University of Bristol (Motor Design Ltd) – ADEPT Early Stage Researcher/PhD Studentship

*Type of award*  PhD Research Studentship  
*Department*  Electrical and Electronic Engineering  
*Details*  Available to start immediately. Please see details below.  
*Duration*  3 years  
*Eligibility*  Students of any nationality but must meet the Marie Curie eligibility criteria (see details below). High 2:1-level degree in a relevant engineering and/or mathematics degree, preferably at Masters level  
*Deadline*  Open until filled.  

**PhD Topic Background/Description**

**Project Overview**
The position is part of the new EU Framework 7 Marie-Curie Initial Training Network ADEPT (ADvanced Electric Powertrain Technology). The goal of ADEPT is to produce a virtual development environment for electric propulsion systems and to train and establish a multi-disciplinary research network. ADEPT will research a range of topics including novel electric machines, advanced power electronics, control strategies and multiphysics design optimisation.

**Research Overview**
The particular role at the University of Bristol is to investigate thermal management in electric machines, including the development of improved methods for calculation of complex loss mechanism such as winding proximity losses and magnet losses and the development of models for different cooling systems suitable for traction motors. There is the opportunity to carry out research into novel cooling types such as oil spray cooling and/or phase change cooling that has much current interest at present in traction applications. The aim is to improve the tools and techniques used for analysis and design.

**Research Plan**
Twelve ESR’s will be employed throughout Europe by ADEPT. The project allocated to the University of Bristol is:
**ESR8: Investigation of thermal analysis and losses for E-propulsion.**
The research will be conducted under supervision of University of Bristol with opportunities for collaborative work with other universities and industrial partners in ADEPT. The initial plan is to spend 2 months at CD-Adapco and 2 months at Jaguar Landrover (JLR). The placements will be fully defined during the initial stages of the project. A generous salary, which includes a mobility allowance, is paid in view of the requirement not to be permanently based in Bristol. A partner ESR associated with the University of Oxford will be working on similar topics and it is envisaged that there will be a lot of interaction between Oxford and Bristol during the project.

The ESR will be expected to assist in the organisation of ADEPT workshops, which will be held on a regular basis at the host institutions.

**Research Fields**
- Electric Motor Design
- Thermal Analysis

**Specific Objectives**
1. rapid prediction of heat generation caused by complex losses such as proximity and magnet losses,
2. accurate prediction of localized hotspots
3. detailed analysis and modelling of modern machine cooling techniques
4. faster simulation of transient duty cycles enabling design optimization and parameter estimation to be carried out.

Thermal issues are a cross-cutting theme that limits performance and impacts lifetime and vehicle integration. For example, material properties such as resistivity and magnetic field strength are temperature dependent. Excessive temperatures may lead to a variety of undesirable effects, such as de-magnetization of permanent magnets, decreased lifetime, and failure of semiconductors and insulation materials used for windings. We seek to improve the tools and techniques for analysis and design in this important area.

**Proposed Tasks/methodologies/opportunities**
- Review of existing modelling techniques for transient thermal machine operation
- Modelling and experimental validation of real world applications based upon academic and industrial secondments
- Attendance, participation and organisation of research facilitating workgroups and observational study designs
- Solution evaluation under consideration of IEC standards

**Proposed Outcomes**
Demonstration of validated thermal modelling tools for a wide variety of electrical machines from <10kW to >1MW which include accurate fluid flow modelling, compromise between high order and low order for fast but accurate simulation, automatic model parameter estimation and sensitivity analysis. Combined this will allow optimised new efficiency and low cost machine designs to be developed very quickly.
ADEPT – Project Consortium
The successful candidate will be employed as a salaried researcher while studying towards a PhD and will be part of a prestigious international consortium, ADEPT, that brings together researchers from eleven European universities:

- University of Bristol
- University of Oxford
- Eindhoven University of Technology
- Université Libre de Bruxelles
- Politecnico di Milano
- Universitatea Tehnica Cluj-Napoca
- Politechnika Lodzka
- Technical University of Munich
- Katholieke Universiteit Leuven
- Universiteit Gent and University of Zilina

and six companies around Europe involved in design of with propulsion system:

- Motor Design Ltd
- LMS International NV
- Advanced Electromagnetics BV
- MACCON GmbH
- Triphase NV
- MOTOR EGINEER SARL.

At present there are also seven associate partners (who will be involved in the project steering committee and student placements):

- Ricardo
- AVL UK Ltd
- CD-Adapco
- Brembo
- IHC Merwede
- Jaguar/Landrover
- SMARTMechanical Company
Project Partners and Supervision

Motor Design Ltd (MDL)
Motor Design Ltd (MDL) is a UK based SME specialising in the development of software for the design of electric motors. MDL develop the Motor-CAD software which is the world’s leading software package dedicated to the optimisation of motor cooling. This software is used by many prestigious companies throughout the world including many of the leading automotive companies and suppliers such as BMW, Bosch, Daewoo, Daimler, Delphi, Ford, GM, JLR, Magna, Magneti Marelli, Peugeot, Porsche, Renault, Visteon, VW, Volvo, etc. MDL have also developed the Motor-LAB software that is used to give fast and accurate predictions of the motors full torque-speed envelope, including efficiency maps, loss maps, etc. This forms an effective link between electromagnetic analysis and thermal analysis to evaluate different motor designs and cooling systems on different drive cycles. Motor-CAD has also been recently updated to form an integrated multi-physics design package for electric motor design, calculate both the electromagnetic and cooling system performance.

