th Flagship Seminar, Chongqing, China, 2012.
- Thermal and Mechanical Aspects of High Performance Electrical Machines, UK Magnetics Society, 2011.
- Marine and Tidal Energy Workshop, Industrial Problems in Marine Energy Workshop, 2009.

Seminars

- Supervising Postgraduate Research Seminar, Iain Davidson, 2013.
- Large-Scale Parallel Computing, University of Edinburgh, 2013.
- LaTeX for scientific publications, Skills Development Edinburgh, 2010.
- Opera 2D/3D FEA Analysis of Electrical Machines, Cobham Ltd. Vector Fields, 2009.
- Project Management for Researchers, Fistral Training & Consultancy Ltd., 2009.
- Project Presentation on International Venture Capital Forum, Athens, 2006.
- Project Management and Entrepreneurship Course, 30 days, METU Technopolis, 2005.

Memberships

2011–Present	IEEE Member
2011–Present	IEEE Power and Energy Society Member
2010–Present	UK Magnetics Society Member
2005–Present	TMMOB Electrical Engineers Society Member

Academic Work

Reviews for	IEEE Transactions of Industrial Electronics
	IEEE Transactions of Industrial Informatics
	IET Renewable Power Generation Journal
	IEEE International Conference on Electrical Machines and Drives
	IET Power Electronics, Machines and Drives Conference
	IEEE International Conference on Electrical Machines

Software

- Programming: Python, R, Matlab, C++.
- Finite Element Analysis: Opera, FEMM, ANSYS, Gmsh, GetDP.
- Computer Aided Design: SolidWorks, AutoCad.
- Computational Fluid Dynamics: OpenFOAM.

Activities & Hobbies

Mountaineering	Active Member of METU Mountaineering Club
Sailing	Dinghy and Yacht Sailing, Certificate of Competence For Operators of Pleasure Craft.
Blogging	asuyatuyolar.org

Languages

English (Fluent), Spanish (Intermediate), Chinese (Beginner)

Publications

I have published 6 journal papers, 15 referred conference papers (2 of which won best paper/poster award), have filed one patent and contributed to two books published by Woodhead Pub. and the IET. My papers have been cited 63 times so far, one paper, which has been included in RAE for UoE, has been cited 20 times.
Link: http://ozan.keysan.me/papers

Refereed Journal Papers

1. **Keysan, O.** and B. Ertan (2012). Real Time Speed & Position Estimation Using Rotor Slot Harmonics. *IEEE Transactions on Industrial Informatics* (c), 1–1.
2. **Keysan, O.**, M. Mueller, A. McDonald, N. Hodgins, and J. Shek (2012). Designing the C-GEN lightweight direct drive generator for wave and tidal energy. *IET Renewable Power Generation* **6**(3), 161.
3. **Keysan, O.**, D. Olczak, and M. A. Mueller (Dec. 2012). A Modular Superconducting Generator for Offshore Wind Turbines. *Journal of Superconductivity and Novel Magnetism*, 1–5.
4. Hodgins, N., **Keysan, O.**, A. McDonald, and M. Mueller (2011). Design and Testing of a Linear Generator for Wave Energy Applications. *IEEE Transactions on Industrial Electronics* (c), 1–10.
5. **Keysan, O.** and M. A. Mueller (Oct. 2011). A Homopolar HTSG Topology for Large Direct-Drive Wind Turbines. *IEEE Transactions on Applied Superconductivity* **21**(5), 3523–3531.
6. **Keysan, O.** and H. B. Ertan (2009). Determination of rotor slot number of an induction motor using an external search coil. *Facta universitatis-series: Electronics and Energetics* **22**(2), 227–234.

Book Chapters

1. **Keysan, O.** (2014). "Electrical Generator Technologies for Offshore Wind Turbines". In: *IET offshore wind farm online reference*, pp.1–20.
2. **Keysan, O.** (2013). "Application of high temperature superconducting machines to direct drive renewable energy systems". In: *Electrical Drives for Direct Drive Renewable Energy Systems*. Ed. by M. Mueller and H. Polinder. Woodhead Publication. ISBN: 84569-783-9.

Patent

1. **Keysan, O.** and H. B. Ertan (2011). *Speed and Rotor Position Estimation of Electrical Machines Using Rotor Slot Harmonics and Higher Order Rotor Slot Harmonics*.

