THE PODIUM INSTITUTE
FOR SPORTS MEDICINE & TECHNOLOGY

## Summary

| | |
|---|---|
| **Job title** | Senior Research Associate in Multiphysics Modelling of Brain Health |
| **Division** | Mathematical, Physical and Life Sciences Division |
| **Department** | Engineering Science |
| **Location** | Institute of Biomedical Engineering, Old Road Campus Research Building, Headington, Oxford, OX3 7DQ |
| **Grade and salary** | Grade 8: £48,235 - £57,255 per annum |
| **Hours** | Full time |
| **Contract type** | Fixed-term until 30th September 2027, with the possibility of extension by a further year |
| **Reporting to** | Professor Johannes Weickenmeier |
| **Vacancy reference** | 179695 |

| | |
|---|---|
| **Research topic** | Multiphysics Modelling, Brain Health, Biomarker Development, Aging and Neurodegeneration, Injury Mechanisms, Medical Image Analysis |
| **Principal Investigator / supervisor** | Professor Johannes Weickenmeier, www.weickenmeierlab.com |
| **Funding partner** | The funds supporting this research project are provided by Podium Analytics, an NGO and registered charity that supports the Podium Institute for Sports Medicine and Technology at the University of Oxford |

## The Role

We are seeking to appoint a highly motivated Senior Research Associate in Multiphysics Modelling of Brain Health. You will be part of an interdisciplinary team of researchers with the primary aim to understand the impact of age, trauma, and neurodegenerative diseases on the brain's unique form and function. We pose that brain shape changes result from continuously evolving microstructure that may be affected by neurodevelopment, age, degeneration, and injury. We seek to uncover fundamental mechanisms of healthy and accelerated brain aging by coupling neurobiology and mechanics to create multiphysics-informed predictive models of the brain. Specifically, our approach combines finite element modelling, mechanical characterization of brain tissues, and medical image analysis. The group's long-term vision is to impact clinical practise by identifying characteristic manifestations of age, trauma, and disease on the brain's form and function.

You will be expected to dedicate your time to i) identifying physiological manifestations and physics-based biomarkers that allow to differentiate between healthy and accelerated brain aging; ii) creating multiphysical constitutive models of cortical tissues degeneration during aging and injury; iii) utilizing longitudinal medical image data to infer brain aging and injury mechanisms; and iv) studying the potential relationship between exposure to head impacts and the development of neurodegenerative diseases such as Alzheimer's, Parkinson's and related dementias later in life.

Reporting to the Principal Investigator, you will help creating a healthy and vibrant research environment within The Podium Institute for Sports Medicine at the University of Oxford. This will involve leading, devising, coordinating, and supervising research projects in this area, leading and/or contributing to the work involved in the collaborations with project partners, guidance to researchers and students, and applying for further funding to underpin the research.

## About the Weickenmeier Group

Professor Johannes Weickenmeier leads the Brain Health Group that is dedicated to understanding the neurobiological and mechanical behaviour of the across the lifecycle. Professor Weickenmeier's group specializes in multiphysics modelling to predict the impact of age, injury, and disease on the brain's form and function. The group has collaborated for several years with leading clinicians in brain aging and Alzheimer's disease in the US and UK, to develop virtual twins of the human brain that predict the long-term outcomes of age and disease on brain change, the emergence of tissue damage, and the degeneration of functional barriers between fluid compartments and the parenchyma.

Major technical areas of research include constitutive modelling of critical mechanisms associated with healthy and accelerated aging. We simulate the spatiotemporal progression of multiple fields in order to couple mechanics-driven deformation, tissue damage, and the progression of tissue lesions, and the spreading of toxic protein populations associated with neurodegenerative diseases such as Alzheimer's and chronic traumatic encephalopathy. In addition, the group has been developing novel image-based methods to infer and detect physiological changes from longitudinal image data. The overall goal is to develop biomarkers that reveal the physiological state of individuals, all the way from early detection of long-term chronic conditions during brain aging.

