School of Aeronautical, Automotive, Chemical
and Materials Engineering
National Centre for Combustion and Aerothermal
Technology (NCCAT)
Rolls-Royce University Technology Centre

Research Associate in Experimental Hydrogen Micro-mix Combustion

Job Ref: REQ221154

As part of the University's ongoing commitment to redeployment, please note that this vacancy may be withdrawn at any stage of the recruitment process if a suitable redeployee is identified.

The National Centre for Combustion and Aerothermal Technology (NCCAT)

The National Centre for Combustion and Aerothermal Technology (NCCAT) acts as the UK's primary research hub for research and development of future low-emission aero gas turbine combustion technologies, strengthening the UK's ability to benefit from the predicted growth in the civil aerospace market. Beyond aerospace applications, NCCAT also provides wider exploitation potential to clients within the automotive and energy sectors, as well as areas such as power generation, marine propulsion, and thermal management applications.

The Centre undertakes strategic research to develop technology for the UK that is critical to the development of next generation combustion systems and acts as a training ground for current and future aerospace engineers in a critical skill area for the UK. In addition, and in conjunction with industrial partners, NCCAT undertakes commercial activities that supports the development of hardware for current generation combustion systems. This necessitates the development and application of highly specialised research techniques in bespoke facilities that are used for commercial activities.

The current NCCAT research team comprises of approximately 55 personnel with around 40 experimental and computational (CFD) research projects underway, covering a range of combustion system and gas turbine internal aerodynamic problems.

Project Description

The challenges associated with decarbonising the aerospace sector have led to a fundamental review of propulsion delivery. The combustion of hydrogen fuel within a novel gas turbine has emerged as a potential front runner, completely eliminating carbonaceous emissions, which promote climate as well as other detrimental effects. The move from current liquid fuelled gas turbines, which have been incrementally tuned for decades, to the combustion of low density gaseous fuels requires a complete rethink of how the combustion zone is formed within a modern gas turbine. Central to this is the unique combustion properties of hydrogen – ultra wide flammability limits, high turbulent flame speeds and high stoichiometric flame temperatures. These high flame temperatures risk increased pollutant emissions, if the combustion is not carefully managed. One mechanism which has risen to prominence through demonstrating effectiveness in reducing emissions production is "micro-mixing", where fuel is injected through arrays of small injection sites.

This project will investigate the fundamental mixing and combustion behaviour of aerospace relevant micro-mix injection systems using high fidelity optical diagnostic techniques. The measurements will be performed on diffusion flames within the newly equipped atmospheric pressure gaseous fuel test facility within NCCAT. The measurements will be used to fully parameterise the non-reacting and combusting performance of micro-mix arrays. Key parameters of interest are the isothermal velocity field and mixture fraction, combusting velocity field,

mixture fraction, temperature field and flame front location. This measurement data will principally be used to understand the fluid mechanic processes underpinning mixing and how this leads to flame stabilisation and emissions production within micro-mix arrays. Of particular interest is the trade-off between array spacing and jet interaction or coalescence. This phenomena has been observed under some micro-mix configurations, resulting in a notable increase in NO_x emissions.

In addition to improving understanding of how aerospace micro-mix injection systems set up conditions for combustion, this project will additionally generate canonical data sets to support validation of combustion modelling approaches. Data will be released through the Open Access framework.

The successful applicant must have a track record of the design, setup and operation of optical diagnostic equipment using imaging techniques and laser diagnostics. It is essential that these measurements have been performed on fluid-flow facilities, with experience of measurement-experiment integration.

This project is funded by the EPSRC for a period of 24 months. The work is closely linked to another project funded through the Horizon Europe framework and through existing partnerships between NCCAT and Rolls-Royce plc.

Eligibility Criteria

No restrictions.

Job Description

Job Grade: Specialist and Supporting Academic Grade 6

To develop and apply optical methods for evaluating and understanding fuel preparation and combustion processes from hydrogen micro-mix fuel injectors. This includes the mechanical design of custom optical assemblies, full experiment setup and operation as well as development work to enable advancement of existing optical diagnostic techniques developed at NCCAT.