Conference Papers: Full Paper Refereed

1. **Keysan, O.**, P Radyjowski, J Burchell, and M. A. Mueller (2014). Towards More Reliable and Cost Effective Superconducting Generators for Wind Turbines. In: *IET Power Electronics, Machines and Drives (PEMD) Conference*. Manchester, pp.1–5.
2. Echenique, E., **Keysan, O.**, and M. Mueller (2013). Rotor loss prediction in air-cored permanent magnet machines. In: *Electric Machines Drives Conference (IEMDC), 2013 IEEE International*, pp.303–310.
3. **Keysan, O.** and M. A. Mueller (2013). An Open Source Tool to Estimate Mass and Efficiency of Wind Turbine Power Take-off Systems. In: *IET Renewable Power Generation Conference 2013*. Bejing, pp.1–6.
4. **Keysan, O.** and M. Mueller (2012). A linear superconducting generator for wave energy converters. In: *6th IET International Conference on Power Electronics, Machines and Drives (PEMD 2012)*. Bristol: IET, pp.B134–B134. ISBN: 978-1-84919-616-1.
5. **Keysan, O.**, A. McDonald, and M. Mueller (2011). A Direct Drive Permanent Magnet Generator Design for a Tidal Current Turbine (SeaGen). In: *International Electric Machines and Drives Conference*, pp.1–6.
6. **Keysan, O.** and M. Mueller (2011). Superconducting generators for renewable energy applications. In: *IET Conference on Renewable Power Generation (RPG 2011)*. Vol. 2020. Edinburgh: IET, pp.12–12.
7. **Keysan, O.** and M. A. Mueller (2011). A Transverse Flux High-Temperature Superconducting Generator Topology for Large Direct Drive Wind Turbines. In: *Superconductivity Centennial Conference*. Vol. 01, pp.1–6.
8. Hodgins, N., **Keysan, O.**, A. McDonald, and M. Mueller (Sept. 2010). Linear generator for direct drive wave energy applications. In: *The XIX International Conference on Electrical Machines - ICEM 2010*. IEEE, pp.1–6. ISBN: 978-1-4244-4174-7.
9. **Keysan, O.** and H. B. Ertan (May 2010). Higher order rotor slot harmonics for rotor speed & position estimation. In: *2010 12th International Conference on Optimization of Electrical and Electronic Equipment*. Brasov: IEEE, pp.416–421. ISBN: 978-1-4244-7019-8.
10. **Keysan, O.** and H. B. Ertan (Sept. 2010). Speed & position estimation by demodulating rotor slot harmonics. In: *The XIX International Conference on Electrical Machines - ICEM 2010*. 3. IEEE, pp.1–6. ISBN: 978-1-4244-4174-7.
11. **Keysan, O.**, A. McDonald, and M. Mueller (2010). Integrated Design and Optimization of a Direct Drive Axial Flux Permanent Magnet Generator for a Tidal Turbine. In: *International Conference on Renewable Energies and Power Quality - ICREPQ'10*. Granada.
12. **Keysan, O.**, A. McDonald, M. Mueller, R. Doherty, and M. Hamilton (2010). C-GEN, a lightweight direct drive generator for marine energy converters. In: *5th IET International Conference on Power Electronics, Machines and Drives (PEMD 2010)*. IET, pp.1–6. ISBN: 978 1 84919 231 6.

13. Hodgins, N., A. McDonald, J. Shek, **Keysan, O.**, and M. Mueller (2009). Current and Future Developments of the C-GEN Lightweight Direct Drive Generator for Wave & Tidal Energy. In: *Proceedings of the 8th European Wave and Tidal Energy Conference*. Uppsala.

Conference Papers: Abstract Referreed

1. **Keysan, O.** and M. A. Mueller (2014). Sizing of Electrical Generators for a Floating OWC Array. In: *European Wind Energy Conference*. Barcelona, pp.1–7.
2. **Keysan, O.**, J. Burchell, and M. A. Mueller (2013). Magnetic and Structural Analysis of a Transverse Flux Claw Pole Linear Machine (Invited Paper). In: *IEEE International Conference on Industrial Technology*. Cape Town, pp.1–5.

National Papers (in Turkish)

1. Ertan, H. B. and **Keysan, O.** (2012). Rotor Oluk Harmoniklerini Kullanarak Asenkron Motorlar İçin Gerçek Zamanda Sensörsüz Hız ve Konum Kestirimi. In: *Eletrik-Elektronik ve Bilgisayar Mühendisliği Sempozyumu*, pp.1–6.
2. **Keysan, O.** and H. B. Ertan (2012). Asenkron Motorlarda Oluk Sayısının Gövde Dışına Takılan Bir Bobinle Belirlenmesi. *EMO Bilimsel Dergi* **2**(3), 29–35.
3. Ertan, H. B. and **Keysan, O.** (2009). Govde disina yerlestirilmis bobin ile asenkron motor hizinin olculmesi. In: *Elektrik-Elektronik, Bilgisayar, Biyomedikal Mühendisliği 13. Ulusal Kongresi*. Vol. 2. 3, pp.37–43.

Technical Reports

1. **Keysan, O.** and M. A. Mueller (2012). *Marina Platform Deliverable 7.2.2, Wind Energy System Components*. Tech. rep., pp. 1–67.
2. **Keysan, O.** and M. A. Mueller (2012). *Marina Platform Deliverable 7.3, Critical Components for Wave Energy Converter Power Take-off Systems*. Tech. rep., pp. 1–48.
3. **Keysan, O.** (2010). *Hayward Tyler, Marinisation of a Direct Drive Permanent Magnet Machine*. Tech. rep., pp. 1–30.
4. **Keysan, O.** (2009). *Aquamarine Power, Oyster C-Gen Rotary Machine Design*. Tech. rep., pp. 1–45.
5. **Keysan O.** (2009). *Archimedes Wave Swing, C-Gen Direct Drive Linear Machine Design*. Tech. rep., pp. 1–28.
6. **Keysan, O.** (2009). *Marine Current Turbines, C-Gen Direct Drive Machine Design*. Tech. rep., pp. 1–31.
7. **Keysan, O.** (2009). *Scotrenewables, Tidal Turbine C-Gen Direct Drive Machine Design*. Tech. rep., pp. 1–48.

Thesis

1. **Keysan, O.** (2014). “Superconducting Generators for Large Offshore Wind Turbines”. PhD Dissertation. University of Edinburgh, p. 228.
2. **Keysan, O.** (2008). “A Non-Invasive Speed and Position Sensor for Induction Machines Using External Search Coils”. MSc. Middle East Technical University, p. 213.

Manuscripts in Preparation

1. Mueller, M. A., **Keysan, O.**, A. Kumaraperumal, and M. Galbraith (2014). “Heat Pipes in Air Cored Windings for Improved Thermal Performance”.
2. Lara, M. R. and **Keysan, O.** (2013). “Detection of Electrical Machine Faults Using Smart Phones”.