## Section 1
### Role Overview

<table>
<thead>
<tr>
<th>Field</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Job title:</strong></td>
<td>Research Assistant or Research Fellow in Gas Turbine Sub-idle Performance Simulation</td>
</tr>
<tr>
<td><strong>Vacancy reference:</strong></td>
<td>3376</td>
</tr>
<tr>
<td><strong>School:</strong></td>
<td>School of Aerospace, Transport and Manufacturing</td>
</tr>
<tr>
<td><strong>Job type:</strong></td>
<td>Full time&lt;br&gt;Fixed Term Contract for 12 months</td>
</tr>
<tr>
<td><strong>Hours of work:</strong></td>
<td>37 hours per week, normally worked Monday to Friday. Flexible working will be considered.</td>
</tr>
<tr>
<td><strong>Salary details:</strong></td>
<td>Research Assistant: Salary level 4 – range £24,739 to £28,338 per annum with additional performance related pay up to £35,420 per annum&lt;br&gt;Research Fellow: Salary level 5 – range £33,309 to £37,127 per annum with additional performance related pay up to £46,409 per annum</td>
</tr>
<tr>
<td><strong>Line Manager:</strong></td>
<td>Prof Vassilios Pachidis, Professor of Propulsion Integration Engineering</td>
</tr>
<tr>
<td><strong>Start date:</strong></td>
<td>As soon as possible</td>
</tr>
<tr>
<td><strong>Closing date for applications:</strong></td>
<td>15 August 2020</td>
</tr>
</tbody>
</table>
Section 2
About Cranfield University

As the UK’s only exclusively postgraduate university, Cranfield’s world-class expertise, large-scale facilities and unrivalled industry partnerships is creating leaders in technology and management globally. Cranfield’s distinctive expertise is in our deep understanding of technology and management and how these work together to benefit the world.

Find out more about Cranfield, our history, and our rankings and awards here.

Corporate Plan (415i)

Our corporate plan is designed to raise the ambition and enhance the distinctiveness of our University through our people (staff, students and alumni), the industry partners we work with and our unrivalled research facilities. To strengthen our distinctive position in higher education and to grow our University, we have raised our ambition through our 415i goals:

What we value

We value ambition, impact, respect and community. These values inform how we work together and our relationships with our partners and students. We believe that success is not only about what we achieve, but how we achieve it. Our values help to define who we are, guide the way we work together and help to shape our decisions. Our shared values were developed with the active engagement of colleagues across the University:

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Ambition – We aim high. We do all we can to achieve excellence.

Impact – We change people’s lives. We make the world a better place.

Respect – We value everyone’s expertise. We support each other.

Community – We build and cherish our Cranfield community. We embrace diversity.

Our shared, stated values help to define who we are and underpin everything we do. Find out more here.

Section 3
About School of Aerospace, Transport and Manufacturing

The School of Aerospace, Transport and Manufacturing (SATM) is a leading provider of postgraduate level engineering education, research and technology support to individuals and organisations. At the forefront of aerospace, manufacturing and transport systems technology and management for over 70 years, we deliver multi-disciplinary solutions to the complex challenges facing industry.

Visit the Cranfield website to learn more about the School’s current research activities, taught programmes and impact:

Learn more about Aerospace

Learn more about Transport Systems

Learn more about Manufacturing

About the Centre for Propulsion Engineering

The Centre for Propulsion Engineering, within SATM at Cranfield, has a strong track record in power plant modelling and performance simulation research. Research activities in the past 50 years, on gas turbine applications in power and propulsion, cover virtually every aspect of the field, such as steady-state and transient performance simulation, diagnostics, novel cycles, engine control, advanced simulation methods and integration. Extensive participation in various EU and UK based projects has strengthened and established the Centre as a key contributor to path breaking research while acquiring a peripheral view of the emergence of new technologies in the field. Propulsion Engineering Centre staff also run a large and extremely successful international activity embracing applied research, industrial short courses and leading MSc and PhD programmes. The Centre is also host to the Rolls-Royce University Technology Centre for Aero Systems Design, Integration & Performance, testimony of the Centre’s global visibility and extensive links with industry.

