

## Summary

<b>Job title</b>	Postdoctoral Research Assistant in Control Engineering
<b>Division</b>	Mathematical, Physical and Life Sciences Division
<b>Department</b>	Engineering Science
<b>Location</b>	Parks Road, Oxford, OX1 3PJ
<b>Grade and salary</b>	Grade 7: £38,674 - £46,913 per annum
<b>Hours</b>	Full time
<b>Contract type</b>	Fixed term for 36 months
<b>Reporting to</b>	Professor Antonis Papachristodoulou
<b>Vacancy reference</b>	179665

<b>Research topic</b>	Performance Analysis and Verification of Nonlinear PDEs using Polynomial Optimisation
<b>Principal Investigator / supervisor</b>	Professor Antonis Papachristodoulou
<b>Project web site</b>	<a href="https://sysos.eng.ox.ac.uk">https://sysos.eng.ox.ac.uk</a>
<b>Funding partner</b>	The funds supporting this research project are provided by the Engineering and Physical Sciences Research Council
<b>Recent publications</b>	<a href="https://doi.org/10.1017/jfm.2019.418">https://doi.org/10.1017/jfm.2019.418</a> <a href="https://doi.org/10.1016/j.sysconle.2017.08.002">https://doi.org/10.1016/j.sysconle.2017.08.002</a> <a href="https://doi.org/10.1016/j.automatica.2015.12.010">https://doi.org/10.1016/j.automatica.2015.12.010</a> <a href="https://doi.org/10.1109/TAC.2015.2479135">https://doi.org/10.1109/TAC.2015.2479135</a>

## The role

This Postdoctoral Research Assistant (PDRA) position is supported by an NSF-EPSRC joint project on “Performance Analysis and Verification of Nonlinear PDEs using Polynomial Optimisation”. The PDRA will be directly supervised by Professor Antonis Papachristodoulou (Engineering Science) and will be embedded in a project team that includes Professor Matthew Peet of Arizona State University (ASU) and a doctoral student at ASU.

The aim of the project is to develop techniques based on sum of squares and polynomial optimisation for the performance analysis and verification of systems described by Partial Differential Equations and apply these to problems in fluid mechanics. The work will be partly mathematical, partly computational and will



involve developing algorithms and implementing these in software for the automated analysis and verification of classes of PDEs.

This is a unique opportunity for a young researcher holding or about to obtain a PhD in Mathematics or Control Theory to undertake research in this interdisciplinary area. The exciting feature of this project is that the Postdoctoral Research Assistant will be collaborating with researchers in the USA.

The main idea that underpins this research is that Sum of Squares approaches for stability analysis and design of nonlinear ODE systems can be applied to infinite dimensional systems described by PDEs and implemented in flow control applications. For the work at Oxford, the following three main tasks are envisioned:

- 1) Develop a Sum of Squares approach to systems described by a classes of PDEs to investigate their stability properties.
- 2) Implement these methods in software.
- 3) Illustrate how these tools can be applied on fluid dynamics problems.

The PDRA will be reporting on the progress of the research to the PI and will present the results of the research at team meetings. They will help in the development of scientific papers to disseminate the results of this work to international scientific journals and will present the work at seminars and conferences. They will take part in public engagement activities and other activities commensurate with the impact plan. They will also be involved in undergraduate and graduate teaching as needed.

## Responsibilities

### Specific Duties

- Under the direction of the PI, conduct research on the stability and performance analysis and verification of systems described by PDEs;
- Develop and write code (MATLAB) to implement and test the research;
- Maintain and develop further SOSTOOLS as a platform for solving Sum of Squares problems;
- Work closely with the other researchers at the collaborating institution as well as supervise DPhil/MEng students in Oxford in furthering the objectives of the project;
- Report regularly on progress to members of the team;
- Write reports on the research and publish these as papers in leading conferences and journals;
- Present the results to academic and industrial partners, as well as the public;
- Create and update a website for the project;
- Help in the organization of workshops relevant to the project;

### Additional Duties

- Manage own academic research and administrative activities. This involves small scale project management, to co-ordinate multiple aspects of work to meet deadlines
- Adapt existing and develop new scientific techniques and experimental protocols
- Test hypotheses and analyse scientific data from a variety of sources, reviewing and refining working hypotheses as appropriate
- Contribute ideas for new research projects
- Develop ideas for generating research income, and present detailed research proposals to senior researchers
- Collaborate in the preparation of scientific reports and journal articles and occasionally present papers and posters
- Use specialist scientific equipment in a laboratory environment
- Act as a source of information and advice to other members of the group on scientific protocols and experimental techniques

- Represent the research group at external meetings/seminars, either with other members of the group or alone
- Carry out collaborative projects with colleagues in partner institutions, and research groups
- The researcher may have the opportunity to undertake ad-hoc paid teaching (this includes lecturing, demonstrating, small-group teaching, tutoring of undergraduates and graduate students and supervision of masters projects in collaboration with the principal investigator). Permission must be sought in advance for each opportunity.
- Any other duties appropriate with the role.