## Your Responsibilities

### Specific Duties

- Contribute and drive the continuous preparation of peer-reviewed journal articles, scientific reports, and presentation of papers and posters at conferences and seminars.
- Take on leadership roles within the research group including (i) coordinating activities with senior researchers and post-doctoral research associates, (ii) mentoring and supporting DPhil students, and (iii) advising master's projects and other student-led research projects.
- Identify and validate mechanics-based biomarkers associated with the manifestation of brain aging, traumatic brain injury, and neurodegenerative diseases.
- Supervise the development of a virtual twin of the brain - a framework we will use to simulate and predict brain changes across the lifecycle.
- Lead efforts on multiphysics constitutive modelling of brain aging, neurodegenerative disease, and traumatic brain injury with a focus on long-term brain shape changes.
- Develop registration-based algorithms to quantify the spatiotemporal changes of the brain from longitudinal medical images.
- Research on methods to analyse potential causes of injury from multimodal dataset (i.e., imaging data, mouth guard recordings, etc.) and build predictive finite element models.

### Additional Duties

- Contribute ideas for new research projects and facilitate new research collaborations within the Podium institute, the University of Oxford, and industrial partners.
- Develop ideas for generating research income and help raise research funds through grant applications.
- Act as a source of information and advice to other members of the group on scientific protocols and experimental techniques.
- 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 master's projects in collaboration with principal investigators). Permission must be sought in advance for each opportunity.
- Liaise with funding bodies and provide information to project stakeholders and represent the research group at external meetings/seminars, either with other members of the team or alone.
- Any other duties appropriate with the role.

## Selection criteria

### Essential selection criteria

- Hold a relevant PhD/DPhil with post-qualification research experience in the field of mechanical engineering, biomedical engineering, applied mathematics or physics.
- Have demonstrated extensive experience in finite element modelling, continuum mechanics, and multiphysics constitutive modelling of the complex time-dependent, mechanobiological behaviour of cortical tissues. Additional experience in soft tissue modelling and/or medical image analysis is desirable.
- Have published papers in the area, and have familiarity with the existing literature and research in the field.
- Be driven by an innate sense of curiosity, independence, and desire for impact.
- Proven programming experience in Python, MATLAB or C/C++. Experience using established medical image analysis algorithms is a plus.
- Have ability to identify, summarise, and critically appraise relevant literature.
- Evidence of solving complex problems with finite element modelling, constitutive modelling, medical image analysis, image registration, and AI techniques.
- Excellent communication skills, including the ability to write for publication, present research proposals and results, and represent the research group at meetings.

### Desirable selection criteria

- Prior work on data-driven multiphysics modelling with application to soft tissues (and preferably the brain)
- Ability to develop methods to process longitudinal image data (i.e., image registration) to detect spatiotemporal changes in the brain.
- Experience of or an interest in establishing new collaborations with peers as well as translational research teams to define innovative solutions to medically relevant problems in brain health.

## 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 two referees and indicate whether we can contact them now.

You will be asked to upload a CV and a supporting statement. The supporting statement must explain how you meet each of the selection criteria for the post using examples of your skills and experience. This may include research proposal, experience gained in employment, education, or during career breaks (such as time out to care for dependants)

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.

## 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.

## The Podium Institute for Sports Medicine and Technology

The Podium Institute for Sports Medicine and Technology at the University of Oxford is a long-term partnership bringing together leaders across sport, science, academia, technology, and business. The initial work of the institute will focus on traumatic injuries such as concussion and serious musculoskeletal injuries, as well as sudden cardiac death and the psychological factors that lead to injury. The institute sits within the Institute of Biomedical Engineering (IBME) in the University's Department of Engineering Science.