In the Centre there are over 150 MSc candidates, some 100+ Doctoral researchers and over 30 academic and research staff. This provides a scale of activity to ensure longer term commitment to key areas of research. The Centre’s in-house performance simulation tools, developed over decades, and optimization methodologies for the whole operating envelope, life and environmental impact have formed the basis of much of the research. During the last decade or more, there has

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been a considerable focus on novel airframes and novel propulsion and power systems, often in the context of climate change.

This post sits with the Gas Turbine Engineering Group within the Centre for Propulsion Engineering. The group is placed between academia and industry and carries out research with a strong scientific and industrial relevance. The core competence of the Group is its ability to undertake detailed modelling studies and performance simulations involving aero-thermo, multi-disciplinary models to improve and extend our understanding of power plant and related systems performance within, but also at the edges, of the operating envelope. There is also a large experimental activity supported by key industrial partners. You will be expected to engage strongly with the Rolls-Royce UTC at Cranfield and interact with Industry contacts.

https://www.cranfield.ac.uk/centres/centre-for-propulsion-engineering

Organisational Chart
Section 4
Job Details

Job Purpose

To support the Clean Sky 2 Joint Technology Initiative programme PROTEUS, recently awarded to the Centre for Propulsion Engineering. Project PROTEUS (PeRformance & Operability of Turbofan Engines Under Sub-idle) focuses on the research and development of new methods and simulation tools to understand and predict the idle and sub-idle performance of the next generation of large civil aero engines.

Idling is broadly defined as an operating condition where an engine operates with no load applied. For the case of gas turbines, the idling speed is the minimum shaft speed required such that the engine may be maintained in stable operation, with the turbine load powering the compressor and auxiliaries, but no significant net useful power (work or thrust) being produced. Sub-idle operation is then any operating regime where the shaft speed is below the idle speed. An aviation engine is exposed to the sub-idle regime on ground start-up or during altitude windmill relight, while other operating regimes require near-idle operation. On the ground, the engine has to operate very close to idle to produce minimum thrust for taxiing and avoid excessive brake wear. During descent, low thrust is required for an appropriate glide slope but, particularly for final approach, the engine must be capable of producing a good thrust response in the case of a go-around. The engine also has to be able to provide aircraft services at all these conditions (power off-take and pneumatic off-take). As the trend for higher bypass ratios and geared configurations continues, so too does the need for improved idle and sub-idle performance prediction capability.

Within Work Package 6 (WP6) of the Engines Integrated Technology Demonstrator of Clean Sky 2, the Topic Manager (Rolls-Royce plc) leads the design and development of technology for a large geared civil turbofan engine demonstrator, the UltraFan™. This technology is likely to enter service within the timeframe of 2025-2050. One of the key technologies required to meet the goals of WP6 is an expert toolset for the prediction of the performance and operability of the UltraFan™ engine throughout its operating envelope, including idle and sub-idle. The primary objective of PROTEUS is to assist in the development of this capability.

The PROTEUS Consortium comprises three Universities; Cranfield University (CU) in the UK (Consortium Lead), University of Cambridge (UCAM) in the UK and the Karlsruhe Institute of Technology (KIT) in Germany. The partners have been specifically chosen based on their world-leading expertise in gas turbine research and technology. Their individual strengths combined cover the fields of aero gas turbine modelling, above-idle and sub-idle performance simulation, turbomachinery internal aerodynamics, high-fidelity (3D CFD) component ‘zooming’ methods, engine integration and external installation aerodynamics, high- and low-fidelity combustion/spray atomisation modelling and simulation, experimental testing and data analysis, large simulation framework development etc. All partners have a strong track record of successful participation in several national and EU Framework Programmes as well as several years of very close engagement with Rolls-Royce plc through its network of University Technology Centres (UTCs).

