Research Associate in Mathematical Image Analysis and Machine Learning for better Food Microstructures

Department of Applied Mathematics and Theoretical Physics

April 2018
The role

**The research project**

Many food products are complex multiphase materials that have microstructures consisting of multiple phases (e.g. air, fat, undissolved solids) bound together by a continuous “matrix phase”. Consistently producing and maintaining such structures though manufacturing and supply chain is an essential part of delivering high-quality products to the consumer.

One of the most common ways to analyse such microstructures is to quench the structures by fast freezing followed by analysis of the frozen structure using cryo-SEM (scanning electron microscopy).

Currently these images are often compared only qualitatively as the segmentation needed to extract quantitative information about the components is currently done manually and is therefore extremely time consuming if reliable statistical data is required. Previous attempts to automate the segmentation in typical images were unsuccessful due to the lack of differentiation between the phases and resulting problems in robustly outlining the components.

With this project, we want to explore new mathematical approaches to allow a robust segmentation that could then be used as a routine method to extract quantitative information from the SEM images of typical food microstructures, which will in turn speed up Unilever’s innovation processes.

The project will require significant innovation on the image analysis side for rendering, automated segmentation, classification and shape analysis methods bespoke for different food microstructures and ready for reliable use in Unilever.

**Key responsibilities**

Duties include developing and conducting individual and collaborative research objectives, proposals and projects. The role holder will be expected to plan and manage their own research and administration, with guidance if required, and to assist in the preparation of proposals and applications to external bodies. He or she must be able to communicate material of a technical nature and be able to build internal and external contacts. He or she may be asked to assist in the supervision of student projects, the development of student research skills, provide instruction or plan/deliver seminars relating to the research area. An allowance for research expenses is included in this position.

Applicants must have (or about to receive) a PhD degree in mathematics or statistics (or a closely related discipline), and have a demonstrably excellent research record and future research potential. The ideal candidate will have experience in image analysis, in particular image segmentation and classification, and in machine learning.
# Person specification

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<th>Essential</th>
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<tr>
<td><strong>Education</strong></td>
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<td>Candidates should hold a PhD or equivalent in statistics, mathematics or a closely related subject, and have an outstanding record of research.</td>
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<td><strong>Academic</strong></td>
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<td>A developing bibliography of research publications</td>
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<td>A track record of securing research funding</td>
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<td>Willing to take a leading role in the supervision of Research Students</td>
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<td>An interdisciplinary and collaborative research approach</td>
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<td><strong>Leadership experience and achievements</strong></td>
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<td>Willingness to undertake management and administrative duties</td>
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<td>Proven ability to lead and inspire a team and work with vision and foresight</td>
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Project Partners

The Cantab Capital Institute for the Mathematics of Information

This position is affiliated with the Cantab Capital Institute for Mathematics of Information which is hosted within the Faculty of Mathematics of the University of Cambridge, comprised of the Department of Applied Mathematics and Theoretical Physics (DAMTP) and the Department of Pure Mathematics and Mathematical Statistics (DPMMS). It accommodates research activity on fundamental mathematical problems and methodology for understanding, analysing, processing and simulating data. Data science research performed in the Institute is at the highest international level, aiming to extract the relevant information from large- and high-dimensional data with a predictable certainty.

Key mathematical expertise represented in the Institute includes statistics; pure, applied and computational analysis; inverse problems; stochastic analysis and probability; convex analysis; stochastic and sparse optimisation; sparsity, compressed sensing and sampling theory; random matrices; harmonic analysis; partial differential equations; functional analysis; discrete geometry; number theory; topology and graph theory; quantum information, to name but a few.

To learn more about the CCIMI please visit http://www.ccimi.maths.cam.ac.uk

The Cambridge Image Analysis group (CIA):

The postholder will be an integrated member of the CIA group, a research group in the Department of Applied Mathematics and Theoretical Physics specialising in the mathematics of digital image and video processing using partial differential equations and variational methods. Our research ranges from the modelling and analysis of such methods to their computational realisation and application.

To learn more about CIA please visit http://www.damtp.cam.ac.uk/research/cia/

Unilever

The research project associated with this position is a collaboration between the aforementioned groups at the University of Cambridge and Unilever. Unilever is one of the biggest global manufacturers of fast moving consumer goods (FMCG) ranging from household cleaners to shampoo and tea and owns global brands such as Axe, Dove, Hellmann’s and Lipton. With brands like Magnum and Cornetto it is also one of the biggest global producers of ice cream.

