| Information on Postgraduate Research Scholarship - Ref: Eng-PhD-10-25 | | | |
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| **Faculty:** | Engineering and Science | **Department:** | School of Engineering |
| **Lead Supervisor:** | Susantha (Jeff) Dissanayake | | |
| **Project Title:** | "Synthetic Data Generation and Physics-Informed Learning for Chemical Engineering Applications" | | |
| **Project Description: (maximum 500 words)** | This research project addresses a fundamental challenge within modern chemical engineering which is the scarcity of representative data in critical and inaccessible domains. In sectors such as aerospace propulsion, nuclear chemical processing, and subsea operations, the collection of comprehensive experimental data is often prevented by extreme operational risks and regulatory restrictions. This lack of information creates a significant barrier for the development of robust machine learning models which require vast amounts of evidence to provide reliable predictions. The project identifies a paradox where the industrial areas that would benefit most from advanced data driven solutions are precisely those where obtaining sufficient real-world data is most difficult.<br>The primary aim of this project is to develop a modular framework for the generation of high-fidelity synthetic data which remains faithful to scientific principles and human behaviours. This will be achieved through a methodology that integrates generative artificial intelligence with physics-informed modelling techniques and human behaviour modelling. By utilising sophisticated architectures such as Generative Adversarial Networks and Diffusion Models, the project will learn to replicate complex data distributions from limited on site observations. To ensure that the resulting synthetic datasets do not produce physically impossible patterns, the research embeds governing equations such as the conservation of mass and energy directly into the learning process through the use of differentiable programming.<br>The research is structured around several clear objectives designed to bridge the gap between theoretical AI and industrial practice in safety-critical environments. First, the project seeks to build a broadly applicable pipeline capable of generating datasets that preserve the statistical characteristics of real-world phenomena while respecting physical bounds. Second, it focuses on the formalisation of domain specific knowledge, including chemical kinetics and the modelling of human-machine interactions, as mathematical constraints within the neural network training procedures. Third, the work aims to establish rigorous validation protocols using quantitative metrics such as the Wasserstein distance to assess the quality and reliability of the synthetic data produced.<br>Furthermore, the programme will demonstrate the practical utility of this framework through targeted implementation in high-risk application areas. These include the study of combustion dynamics in chemical reactions where extreme temperatures preclude traditional measurement, and the modelling of industrial dust explosions where | | |

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| | safety regulations restrict large scale testing. A final objective involves a systematic comparison of model performance to quantify how effectively synthetic data can be used to train surrogate models for unexplored operational regimes.<br>The ultimate outcome of these activities will be a validated prototype and a set of benchmarking guidelines that ensure the security and trustworthiness of synthetic data in engineering design. By providing a safe environment for exploring scenarios that are too dangerous to investigate experimentally, this research supports the development of more resilient and sustainable industrial processes. The project establishes a foundation for future innovations in predictive maintenance and risk assessment, ensuring that the UK maintains its leadership in the application of artificial intelligence to the most challenging problems in chemical engineering.<br><br>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:** | |
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| **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 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** | **E** |

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| 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** |
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| Python language is required. | **D** |
| AI, applications, Agentic AI, Publication in AI, ML, Mathematical modelling, | **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** |

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| **Closing date for applications:** | ***midnight UTC 20th February 2026*** |
| **For further information contact:** | ***01634883892*** |

**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.