PROTEUS aims to develop a toolset capable of predicting the idle and sub-idle performance and operability of VHBR geared civil turbofan engines. Work will focus on the characterisation of the performance of key engine components at idle and sub-idle conditions using high-fidelity models and simulations along with validation against experimental data provided by the Topic Manager. Results from the higher-order simulations will be subsequently reduced into appropriate 0D (or 1D)
component characteristics for rapid whole-engine performance analyses. This will enable sub-idle considerations to be included in the initial phase of the engine’s preliminary design.

PROTEUS capitalises on several in-house methods, previously developed by the Consortium partners, for idle and sub-idle component performance map generation and will also identify new methods to model, manage and improve engine performance and operability in these conditions. This will be achieved through detailed internal (turbomachinery) and external (intake, nacelle, nozzle) component aerodynamic performance characterization and comparison of derived results with experimental data. The toolset envisaged will be matured to TRL6 through validation against test data collected from the UltraFan™ demonstrator program.

You will be required to work primarily on the transient aero/thermodynamic performance analysis of aero gas-turbine engines with particular focus on sub-idle, ground start and altitude relight performance. This will involve the further development of existing methods and tools and the transfer of those into Rolls-Royce. You will join an existing team of 1 Professor, 2 Research Fellows and 1 PhD student. You will be required to help supervise postgraduate MSc students supporting related research activities and interact with other members of staff within the UTC. This position may require spending extended periods of time in Rolls-Royce Derby and/or Bristol.

### Key Deliverables

<table>
<thead>
<tr>
<th>Description of Deliverables</th>
<th>% of time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Ensure the delivery of project goals. Transfer knowledge and toolkit developed at Cranfield into industry. Further development of methods and tools. Participation in the organisational, management and dissemination activities in support of various projects. At Research Fellow level you will play a major role in this regard, at Research Assistant level you will play a role supporting this more often.</td>
<td>70%</td>
</tr>
<tr>
<td>2. Perform other tasks as required by the line manager or nominee.</td>
<td>10%</td>
</tr>
<tr>
<td>3. Contribute to research papers in high-impact journals and academic conferences. At Research Fellow level you will write and publish high quality papers and present at conferences.</td>
<td>10%</td>
</tr>
<tr>
<td>4. Assist in the supervision of MSc student Thesis projects.</td>
<td>5%</td>
</tr>
<tr>
<td>5. Help develop research proposals aligned with the continuing ambitions of the Centre.</td>
<td>5%</td>
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</table>

Please be advised that the percentages allocated for the key deliverables may be adapted to take into account the needs of the School and / or University.
Planning and organising

You will be self-directed and organised. You should be able to develop a forward research plan for yourself and others over both short and extended timescales. You should have strong project management skills, ensuring that milestones and deliverables are achieved in time and to high quality. You will primarily be based at Cranfield University but with additional placements in industry to facilitate dissemination and knowledge transfer, if necessary.

The role will involve short-term responsibilities such as day-to-day project management, interaction with a wider project team and organising project meetings. As different tasks will require different time periods for planning, flexibility and good coordination skills will be important. There will be regular project meetings with the line manager and quarterly meetings with industrial partners.

Work will need to be clearly documented on a day-to-day basis, showing a clear development path for the project(s). On an ad-hoc basis you will be required to assist with other related projects where your skills may be relevant to apply. For example, the MSc in Thermal Power runs twice a year from October through to September and from March to February, and has an individual research project. You will be involved, to some extent in this, supporting the students with their studies. Throughout the year, you will also be expected to support the research activities of the Head of Group.

Communicating and influencing

The primary communication will be with Prof Vassilios Pachidis, Head of the Gas Turbine Engineering Group and Director of the Rolls-Royce UTC in Cranfield, with whom you should discuss project matters and ensure regular updates. You will also need to be confident in engaging with Cranfield colleagues in research and professional roles and with our external partners.

You will be expected to communicate scientific results effectively through reports and presentations at national and international meetings/conferences, and to prepare articles suitable for publication in high-impact peer-reviewed journals. There is an expectation that at least 2 peer reviewed journal papers will be published a year.