## Selection criteria

### Essential selection criteria

- A good first degree in Engineering or Mathematics, with specialization in control systems.
- Have or be about to complete a PhD (or equivalent qualification) in Control Theory/Dynamical Systems or a highly relevant subject in Mathematics.
- Experience in the analysis and design of feedback control systems using LMI and Sum of Squares approaches.
- Track record of published work concomitant with your experience.
- Expertise and experience in computer programming.
- Ability to work well independently, and as part of a team, as well as to possess interpersonal skills necessary to contribute effectively to a collaborative project.
- Ability to communicate scientific ideas to an expert and lay audience, both orally and written.
- Ability to contribute ideas for new research projects and research income generation.

### Desirable selection criteria

- Evidence of high self-motivation and good organizational skills.
- Ability to prioritize the relevant workload to meet deadlines.

## Pre-employment screening

### Standard checks

If you are offered the post, the offer will be subject to standard pre-employment checks. You will be asked to provide proof of your right-to-work in the UK; proof of your identity; and (if we haven't done so already) we will contact the referees you have nominated. You will also be asked to complete a health declaration so that you can tell us about any health conditions or disabilities for which you may need us to make appropriate adjustments.

Please read the candidate notes on the University's pre-employment screening procedures at: <https://www.jobs.ox.ac.uk/pre-employment-checks>

## About the University of Oxford

Welcome to the University of Oxford. We aim to lead the world in research and education for the benefit of society both in the UK and globally. Oxford's researchers engage with academic, commercial and cultural partners across the world to stimulate high-quality research and enable innovation through a broad range of social, policy and economic impacts.

We believe our strengths lie both in empowering individuals and teams to address fundamental questions of global significance, while providing all our staff with a welcoming and inclusive workplace that enables everyone to develop and do their best work. Recognising that diversity is our strength, vital for innovation

and creativity, we aspire to build a truly diverse community which values and respects every individual's unique contribution.

While we have long traditions of scholarship, we are also forward-looking, creative and cutting-edge. Oxford is one of Europe's most entrepreneurial universities and we rank first in the UK for university spin-outs, and in recent years we have spun out 15-20 new companies every year. We are also recognised as leaders in support for social enterprise.

Join us and you will find a unique, democratic and international community, a great range of staff benefits and access to a vibrant array of cultural activities in the beautiful city of Oxford.

For more information, please visit [www.ox.ac.uk/about/organisation](http://www.ox.ac.uk/about/organisation).

## The Mathematical, Physical, and Life Sciences Division

The Mathematical, Physical, and Life Sciences (MPLS) Division is one of the four academic divisions of the University. In the results of the six-yearly UK-wide assessment of university research, REF2014, the MPLS division received the highest overall grade point average (GPA) and the highest GPA for outputs. We received the highest proportion of 4\* outputs, and the highest proportion of 4\* activity overall. More than 50 per cent of MPLS activity was assessed as world leading.

The MPLS Division's 10 departments and 3 interdisciplinary units span the full spectrum of the mathematical, computational, physical, engineering and life sciences, and undertake both fundamental research and cutting-edge applied work. Our research addresses major societal and technological challenges and is increasingly focused on key interdisciplinary issues. MPLS is proud to be the home of some of the most creative and innovative scientific thinkers and leaders working in academe. We have a strong tradition of attracting and nurturing the very best early career researchers who regularly secure prestigious fellowships.

We have around 6,000 students and play a major role in training the next generation of leading scientists. Oxford's international reputation for excellence in teaching is reflected in its position at the top of the major league tables and subject assessments.

MPLS is dedicated to bringing the wonder and potential of science to the attention of audiences far beyond the world of academia. We have a strong commitment to supporting public engagement in science through initiatives including the Oxford Sparks portal (<http://www.oxfordsparks.net/>) and a large variety of outreach activities. We also endeavour to bring the potential of our scientific efforts forward for practical and beneficial application to the real world and our desire is to link our best scientific minds with industry and public policy makers.