The Unilever food and refreshment (F&R) business is driving to improve the sustainability and nutritional profiles of existing products as well as constantly exploring new product formats and channels. Many of these innovations rely strongly on the optimisation of formulation and process parameters to form stable microstructures. As described above, these structures are generally complex multiphase systems that are quite hard to characterise due to their instability, fragility and temperature sensitivity.

In this project, we want to explore advanced and appropriate image processing techniques to develop customized algorithms to extract valuable quantitative data for our research.
Terms of appointment

Tenure and probation
Appointment will be made on a fixed-term basis for 18 months. Appointments will be subject to satisfactory completion of a probationary period which will be set dependant on the length of tenure.

Hours of Work and Working Pattern
The appointment is full-time working Monday-Friday.

Pension
You will automatically be enrolled to become a member of USS (Universities Superannuation Scheme) — a defined benefits pension scheme. If you are already a member of the NHS Pension scheme, you may be eligible to continue in the scheme and should contact the Pensions section of the University.

For further information please visit: www.pensions.admin.cam.ac.uk/.

Annual leave
Full time research staff are entitled to annual paid leave of 33 days plus public holidays.

General information

Right to work in the UK
We have a legal responsibility to ensure that you have the right to work in the UK before you can start working for us. If you do not have the right to work in the UK already, any offer of employment we make to you will be conditional upon you gaining it.

Health declaration
Once an offer of employment has been made the successful candidate will be required to complete a work health declaration form.

Qualifications
The person specification for this position lists qualifications that are essential and/or desirable. Please note that if you are offered the post you will be asked to provide your relevant original certificates of these qualifications.

References
Offers of appointment will be subject to the receipt of satisfactory references.

Information if you have a disability
The University welcomes applications from individuals with disabilities. We are committed to ensuring fair treatment throughout the recruitment process. We will make adjustments to enable applicants to compete to the best of their ability wherever it is reasonable to do so and, if successful, to assist them during their employment. Information for disabled applicants is available at www.admin.cam.ac.uk/offices/hr/staff/disabled/

We encourage you to declare any disability that you may have, and any reasonable adjustments that you may require, in the section provided for this purpose in the application form. This will enable us to accommodate your needs throughout the process as required. However, applicants and employees may declare a disability at any time.

If you prefer to discuss any special arrangements connected with a disability, please contact, Ms Julie Bazin, on 01223 764289 or by email on hr-office@maths.cam.ac.uk.

Alternatively, you may contact the HR Business Manager responsible for the department you are applying to via hrenquiries@admin.cam.ac.uk.
The University

The University of Cambridge is one of the world’s oldest and most successful universities. We are a renowned centre for research, education, and scholarship that makes a significant contribution to society. The University is consistently ranked amongst the top universities in the world. Our affiliates have won more Nobel Prizes than any other University.

Our sustained pursuit of academic excellence is built on a long history of first-class teaching and research within a distinctive collegiate system. For eight centuries our ideas and innovations have shaped the world. Our principal goal is to remain one of the world’s leading universities in an increasingly competitive global higher education sector. Today the University of Cambridge is at the centre of a cluster of over 4,300 businesses employing 58,000 people. Our capital investment projects include the West Cambridge site, the North West Cambridge development and the growth of the Biomedical Campus in the south of the city. The North West Cambridge development includes the opening of a primary school – the first in the UK to be managed by a University. So we are deeply embedded in, and committed to serving, our local community. These are all conspicuous signs of a University that is not only adapting to new needs, but also anticipating the future.

Our mission is to contribute to society through the pursuit of education, learning, and research at the highest international levels of excellence. Our core values are:

- freedom of thought and expression; and
- freedom from discrimination.
The University is one of the world’s leading academic centres. It comprises 150 faculties and departments, together with a central administration and other institutions. Our institutions, museums and collections are a world-class resource for researchers, students and members of the public representing one of the country’s highest concentrations of internationally important collections.

The University has an annual income of £1.66 billion. Research income, won competitively from the UK Research Councils, the European Union (EU), major charities and industry, exceeds £400 million per annum and continues to grow.

The Colleges and the University remain committed to admitting the best students regardless of their background and to investing considerable resources both in widening access and financial support.

The 31 Colleges are self-governing, separate legal entities which appoint their own staff. Many academic staff are invited to join a College as a Teaching Fellow, which provides a further social and intellectual dimension. The Colleges admit students, provide student accommodation and deliver small group teaching. The University awards degrees and its faculties and departments provide lectures and seminars for students and determine the syllabi for teaching and conducting research.