You will be expected to be able to relay information about your work in a clear and concise manner and to discuss problems constructively with your line manager and other colleagues.

Problem solving

You will be expected to be a confident and independent researcher with experience in design space exploration studies, gas turbine aerodynamics, engine performance modelling & simulation, integrated system studies and conceptual system flow behavior exploration. The nature of the research work where you are both independent and remote means that problem solving will be an agreed part of your role, to ensure we mitigate as much as possible any problems that may arise. Local on-site problems will be dealt with by you in consultation with local experts.

For modelling work you will be expected to work alongside Cranfield experts but mostly independently. You may need to work with supplier support or online user communities where necessary.

The data processing and analysis is likely to require coming up with solutions to best handle and analyse the data and the presentation of the outputs.

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Decision making

Decisions that are practical and logistics related, whilst conducting the research can be taken independently, but any significant deviation from the agreed project plan or goals needs to be discussed and approved by Prof Pachidis.

I) Decisions you will take without reference to others

- Day-to-day management and planning of on-going research within the overall specifications provided by the project proposals.
- Approaches to process, analyse and represent the data outputs.
- Draft delivery of high quality research and reports to deadline and quality.
- Active participation in the implementation of health and safety procedures in the areas in which you work.
- Drafting reports, minutes, actions and papers.
- Identifying, collating and communicating associated research papers and reports.

II) Decisions you will refer to your manager/colleagues

- Aspects potentially affecting the operation of the project or the outcome of the results, such that they will have influence on the success of the project meeting the goals.
- Any requirement to spend funds relating to the project including travel.
- Developing new research proposals, consultancy work and sources of funding.
- Balancing research, project management and publication/proposal related activities.
- Activities to enable the dissemination and exploitation of research results.
- Budgetary issues related to research contracts.
- Decisions that involve modifications to contracted deliverables.
- Developing a personal development plan.
- Writing journal and conference papers – final submission.
- Research support for PhD and MSc students.

Guiding framework

Formal guidance usually takes place during the annual personal development review with the Head of Group, where objectives are set and strategies to achieve those objectives are discussed. This is also an opportunity to raise any issue relating to work environment and career objectives including opportunities for promotion. The Head of Centre is usually freely available to offer advice and deal with any issue as and when they arise.

The University’s policies and procedures are published and made available to all staff. Feedback and guidance would be expected from peers/referees through the submission of research to journals and conference presentations.
Impact

Each member of academic and research staff is expected to play a proactive role in the generation of income for the Centre.

The University operates a collegiate system where many decisions are taken in full consultation with the faculty members. Membership of bodies such as Senate, which influence the decision making process of the University, is encouraged and supported.

The Centre aims for its staff to be recognised within both academia and the aerospace industry as credible and trustworthy domain experts. General focus areas;

- Growth in wealth, reputation and capabilities of the activities within the Propulsion Engineering Centre.
- Strengthen research activity.
- Reputation development through publications and research dissemination.
- Project supervision (shared responsibility).
- Jointly with the Head of Group, you will also be encouraged to submit significant academic papers eligible for inclusion in the Research Excellence Framework (REF).

Facts and Figures

Cranfield University excels in strategic and applied research. In the latest 2014 Research Excellence Framework (REF), 81% of our research was considered ‘world leading’ or ‘internationally excellent’ in its quality. We are in the top 40 in the world for Engineering - Mechanical, Aeronautical and Manufacturing (QS world rankings 2019). The only other UK institutions in the top 40 are Cambridge, Oxford, Imperial College London and Manchester.

Cranfield is a ‘Top 5’ research institute, based on commercial income. We were second only to Imperial College London, in terms of research power in REF 2014.

Our world class academics, with proven research records, are in constant touch with industry through research, consultancy and product development. Over 5000 students from over 100 countries study either full- or part-time, or in parallel with their career.