Job Duties

- To become familiar with the application of optical measurement techniques at use within NCCAT.
- Development of optical measurement techniques for the measurement of velocity fields, mixing characteristics and combustion performance.
- To undertake experimental measurements using the combustion test facilities available within NCCAT.
- To support the design and development of new experimental test facilities and imaging techniques.
- To develop new and/or use exiting techniques for the analysis of data.
- To collaborate and work with other researchers within NCCAT and at Rolls-Royce.
- To assist in the training of more junior researchers and research students within the group.
- To write reports, conference and journal papers on research outcomes and make presentations at appropriate workshops, meetings, conferences etc.
- To engage in training programmes in the University (e.g. through Staff Development) and elsewhere as required.
- To perform risk assessments, method statements and implement safety procedures.
- Always maintain confidentiality and ensure that intellectual property (IPR) agreements are not violated.
- To undertake such other duties as may reasonably be requested and that are commensurate with the nature and grade of the post.

Points To Note

The purpose of this job description is to indicate the general level of duties and responsibility of the post. The detailed duties may vary from time to time without changing the general character or level of responsibility entailed.

Special Conditions

All staff have a statutory responsibility to take reasonable care of themselves, others and the environment and to prevent harm by their acts or omissions. All staff are therefore required to adhere to the University's Health, Safety and Environmental Policy & Procedures. All staff should hold a duty and commitment to observing the University's Equality & Diversity policy and procedures at all times. Duties must be carried out in accordance with relevant Equality & Diversity legislation and University policies/procedures. Successful completion of probation will be dependent on attendance at the University's mandatory courses which include Respecting Diversity and, where appropriate, Recruitment and Selection.

Person Specification

Your application will be reviewed with respect to meeting the essential and desirable criteria listed below. Your application will be reviewed against the essential and desirable criteria listed below. Applicants are strongly advised to explicitly state and evidence how they meet each of the essential (and desirable) criteria in their application. Stages of assessment are as follows:

1 – Application
2 – Interview

Essential Criteria

Area	Criteria	Stage
Experience	Recent relevant research in an academic or industrial environment	1, 2
	Experience in fluid mechanics, aerodynamics and/or combustion science	1, 2
	Experience in experimental optical diagnostics	1, 2
	Evidence of writing academic papers or equivalent reports	1, 2
	Mechanical design of multi-part assemblies	1, 2
	The safe use and alignment of Class 4 lasers	1, 2
Skills and abilities	Ability to work independently and also as part of a team	1, 2
	Good communication skills	1, 2
	Ability in problem solving, in particular related to experimental methods	1, 2
	Ability to write project reports and make technical presentations to industrial and academic research groups	1, 2
	Use of data analysis software such as MATLAB/C++	1, 2
	Ability to use 3D CAD software	1, 2
Training	A willingness to undertake further training as appropriate and to adopt new procedures as and when required	1, 2
Qualifications	A 2.1 or higher first degree in a relevant engineering discipline	1
	A relevant PhD qualification (or near completion) in a relevant subject area	1
Other	Commitment to observing the University's Equal Opportunities policy at all times.	1

Desirable Criteria

Area	Criteria	Stage
Experience	Experience of optical combustion measurements	1, 2
	Understanding of shear layer / jet mixing	1, 2
	Experience in applying laser induced fluorescence or chemiluminescence measurements for understanding combustion	1, 2
	Experimental experience of combustion using gaseous fuels	1, 2
	Development of optical measurement techniques	1, 2
Skills and abilities	Ability to use LaVision DaVis acquisition and data processing software	1, 2
	Proficiency in relevant laser diagnostics, e.g. particle image velocimetry.	1, 2
	Experience in helping to formulate research proposals	1, 2

Conditions of Service

The position is full-time and fixed term for a period of 22 months. Salary will be on Specialist and Supporting Academic Grade 6, £32,348 - £40,931 per annum (pay award pending), at a starting salary to be confirmed on offer of appointment.

The appointment will be subject to the University's Terms and Conditions of Employment for staff grades 6 and above, details of which can be found here.

The University is committed to enabling staff to maintain a healthy work-home balance and has a number of family-friendly policies which can be found here.

The University offers a wide range of employee benefits which can be found here.

We also offer an on-campus nursery with subsidised places, subsidised places at local holiday clubs and a childcare voucher scheme (further details are available at: http://www.lboro.ac.uk/services/hr/a-z/childcare-information---page.html

In addition, the University is supportive, wherever possible, of flexible working arrangements. We also strive to create a culture that supports equality and celebrates diversity throughout the campus. The University holds a Bronze Athena SWAN award which recognises the importance of support for women at all stages of their academic career. For further information on Athena SWAN see http://www.lboro.ac.uk/services/hr/athena-swan/