Aston University
BIRMINGHAM UK

Early-Stage Researcher project POSTDIGITAL Plus (two posts)

Reference: 0005-25

Grade: N/A

Salary: £42,100 to £46,000, per annum, depending on experience

Contract Type: Fixed Term (Up to 36 months)

Basis: Full Time

Job description

Job Purpose:

Position 1 (POSTDIGITAL+ DC4): Bayesian and other advanced approaches for the development of photonic neural networks.
Position 2 (POSTDIGITAL+ DC8): New architectures of optical reservoir computing and extreme learning machine.

Applications are invited by Aston Institute of Photonic Technologies (AIPT) for two prestigious **three-year postgraduate positions** (leading to a PhD) as **Doctoral Candidates** (DC) within the European Doctoral Network project **Post-Digital Computing + (POSTDIGITAL Plus).** The project is funded by Horizon Europe Marie Sklodowska-Curie Actions (MSCA), with the UK candidate supported by the EPSRC. The successful candidate will receive a generous monthly salary, membership in a high-quality pension scheme, full social security benefits and a fee bursary to fully cover the PhD tuition fees. Successful candidates with family will be entitled to an enhanced salary. Notably**,** several months of the study and research period will be spent in the industrial sector with either Hewlett Packard Enterprise (Belgium) or Thales (France). The successful applicant will benefit from close interaction and joint training events with the project's world-leading industrial partners: VLC Photonics (Spain), Akhetonics (Germany), NcodiN (France), IBM (Switzerland). The project also involves dynamic interaction and collaboration with leading EU research organisations and universities: University of the Balearic Islands (Spain), Agencia Estatal de Consejo Superior de Investigaciones Cientificas – CSIC (Spain), Centre national de la recherche scientifique – CNRS (France), Ghent University (Belgium), Université libre de Bruxelles (Belgium), Université Paris-Saclay (France) and a bespoke training program in advanced technical and personal soft skills. The successful Aston applicants will be fully integrated into the project's cohort of 17 POSTDIGITAL Plus PhD students.

Both Doctoral Candidates will be fully integrated into the prestigious Marie Skłodowska-Curie Actions (MSCA) Doctoral Network (DN) programme, an initiative by the European Commission to train creative, entrepreneurial, innovative researchers, who are able to face current and future societal challenges and will convert knowledge and ideas into products and services for the economic and social benefit of Europe.

Background to the Project:

European Doctoral Network on POSTDIGITAL Plus (https://cordis.europa.eu/project/id/101169118) brings together internationally leading teams from academia, research centres and leaders of industry, including IBM, Thales, Hewlett Packard Enterprise Belgium and three regarded start-ups NcodiN, Akhetronics and VLC Photonics in the field of optical computing to train a cohort of 17 doctoral candidates in the inter-disciplinary fields of emerging disruptive neuromorphic computational technologies and their applications. POST-DIGITAL Plus has the ambition and the vision to create a new generation of scientific and industrial leaders that will greatly contribute to strengthening Europe's human resources and industry competitiveness in future digital and post digital economy and technology.

Training and Secondments

The **POSTDIGITAL Plus** Training Programme will be implemented through the unique combination of the "hands-on" research training, non-academic placements and advanced inter/multidisciplinary/ inter-sectoral training together with an extensive transferable skills training and attendance in conferences, workshops and symposia. **POSTDIGITAL Plus** 's 17 Doctoral Candidates will each spend significant time directly with its world leading industrial partners (VLC Photonics (Spain), Akhetonics (Germany), NcodiN (France), IBM (Switzerland)) to acquire specific skills and knowledge highly required by the private sector. Upon completion of **POSTDIGITAL Plus's** advanced research and bespoke training programme, it's PhD students will be able to breach the inter-sectorial divide and become the next generation of leaders in industry or academia.

PhD Project title associated with the position 1: Bayesian and other advanced approaches for the development of photonic neural networks.