At Cranfield, we value Diversity and Inclusion, and aim to create and maintain a culture in which everyone can work and study together harmoniously with dignity and respect, and realise their full potential. We particularly welcome female applicants and actively consider flexible working options such as part-time, compressed or flexible hours and/or an element of homeworking. To further demonstrate our commitment to progressing gender diversity in STEM, we are members of WES & Working Families, and sponsors of International Women in Engineering Day.

- Student/staff ratio – 3:1
- Our £5 million annual bursary fund supports students from across the globe.
- We graduate over 75% of the UK’s postgraduate aerospace engineers.
- We deliver the UK Ministry of Defence’s largest educational contract.
- Almost half of our students study whilst in employment.
- We provide professional development to 20,000 individuals annually
Other Information

Health & Safety at work is the highest priority at Cranfield University. We expect every individual to protect their safety and that of others at all times. SATM is actively pursuing accreditation for BS OHSAS 18001 Occupational Health and Safety which sets out the minimum requirements for occupational health and safety management best practice. You will be expected to comply with all H&S guidance as well as support the process to establish accreditation.

Section 5
Am I suited to this role?

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Essential</th>
<th>Desirable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Education / Qualifications</td>
<td><strong>Research Assistant</strong>: MSc degree relevant to Gas Turbine technology</td>
<td></td>
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<tr>
<td></td>
<td><strong>Research Fellow</strong>: PhD (or close to completion) degree in a closely relevant engineering discipline</td>
<td></td>
</tr>
<tr>
<td>Experience</td>
<td>1. Experience in Gas Turbine engine performance modelling and simulation.</td>
<td><strong>Research Fellow Level</strong>:</td>
</tr>
<tr>
<td></td>
<td>2. Experience in gas turbine aerothermodynamics, performance, design space exploration, flow simulation, integrated system studies.</td>
<td>1. Publications portfolio</td>
</tr>
<tr>
<td></td>
<td>3. <strong>Research Fellow Level</strong>: Developing track record of publishing in high quality journals</td>
<td>2. Patents</td>
</tr>
<tr>
<td></td>
<td>4. <strong>Research Fellow Level</strong>: Growing experience of leading Research Activities</td>
<td>3. Industrial collaborative working</td>
</tr>
<tr>
<td>Knowledge</td>
<td>1. Knowledge of GT performance simulation tools (TurboMatch, GasTurb, NPSS, other)</td>
<td>4. Project management experience</td>
</tr>
<tr>
<td></td>
<td>2. Knowledge of aero/thermo dynamics and thermofluids</td>
<td>5. Experience in dealing with large integrated system aerodynamic studies</td>
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<tr>
<td></td>
<td>3. Knowledge of turbine and compression system aerodynamics</td>
<td>6. Experience in various aspects of turbomachinery aerodynamics</td>
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<td></td>
<td>4. Knowledge of flow feature manipulation and effect on system performance</td>
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<tr>
<td></td>
<td>5. Knowledge of turbomachinery and internal flow design methodologies</td>
<td></td>
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<tr>
<td>Skills / Aptitudes</td>
<td>Values</td>
<td>Other</td>
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<td>---------------------</td>
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</tbody>
</table>
| 6. Knowledge of integrated analysis of various sub-systems  
7. Practical application of gas turbine and systems performance simulation techniques and modelling  
2. Professional conduct. |
| 1. Familiarity with use of engineering computing systems  
2. Expertise in Computational Fluid Dynamics at varying levels of fidelity  
3. Use of engineering simulations and modelling to conceptualize, optimize and evaluate design solutions  
4. Knowledge of turbomachinery design systems  
5. An ability to work independently  
6. Problem solving  
7. Good presentation and report writing skill | | |
| 1. Computer programming skills (MATLAB, Fortran and Python)  
2. Computational Fluid Dynamics applied to gas turbine engine components  
3. Computational Fluid Dynamics used in design space exploration  
4. Experience in Turbomachinery and internal flow design  
5. Experience in large system integration studies  
6. Optimization  
7. Analytical skills | | |

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