Information on Postgraduate Research Scholarship - Ref: Eng-PhD-09-25			
Faculty:	Engineering and Science	**Department:**	School of Engineering
Lead Supervisor:	Dr Zahra Sangelaji		
Project Title:	Sliding-Mode Observer-Based Control for Modular Multilevel Dual Active Bridge Converters Using Wide-Band Gap Semiconductors for High-Power Applications		
Project Description: (maximum 500 words)	The transition to clean, efficient, and sustainable energy systems is one of the defining challenges of our time. Power electronics plays a vital role in this transition, enabling technologies such as electric vehicles, renewable energy systems, and future electric aircraft. This PhD project addresses a key challenge in this area by developing next-generation power converters that are more powerful, efficient, and lightweight, directly supporting the UK government's 2050 Net-Zero targets. At the centre of this research are Dual Active Bridge (DAB) converters, which are widely used to transfer electrical power efficiently between energy sources and loads. Although DAB converters are already used in many modern systems, they face important limitations when higher power levels are required. Emerging applications, including fully electric aircraft and high-power fast charging, demand substantially higher power capability without sacrificing efficiency or increasing system weight, volume, or cost. A key focus of this project is the use of wide-bandgap semiconductor technologies, particularly silicon carbide (SiC) and gallium nitride (GaN). These devices are attractive because they can switch much faster than traditional silicon-based semiconductors, enabling smaller magnetic components, higher power density, and improved efficiency. In practice, however, WBG devices introduce power-handling and robustness constraints when systems are scaled to high power levels. This remains a major barrier for applications with demanding power requirements, often 50 kW and above, such as more-electric and fully electric aircraft. To overcome these challenges, the project investigates modular power converter architectures, in which total power is shared across multiple converter modules. Modularisation improves scalability and fault tolerance but introduces challenges related to system dynamics, power sharing, and control complexity. Variations between semiconductor devices can result in unequal power distribution, reducing reliability and lifetime if not properly controlled. Existing control approaches for modular DAB converters often rely on large numbers of sensors and complex hardware to maintain stability and balanced operation. While effective, this increases system complexity,		

	potentially offsetting the benefits of WBG-based solutions. In addition, DAB converters exhibit strongly nonlinear behaviour over a wide operating range, limiting the effectiveness of conventional linear control techniques. The aim of this PhD is to develop a model-based nonlinear control approach tailored to modular DAB converters. A central goal is an observer-based control system capable of estimating key internal variables accurately without requiring an extensive sensor set. In particular, the project will explore a sliding-mode observer framework to support stable, robust control and consistent module-to-module power sharing. This studentship offers the opportunity to work at the intersection of clean energy, transportation electrification, and advanced power electronics. The successful candidate will develop skills in system modelling, control design, simulation, and experimental validation, while contributing to technologies with strong industrial relevance and societal impact. The project is well suited to candidates with a background in electrical, electronic, or control engineering who are motivated to address practical engineering challenges aligned with the Net-Zero agenda. This scholarship is awarded competitively, and all applications are carefully reviewed. While we cannot guarantee an offer, we encourage strong candidates to apply.
Duration:	3 years, Full-Time Study or 6 years, Part-Time Study

Support available (subject to satisfactory performance):

A successful Home candidate will receive:

- A Full tuition fee waiver at the university Home-student rate for the specified duration of the scholarship

A successful International candidate will receive:

- A tuition fee waiver for 50% of the International-student rate for the specified duration of the scholarship.

Tuition fees are subject to annual increases.

This scholarship does not include funding for living expenses.

Person Specification of Essential (E) or Desirable (D) requirements:

Criteria:	**E or D**
Education and Training:	
• 1st Class or 2nd class, First Division (Upper Second Class) honours degree or a taught master's degree with a minimum average of 60% in all areas of assessment (UK or UK equivalent) in a relevant area to the proposed research project	**E**
• For those whose first language is not English and/or if from a country where English is not the majority spoken language (as recognised by the UKBA), a	**E**

language proficiency score of at least IELTS 6.5 (in all elements of the test) or an equivalent UK VISA and Immigration secure English Language Test is required, if your programme falls within the faculty of Engineering and Science a language proficiency score of at least IELTS 6.5 overall with a minimum of 6.0 in all elements of the test or an equivalent UK VISA and Immigration secure English Language Test is required. Unless the degree above was taught in English **and** obtained in a majority English speaking country, e.g. UK, USA, Australia, New Zealand, etc, as recognised by the UKBA.	
Experience & Skills:	
• Previous experience of undertaking research (e.g. undergraduate or taught master's dissertation)	**E**
• Background in electrical or electronic engineering, with interest in power electronics and/or control systems	**E**
• Experience with modelling and simulation tools (e.g. MATLAB/Simulink or similar) for analysing and designing engineering systems	**D**
Personal Attributes:	
• Understands the fundamental differences between a taught degree and a research degree in terms of approach and personal discipline/motivation	**E**
• Able to, under guidance, complete independent work successfully	**E**
Other Requirements:	
• This scholarship may require Academic Technology Approval Scheme approval for the successful candidate if from outside of the EU/EEA	**E**
• The scholarship must commence before 15th July 2026 (offers will be withdrawn if this condition is not met)	**E**

Closing date for applications:	***midnight UTC on 20th February 2026***
For further information contact:	***z.sangelaji@gre.ac.uk***

Making an application:

Please read this information before making an application. Information on the application process is available at: https://www.gre.ac.uk/research/study/apply/application-process. Applications need to be made online via this link. **No other form of application will be considered**.

All applications **must include** the following information. **Applications not containing these documents will not be considered.**

- **Scholarship Reference Number (*insert reference*)**– included in the personal statement section together with your personal statement as to why you are applying
- **a CV including 2 referees** *
- **academic qualification certificates/transcripts and IELTs/English Language certificate if you are an international applicant or if English is not your first language or you are from a country where English is not the majority spoken language as defined by the UK Border Agency** *

**upload to the qualification section of the application form. Attachments must be a PDF format.*

Before submitting your application, you are encouraged to liaise with the Lead Supervisor on the details above.

September 2021