The University’s estate is undergoing the most significant transformation in its history. Cambridge has been able to create a new science and technology campus to the west of the city centre, and is now expanding further to the north west of Cambridge including investing in affordable homes for University key workers and community facilities. Even with our continued development, the University remains within walking or cycling distance across the campus. The University is a major partner on the Cambridge Biomedical Campus and we continue to redevelop our historic city centre sites demonstrating our determination to ensure that we can offer the best facilities and opportunities for our staff and students.

Our instinct for seeking out excellence and setting up enduring and mutually beneficial collaborations has led us to establish strategic partnerships across the globe. Whether it is the successful Cambridge-Africa Programme involving universities in Ghana, Uganda and elsewhere on the African continent; or the close association with the government of India to pursue new research in crop science; or the creation, with Germany’s Max Planck Institutes, of a Cambridge-based centre for the study of ethics, human economy and social change – international partnerships are now an inextricable part of the University’s make-up.

Our ideas and innovations have shaped the world. Our campaign, 'Dear World... Yours, Cambridge', will raise £2 billion to help us shape all our futures.
Working at the University

and innovative community, with more than 18,000 students and over 11,000 staff from all walks of life and corners of the world.

The University continually explores strategies to attract and retain the best people. It is committed to supporting its staff to achieve their best. We are a fair, diverse and inclusive society and we believe our staff are our greatest asset. There is strong commitment to developing institutional leadership and supporting and encouraging staff development at all levels. Furthermore, the University’s Athena SWAN award recognises and celebrates good practice in recruiting, retaining and promoting women. We offer a variety of roles including academic, research, professional, managerial and support roles. We also offer extensive benefits and excellent learning opportunities within a stimulating working environment. The University has signed up to the Race Equality Charter, a notional framework for improving the representation, progression and success of minority ethnic staff and students within higher education.

Living in Cambridge

Cambridge is rich in cultural diversity. From beautiful University and College buildings, museums and art galleries, quaint gardens and punts on the River Cam, to a vibrant restaurant and café scene, our employees are surrounded by the wonderful features of this unique city.

If you prefer the faster pace of life, London is a 45 minute train journey away. For those travelling from overseas, Stansted Airport is just 45 minutes away and Heathrow Airport under 2 hours away.

The University is a short distance from a host of other attractions such as Ely Cathedral, Newmarket Races and various wildlife parks and stately homes.

Cambridge is also within easy reach of the beautiful Broads and coastlines of Norfolk and Suffolk.

Further information about attractions in and around Cambridge can be found at Visit Cambridge, the official tourism website for the city.
What Cambridge can offer

We offer a comprehensive reward package to attract, motivate and retain high performing staff at all levels and in all areas of work. The University offers a wide range of competitive benefits, from family leave entitlement, to shopping and travel discount schemes. Our generous annual leave package contributes to the positive wellbeing of our University employees. Sabbatical leave enables academics to focus on research and scholarship, whilst still maintaining their full salary. The University also has a career break scheme for academic and academic-related staff, with additional flexible working policies for all other staff.

CAMbens employee benefits
We offer a CAMbens scheme for University employees, providing access to online and in-store shopping discounts and cashback. With more than 2,000 participating retailers, employees can save money on a wide range of household expenses, from groceries and clothes, to holidays and insurance and much more. A range of local discounts are also available, helping employees to save money whilst also supporting local Cambridge businesses. CAMbens Cars and CAMbens Cycle to Work salary sacrifice schemes are also available, which enable employees to save money on transport costs. A 10% discount rate on the purchase of train season tickets, bulk buy tickets and an interest free travel to work loan are also available for staff of the University of Cambridge.

