Information on Postgraduate Research Scholarship - Ref: Eng-PhD-05-25			
Faculty:	Engineering and Science	**Department:**	School of Engineering
Lead Supervisor:	Hamid Salehi		
Project Title:	Real-time powder bed defect detection and prediction using texture-based imaging and AI		
Project Description: (maximum 500 words)	Additive manufacturing (AM) has become a cornerstone of advanced manufacturing, offering unparalleled design freedom, material efficiency, and the ability to fabricate complex components across aerospace, biomedical, and energy sectors. Among AM technologies, powder bed fusion (PBF) is particularly attractive due to its high resolution and suitability for both metallic and polymeric materials. Despite these advantages, the widespread industrial adoption of PBF remains limited by process instabilities, especially those arising during powder spreading. Variations in powder bed density, surface texture, and layer uniformity can accumulate throughout the build process, leading to porosity, incomplete fusion, surface defects, and ultimately compromised mechanical performance. Currently, powder bed quality is predominantly assessed using post-process inspection techniques such as X-ray computed tomography and surface metrology. While effective at identifying defects, these methods are inherently reactive, detecting failures only after manufacturing is complete. This results in increased material waste, extended production times, and high rejection rates. There is therefore a critical need for in-situ, real-time monitoring systems capable of detecting and predicting powder bed defects during the layer deposition stage, enabling proactive intervention before defects propagate. This PhD project aims to develop a real-time, image-based framework for powder bed defect detection and prediction in powder bed fusion processes. Building on recent advances in texture-based image analysis for quantifying powder bed surface quality, the research will integrate high-speed imaging, advanced texture metrics, and artificial intelligence to characterise powder spreading behaviour and forecast defect formation during manufacturing. The research will begin with the development of an in-situ high-speed imaging system capable of capturing powder bed evolution under a range of spreading conditions, including variations in recoater geometry, blade gap, and powder type. Texture features such as Haralick descriptors, Local Binary Patterns (LBP), and Gabor filters will be extracted using GPU-accelerated algorithms to enable near real-time processing. These texture descriptors will be used to quantify spatial and temporal variations in powder bed quality. Machine learning and deep learning techniques will then be employed to interpret the extracted texture information. Convolutional Neural Networks (CNNs) will be trained to classify spatial defects at the layer		

	level, while Recurrent Neural Networks (RNNs) and temporal models will be used to predict defect emergence based on the evolution of texture patterns across successive layers. The influence of powder characteristics—such as particle size distribution, morphology, and cohesiveness—on spreading uniformity and defect occurrence will also be systematically investigated. The project will be conducted at the Wolfson Centre for Bulk Solids Handling Technology, utilising existing experimental facilities and computational infrastructure. The expected outcomes include a validated real-time monitoring framework for powder bed quality, predictive models capable of forecasting defects during spreading, and new insights into the relationships between powder properties, process parameters, and defect formation. Ultimately, this research will contribute toward the development of intelligent, autonomous additive manufacturing systems, supporting defect-free production and advancing the digitalisation of manufacturing processes. 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 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	**E**

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**
• Previous Knowledge in programming and particulate material handling.	**E**
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:	***Dr. Hamid Salehi, H.Salehi@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.