University of Bristol (Electrical Energy Management Group)
The Electrical Energy Management Group currently comprises 6 academic staff and 25 researchers. Its core research lies in the fields of design of electro-mechanical energy conversion devices, power electronic conversion, and advanced control. Recent activities have focussed on improvements in the efficiency, specific output, dynamic performance and reliability of electric drive systems. On-going research projects include:

- Torque/power dense generator systems for aircraft and wind/tidal energy;
- Compact, high efficiency traction motor drives for electric and hybrid vehicles;
- High specific torque, direct electric drives for rotorcraft;
- Multi-level power converters for aircraft and automotive applications;
- Highly efficient grid-tied inverter technologies;
- Low power energy management and energy scavenging;
- Direct torque control and sensorless control of electric drives.

Research funding comes from a variety of sources including the Engineering and Physical Sciences Research Council (EPSRC), the Technology Strategy Board (TSB), the European Union and directly from industry. Collaborators include Airbus, Augusta-Westland Helicopters and Qinetiq. The Group is a member of the EPSRC Virtual Centre in Underpinning Power Electronics where it is active in the Components, Converters and Drives Themes. Safran Power Systems UK is funding a rolling University Research Centre program in electric drive technologies for the more electric aircraft. The Group hosts three fully instrumented hardware-in-the-loop test cells for automated test of electrical drives, generators and actuators with ratings of up to 500kW. These are being substantially extended for new activities on aircraft actuation systems and hybrid vehicle powertrain. Furthermore the Group has full access to state-of-the-art workshops including numerically controlled machining centres and a wire-eroder, and large test facilities such as EMC chambers and wind tunnels.
Further Particulars

Experience
The successful candidate will have a first degree at a first class degree level in Electrical and Electrical Engineering or Mechanical Engineering (or equivalent) and will need to demonstrate experience of electrical machine modelling (be it electrical or thermal modelling) as part of that training.

Ideally you will have previous experience of:

- mathematical modelling of physical phenomena in one or many of the following packages:
  - MATLAB/SIMULINK/Sim-Power Systems/Simscape
  - Synopsis Saber
  - SPICE based modelling package
- Finite element analysis modelling of electro-magnetic systems
- designing and conducting laboratory based experiments to validate theoretical assertions/models
- programming in low and high level languages
  - for implementing mathematical models for personal use
  - for coding software packages for commercial use.

Nationality
At the time of application, you must not have resided or carried out your main activity (work, studies, etc.) in the UK for a significant period in the last 3 years. Short stays such as holidays are not taken into account. Applicants can be of any nationality.

Career Stage
You must, at the time of recruitment, be in the first four years (full-time equivalent research experience) of your research career and have not yet been awarded a doctoral degree. Full-time Equivalent Research Experience is measured from the date when a researcher obtained the degree which would formally entitle him/her to embark on a doctorate, either in the country in which the degree was obtained or in the country in which the researcher is recruited, irrespective of whether or not a doctorate is or was ever envisaged.

Selection Procedure
To ensure high scientific level of recruited ESRs as well as project success, final decisions will be consulted at the consortium level.

Scholarship Details
Salary rates and additional mobility, career and travel allowances are as per the Marie Curie programme (see Annex 3 of this document http://ec.europa.eu/research/participants/portal/download?docId=31562, page 69).

Salary for this grade: Marie Curie rates will apply. Candidates will receive a gross salary (before both employer and employee contributions to tax/pension/national insurance etc. subject to the regulations of the host country) consisting of:

- Living allowance: €38,000/year.
- Mobility allowance: €700/month (single applicants) or €1,000/month (applicants with dependents)
These allowances will be adjusted by a country coefficient value (1.344 (UK)).

Applicants’ PhD tuition fees will also be covered by the ADEPT initial training network. The ETR will be employed by Motor Design Ltd and will subject to employer deductions which will vary according to exchange rate, pension scheme membership, etc. Salary is given in Euros but will be paid in Sterling (exchange rates at the time will apply).

**Informal enquiries**

For general enquiries, please email gsen-pgrs@bristol.ac.uk

Any queries can be directed to Dr David Drury (d.drury@bristol.ac.uk) with the title of the post in the subject line of the email.

**Application Details**

To apply for this studentship submit a PhD application for PhD Electrical and Electronic Engineering, using our [online application system](#).

Please ensure that in the Funding section you tick “I would like to be considered for a funding award from the Department” and specify the title of the scholarship in the “other” box below.

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