Family-friendly policies
The University recognises the importance of supporting its staff. We have a range of family-friendly policies to aid employees’ work-life balance including a generous maternity, adoption and shared parental leave entitlement of 18 weeks full pay and emergency family care support via My Family Care. In addition, our highly regarded workplace nurseries, childcare vouchers, a childcare salary sacrifice scheme and a high quality holiday play scheme are available to help support University employees with caring responsibilities. The Newcomers and Visiting Scholars Group is an organisation within the University run by volunteers whose aim is to help newly arrived wives, husbands, partners and families of Visiting Scholars and members of the University to settle in Cambridge and give them an opportunity to meet local people. The Office of Postdoctoral Affairs supports the postdoctoral community within Cambridge. Further details are available here: https://www.opda.cam.ac.uk/

Your wellbeing
The University’s Sport Centre, Counselling Services and Occupational Health are just some of the support services available to University employees to promote their physical and mental wellbeing. There are many societies in Cambridge catering for almost every taste and interest. Whether you want to take part in a sport, participate in music or drama, pursue a hobby, or join a political group, you will almost certainly find that a society exists for this purpose. The University also hosts the Cambridge Science Festival and Cambridge Festival of Ideas, as well as Open Cambridge weekend, which together attract over 50,000 visitors per year. The festivals are a great opportunity to get your first taste of public engagement, through volunteering, supporting hands-on activities or proposing a talk.
What Cambridge can offer

Pay and benefits
The University salary structure includes automatic service-related pay progression in many of its grades and an annual cost of living increase. In addition to this, employees are rewarded for outstanding contribution through a number of regular pay progression schemes. The University offers attractive pensions schemes for employees, with an additional benefit of a salary exchange arrangement providing tax and national insurance savings. Payroll giving is also a simple, tax-efficient way for employees to make monthly donations to charity.

Relocating to Cambridge
The University Accommodation Service exists to help employees in their search for a rental home in Cambridge. A new University development at North West Cambridge called Eddington offers subsidised rented accommodation to University staff. The development consists of high quality furnished one and two bedroom apartments. For more information about the development and how to apply please visit the website www.nwcambridge.co.uk

Equality & diversity
The University has a vibrant and varied community. We support and encourage under-represented groups and we value diversity. We welcome applications from individuals with disabilities. Our recruitment and selection procedures follow best practice. We have an Equal Opportunities Policy, along with a range of diversity networks for women, black and minority ethnic and lesbian, gay, bisexual and transgender staff. More details are available here: http://www.equality.admin.cam.ac.uk/

Development opportunities
We support new employees to settle in through various activities. The encouragement of career development for all staff is one of the University’s values and we put this into practice through various services and initiatives. Our Personal and Professional Development Department provides development opportunities and courses for all University employees. These include face-to-face sessions, online learning modules and webinars. Employees may also apply for financial support to undertake training that will lead to a qualification. We offer reduced staff fees for University of Cambridge graduate courses and the opportunity to attend lectures and seminars held by University departments and institutions. The CareerStart@Cam programme also supports employees in assistant staff roles who do not hold higher education qualifications to develop their skills, experience and

The importance of helping individuals settle into a new area is also recognised by the University. The Shared Equity Scheme provides financial assistance to qualifying new members of staff with the purchase of living accommodation, where they have to relocate to take up their appointment. Removal expenses are also available for qualifying new members of staff. The University has introduced a Rental Deposit Loan Scheme to support new starters and existing employees with the set up costs of renting privately in the Cambridge area: https://www.hr.admin.cam.ac.uk/pay-benefits/cambens-employee-benefits/financial/shared-equity-scheme provides financial assistance to qualifying new members of staff with the purchase of living accommodation, where they have to relocate to take up their appointment. Removal expenses are also available for qualifying new members of staff. The University has introduced a Rental Deposit Loan Scheme to support new starters and existing employees with the set up costs of renting privately in the Cambridge area: https://www.hr.admin.cam.ac.uk/pay-benefits/cambens-employee-benefits/relocation-housing/rental-deposit-loan-scheme

Whether it is understanding the molecular basis of neurodegenerative diseases, or helping farmers in India increase their yield, or discovering better ways to live in large cities –
I know that what we do in Cambridge affects lives, and livelihoods, the world over.

Vice Chancellor Emeritus, Professor Sir Leszek Borysiewicz, 2016
How to apply

Applications should be submitted online via the University of Cambridge jobs page [www.jobs.cam.ac.uk](http://www.jobs.cam.ac.uk) by clicking “Apply online” in the job advert. You will need an email address to register for our online system. You will need to upload a full curriculum vitae, research statement (no more than two sides of UK A4 size of current and proposed research), list of publications and the contact details of two academic referees. Please ensure that your referees are aware that they will be contacted by the HR Office Administrator to request that they upload a reference for you to our Web Recruitment System, and please encourage them to respond promptly.

If you have any queries regarding the application process please contact LE15430@maths.cam.ac.uk

The closing date for applications is 15 June 2018

Interviews are expected to be held week commencing 25 June 2018