For more information about the MPLS division, please visit: <http://www.mpls.ox.ac.uk/>

## Engineering Science Department

Engineering teaching and research takes place at Oxford in a unified Department of Engineering Science whose academic staff are committed to a common engineering foundation as well as to advanced work in their own specialties, which include most branches of the subject. We have especially strong links with computer science, materials science, and medicine. The Department employs 140 academic staff and has around 770 research students, 700 undergraduates and 200 researchers at any one time. Our research and education activities are supported by over 230 Professional and Technical staff.

Direct funding of research grants and contracts, from a variety of sources, amounts to an annual turnover of approximately £73m, of which research grant income is approximately £34m. Research activities fall into 8 broad headings, though there is much interdisciplinary research in practice: Information

Engineering (Robotics, Computer Vision and Machine Learning); Control; Thermofluids; Materials and Mechanics; Civil and Offshore; Electrical and Optoelectronic; Chemical and Process; and Biomedical.

### **Research Excellence**

The results of the seven-yearly UK-wide assessment of university research, REF2021, published on 12<sup>th</sup> May 2022, demonstrate that the University of Oxford made the highest volume of world-leading research submissions. The Department of Engineering Science had 71% of submissions which met the requirements for the highest grading of 4\* (research that is world-leading in terms of originality, significance, and rigour).

### **Teaching**

Each year 170-180 new undergraduates start the 4-year course leading to the MEng degree in Engineering Science. The course is accredited at MEng level by the major engineering institutions. The syllabus has a common core extending through the first two years, with specialist options introduced in the third year, and the fourth year offering further specialist material and a major project.

### **Working for the Department**

The Department of Engineering Science is a diverse, inventive, and dynamic place to work. There are many benefits to working for the University of Oxford, including flexible working arrangements, competitive benefits including a contributory salary scheme, travel discounts, and attractive family policies, as well as many training and self-development opportunities and a wealth of support for mental health and work-life balance.

The Department holds a bronze Athena Swan award to recognise advancement of gender equality: representation, progression and success for all. We have an active Equality and Diversity Committee who evaluate our position and help formulate plans to take us forward.

Researchers are supported via training, a researcher committee, regular events, career development support and opportunities to develop science communication and other useful skills. We have a well-established and active Women in Engineering network which fosters a supportive community for women engineers across various disciplines, organizes engaging and inspiring events for all.

Further information about the Department is available at [www.eng.ox.ac.uk/about/](http://www.eng.ox.ac.uk/about/).

### **The Control Group**

The control group within the Department of Engineering Science at the University of Oxford was formed nearly 60 years ago. Currently, the group consists of nine members of academic staff, together with over 40 postdoctoral researchers and postgraduate students. One member of the group is a Fellow of the IEEE and academics regularly receive awards for their publications, teaching and supervision.

Current areas of activity within the control group span both theory and applications. At the theory end, members of the group work on large-scale, embedded, robust and distributed optimization, polynomial/sum of squares methods and optimal, robust, and model predictive control. The group also covers applications ranging from biology to battery/energy management systems, transportation, aerospace, manufacturing systems and agriculture. This research is being carried out in collaboration with other academics in the Department of Engineering Science, as well as with other departments within Oxford (including Computer Science, Mathematics, Materials, Biology, Geography, and Biochemistry) and with other universities in the UK and abroad, as well as with industrial partners.

For more information, please visit: [www.eng.ox.ac.uk/control](http://www.eng.ox.ac.uk/control).

## How to apply

Applications are made through our online recruitment portal. Information about how to apply is available on our Jobs website <https://www.jobs.ox.ac.uk/how-to-apply>.

Your application will be judged solely on the basis of how you demonstrate that you meet the selection criteria stated in the job description.

As part of your application you will be asked to provide details of three referees and indicate whether we can contact them now.

You will be asked to upload a CV and a supporting statement. The supporting statement should not be longer than 5 pages and must explain how you meet each of the selection criteria for the post using examples of your skills and experience. This may include experience gained in employment, education, or during career breaks (such as time out to care for dependants). It should also include a description of your previous research and how this project aligns with your future research interests and your career.

Please upload all documents **as PDF files** with your name and the document type in the filename.

All applications must be received by **midday** UK time on the closing date stated in the online advertisement.

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## Information for priority candidates

A priority candidate is a University employee who is seeking redeployment because they have been advised that they are at risk of redundancy, or on grounds of ill-health/disability. Priority candidates are issued with a redeployment letter by their employing department(s).