The photonic NNs' parameters (weights and activations) are noisy as they are affected by process variations and intrinsic noise. At the same time, Bayesian NNs methodology is grounded upon the optimisation of the neural nets with random weights and activations. Thus, the Bayesian NNs aside from numerous other benefits (prediction confidence control, better noise tolerance, generalisability, and data efficiency), are the best-fit solution for the efficient neuro-photonic realisation in resource-demanding applications: by considering explicitly the uncertainty in the weights and activation functions, Bayesian NNs can effectively account for device variability, noise, and measurement errors inherent to the neuromorphic photonic devices. The new noise mitigation approach will then juxtaposed with the ones proposed by CNRS: ghost neurons & pooling of neurons population. Then, we plan to extend the research further and address, e.g., the photonic realisation of the Kolmogorov-Arnold Networks (KANs).

Expected Results: Experimental realisation & demonstration of photonic NNs developed via the Bayesian approach. All-round comparison for the Bayesian photonic NNs with the «conventional» approaches, in terms of processing speed, inference quality, & energy consumption. Efficient photonic realisation of KANs.

PhD Project title associated with the position 2: New architectures of optical reservoir computing and extreme learning machine.

The project aims to delve into reservoir computing schemes utilizing nonlinear optical devices, with a specific focus on Semiconductor Optical Amplifiers (SOA). Objectives include a theoretical analysis and extensive simulations to understand the impact of system hyperparameters on performance and memory depth, and experimental validation to assess real-world performance. The project also intends to optimize the system for optical weighting for the readout layer, aiming at all-optical signal processing for channel equalization in telecom systems.

Expected Results: Experimental demonstration of new optical reservoir computing and extreme learning machine designs using SOA and other photonic nonlinear devices. Realization of all-optical channel equalization utilizing SOA-based reservoir computing.

Salary

The successful candidates will be employed on a full-time basis with a competitive salary in accordance with the MSCA regulations for Doctoral Candidates and the personal circumstances of the applicant. The successful candidate will receive a generous financial package consisting of the MSCA living allowance and a mobility allowance, eligible candidates with family will also receive an additional family allowance according to the rules of the MSCA. Social security, pension contributions and a PhD fee waiver are included in this package.

Main Duties/Responsibilities

For position 1:

- **To design, develop and implement new advanced neural network methodologies** tailored for photonic hardware, explicitly accounting for device variability, process variations, and intrinsic noise.
- **To design, optimize, and compare** the Bayesian and KAN photonic neural networks against conventional photonic NN approaches in terms of processing speed, inference accuracy, and energy consumption.
- **To investigate and mitigate noise** through Bayesian techniques and to juxtapose these approaches with alternative noise-mitigation strategies (e.g., ghost neurons, pooling of neuron populations).
- **To carry out theoretical, numerical, and experimental validations** of the developed Bayesian and KAN photonic NNs, ensuring robustness and reliability for resource-demanding applications.
- **To disseminate results** through publications in high-impact journals and major international conferences.
- **To contribute to project reports** and collaborate with project partners to ensure timely delivery of milestones.
- **To engage in training and professional development** aligned with personal goals and the strategic objectives of the institute.
- **To support the development of further research proposals** and undertake any other relevant duties as may be reasonably requested by the supervisor(s).

For position 2:

- **To investigate and design new optical reservoir computing** and extreme learning machine **architectures** leveraging nonlinear optical devices, with a focus on semiconductor optical amplifiers.
- **To conduct theoretical analyses and extensive simulations** to study the impact of system hyperparameters on performance and memory depth.
- **To experimentally validate and benchmark** the proposed reservoir computing and extreme learning machine schemes, assessing their real-world performance and robustness.
- **To optimize and implement all-optical weighting** of the readout layer, targeting all-optical channel equalization in telecom systems.
- **To contribute to high-impact publications** and major international conferences with research outcomes.
- **To collaborate on project reports** and coordinate with partners in meeting the project objectives and timelines.
- **To engage in professional development** and relevant training aligned with personal career growth and institutional goals.
- **To support further funding initiatives** and undertake additional duties as requested by the supervisor(s).

POSTDIGITAL Plus is looking for candidates with **exceptional skills and grades** in engineering or physics and/or computer science and/or signal processing, with the strong and proven knowledge of machine learning and/or some expertise in the areas related to optics / photonics, communications or electrical engineering. Preferred skill requirements include experience in scientific programming and computing, signal processing, communications and information theory, statistical analysis, optical communication systems. Knowledge of linear algebra, mathematical physics, and numerical analysis are an asset. The candidate will have a strong drive to carry out the cutting-edge research for a doctoral degree.