The Podium institute aims to shift the traditional emphasis of research into sports injury - which is predominantly adult-centric and based upon treatment – by concentrating on younger athletes, 11-18 years old, and focuses on prevention rather than cure. The institute will aim to develop new technologies to monitor and analyse the individual factors that currently lead to youth sports injuries, and offer practical solutions for safer sports practices, focusing on safety for lifelong health, rather than performance. A hallmark of the Institute is the development and validation of new technologies for sport injury detection and prevention and for lifelong health.

## Institute of Biomedical Engineering

The Institute of Biomedical Engineering (IBME), a research institute of the Department of Engineering Science, is situated on the Old Road Campus in Headington (about a mile from the centre of Oxford), close to the Churchill Hospital, the Oxford Cancer Hospital and less than half a mile away from the John Radcliffe Hospitals and the Children's Hospital. The current Institute Director is Prof. Constantin Coussios FREng. Primary activities (and the central administration for the IBME) are based at the Old Road Campus Research Building, with activities in the Botnar Research Centre, Big Data Institute and on the Keble Road Triangle site of the Department of Engineering Science.

The IBME offers a world-class and vibrant venue for biomedical engineering research and postgraduate research training where engineers and clinicians work together on addressing unmet needs in the prevention, early diagnosis and treatment of major diseases and conditions. The Institute's core mission is to develop novel medical devices, healthcare technologies, and systems capable of delivering substantial healthcare benefit, and to translate new engineering technologies into clinical practice. The Institute won a Queen's Anniversary Prize for its healthcare technology innovation activities in 2015. Oxford biomedical engineering has a sustained track record of translational research and healthcare technology commercialisation which goes back to the 1960s but has been particularly prolific in the last two decades. The Oxfordshire region's life sciences and healthcare innovation system is also recognised as one of the most dynamic in Europe, and provides opportunities for academic-business collaborations, industrial-funded research collaborations, as well as a destination for university research innovations and a trained skilled workforce.

Within the IBME there are currently six research clusters: Biomedical Image Analysis, Neurotechnology & Brain Therapies, Biomedical Signal Processing, Modelling and Instrumentation, Non-invasive Therapy and Drug Delivery, Biomaterials and Regenerative Medicine & Biomechanics. In addition, we strive to provide a supportive environment for independent early career researchers which include Royal Academy of Engineering Research Fellows as well as Junior Research Fellows.

More information about the Institute and its research programmes may be found at www.ibme.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, medicine and also the Saïd Business School. The Department employs 120 academic staff (this number includes 13 statutory professors appointed in the main branches of the discipline, and 25 full professors); in addition, there are nine visiting professors. There is an experienced team of teaching support staff, professional services and administrative staff and technicians. The Department has well-equipped laboratories and workshops, which together with offices, lecture theatres, library and other facilities have a net floor area of about 25,000 square metres.

The Department is ranked fifth in the world, and the top European University, in the 2023 *Times Higher Education World University Rankings* for Engineering & Technology. Further information about the Department is available at www.eng.ox.ac.uk.

### Teaching

We aim to admit 170-180 undergraduates per year to take a 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. Specialist options are introduced in the third year, and the fourth year includes further specialist material and a major project.

### Research

Research in the Department is particularly strong. We have approximately 600 research students and about 250 postdoctoral researchers. Direct funding of research grants and contracts, from a variety of sources, amounts to an annual turnover of approximately £70m.

The results of the seven-yearly UK-wide assessment of university research, REF2021, published on 12th 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).
Research activities fall into 8 broad headings, though there is much overlapping 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.

The Department of Engineering Science holds a bronze Athena Swan award to recognise advancement of gender equality: representation, progression and success for all.

## 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/

# Additional Information

## 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).

## 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

To return to the online application at any stage, please go to: 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 70th 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 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. We also subscribe to the Work+Family Space, a service that provides practical advice and support for employees who have caring responsibilities. The service offers a free telephone advice line, and the ability to book emergency back-up care for children, adult dependents and elderly relatives. See https://hr.admin.ox.ac.uk/my-family-care

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.