If you are a priority candidate, please ensure that you attach your redeployment letter to your application (or email it to the contact address on the advert if the application form used for the vacancy does not allow attachments).

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## If you need help

Application FAQs, including technical troubleshooting advice is available at:  
<https://staff.web.ox.ac.uk/recruitment-support-faqs>

Non-technical questions about this job should be addressed to the recruiting department directly:  
[recruitment@eng.ox.ac.uk](mailto:recruitment@eng.ox.ac.uk)

To return to the online application at any stage, please go to: [www.recruit.ox.ac.uk](http://www.recruit.ox.ac.uk).

Please note that you will receive an automated email from our online recruitment portal to confirm receipt of your application. **Please check your spam/junk mail** if you do not receive this email.

## Important information for candidates

### Data Privacy

Please note that any personal data submitted to the University as part of the job application process will be processed in accordance with the GDPR and related UK data protection legislation. For further information, please see the University's Privacy Notice for Job Applicants at:  
<https://compliance.admin.ox.ac.uk/job-applicant-privacy-policy>. The University's Policy on Data Protection is available at: <https://compliance.admin.ox.ac.uk/data-protection-policy>.

### The University's policy on retirement

The University operates an Employer Justified Retirement Age (EJRA) for very senior research posts at **grade RSIV/D35 and clinical equivalents E62 and E82**, which with effect from 1 October 2023 will be 30

September before the 70<sup>th</sup> birthday. The justification for this is explained at:  
<https://hr.admin.ox.ac.uk/the-ejra>.

For **existing** employees on these grades, any employment beyond the retirement age is subject to approval through the procedures: <https://hr.admin.ox.ac.uk/the-ejra>.

There is no normal or fixed age at which staff in posts at other grades have to retire. Staff at these grades may elect to retire in accordance with the rules of the applicable pension scheme, as may be amended from time to time.

#### Equality of opportunity

Entry into employment with the University and progression within employment will be determined only by personal merit and the application of criteria which are related to the duties of each particular post and the relevant salary structure. In all cases, ability to perform the job will be the primary consideration. No applicant or member of staff shall be discriminated against because of age, disability, gender reassignment, marriage or civil partnership, pregnancy or maternity, race, religion or belief, sex, or sexual orientation.

## Benefits of working at the University

### Employee benefits

University employees enjoy 38 days' paid holiday, generous pension schemes, travel discounts, and a variety of professional development opportunities. Our range of other employee benefits and discounts also includes free entry to the Botanic Gardens and University colleges, and discounts at University museums. See <https://hr.admin.ox.ac.uk/staff-benefits>

### University Club and sports facilities

Membership of the University Club is free for all University staff. The University Club offers social, sporting, and hospitality facilities. Staff can also use the University Sports Centre on Iffley Road at discounted rates, including a fitness centre, powerlifting room, and swimming pool. See [www.club.ox.ac.uk](http://www.club.ox.ac.uk) and <https://www.sport.ox.ac.uk/>.

### Information for staff new to Oxford

If you are relocating to Oxfordshire from overseas or elsewhere in the UK, the University's Welcome Service website includes practical information about settling in the area, including advice on relocation, accommodation, and local schools. See <https://welcome.ox.ac.uk/>

There is also a visa loan scheme to cover the costs of UK visa applications for staff and their dependents. See <https://staffimmigration.admin.ox.ac.uk/visa-loan-scheme>

### Family-friendly benefits

With one of the most generous family leave schemes in the Higher Education sector, and a range of flexible working options, Oxford aims to be a family-friendly employer

The University has excellent childcare services, including five University nurseries as well as University-supported places at many other private nurseries.

For full details, including how to apply and the costs, see <https://childcare.admin.ox.ac.uk/>

### Disabled staff

We are committed to supporting members of staff with disabilities or long-term health conditions. For further details, including information about how to make contact, in confidence, with the University's Staff Disability Advisor, see <https://edu.admin.ox.ac.uk/disability-support>

### Staff networks

The University has a number of staff networks including the Oxford Research Staff Society, BME staff network, LGBT+ staff network and a disabled staff network. You can find more information at <https://edu.admin.ox.ac.uk/networks>

### The University of Oxford Newcomers' Club

The University of Oxford Newcomers' Club is an organisation run by volunteers that aims to assist the partners of new staff settle into Oxford, and provides them with an opportunity to meet people and make connections in the local area. See [www.newcomers.ox.ac.uk](http://www.newcomers.ox.ac.uk).