Applicants holding a Master of Science degree (or expected to be awarded one soon) in Electrical Engineering, Physics, Applied Mathematics, Computer/Data Science, or equivalent, are especially encouraged to apply.

For informal enquiries about this project and other opportunities within the AIPT, contact. Prof. Sergei Turitsyn by email: s.k.turitsyn@aston.ac.uk

The successful applicant is expected to register for a PhD at Aston University and therefore will have to comply with minimum PhD Entry Requirements to be found in the section “Entry Requirements” detailed here.

Additional responsibilities

- Engage in continuous personal and professional development in line with the demands of the role, including undertaking relevant training and development activities.
- Ensure and promote the personal health, safety and wellbeing of staff and students.
- Carry out duties in a way which promotes fairness in all matters and which engenders trust.
- Promote equality of opportunity and support diversity and inclusion as well as working to support the University’s environmental sustainability agenda and practices.

Person specification

	Essential	Method of assessment
Education and qualifications	BSc or MSc qualification in Computer/Data Science, Communications, Electrical Engineering, Physics, Applied Mathematics, or equivalent.	Application form and interview
Experience	Experience in theoretical and/or experimental work, knowledge of scientific programming and computing, particularly in the context of application to machine learning (Python, Tensorflow, etc.) and photonics.	Application form and interview
Aptitude and skills	English Language: Minimum requirements can be found in the section “English Language Entry Requirements” detailed here Comply with MSCA eligibility and mobility criteria as listed below.	Application form and interview

MSCA Eligibility and Mobility rules:

Applicants must be doctoral Candidates and **not** have been awarded a doctoral degree. Researchers who have successfully defended their doctoral thesis, but who have not yet formally been awarded the doctoral degree are not considered eligible.

Researchers may **not** have resided or carried out their main activity (work, studies, etc.) in the UK for more than 12 months in the 3 years immediately before the first day of POST-DIGITAL Plus employment. Short stays, such as holidays, are not taken into account.

Compliance with these rules will need to be demonstrated at a later stage of the application process.

University values

All staff are expected to demonstrate/promote the University's values and expectations, which are an integral part of our strategy and underpin the culture of the University. In addition, our leaders are expected to be accountable, help to execute strategic visions of the University and share and set clear expectations that inspire those around them.

How to apply

You can apply for this role online via our website https://www2.aston.ac.uk/staff-public/hr/jobs.

Applications should be submitted by 23.59 on the advertised closing date.
All applicants must complete an application form, along with your CV.

Any CV sent direct to the Recruitment Team and Recruiting Manager will not be accepted.

If you require a manual application form, then please contact the Recruitment Team via recruitment@aston.ac.uk.

Contact information

Enquiries about the vacancy:

Name: Prof. Sergei Turitsyn
Job Title: Professor
Email: s.k.turitsyn@aston.ac.uk

Enquiries about the application process, shortlisting or interviews:
Recruitment Team via recruitment@aston.ac.uk or 0121 204 4500.

Additional information

Visit our website https://www2.aston.ac.uk/staff-public/hr for full details of our salary scales and benefits Aston University staff enjoy.

Salary scales: https://www2.aston.ac.uk/staff-public/hr/payroll-and-pensions/salary-scales/index

Benefits: Benefits and Rewards | Aston University

Working in Birmingham: https://www2.aston.ac.uk/birmingham

Employment of Ex-Offenders: Under the Rehabilitation of Offenders Act 1974, a person with a criminal record is not required to disclose any spent convictions unless the positions they applying for is listed an exception under the act.

Eligibility to work in the UK: You should ensure that you meet the eligibility requirements, including meeting the English language standards. If you do not meet the eligibility criteria, any application for a work visa would be unsuccessful. Please see UKVI guidance for further information on eligibility, knowledge of English requirements and approved test centres https://www.gov.uk/tier-2-general

With the end of free movement for EU/EEA/Swiss nationals from 1 January 2021, the UK's new immigration system applies to all non-UK/Irish nationals who require a visa.

Where an individual is subject to UK immigration control, they will require a visa to work in the UK.

The following individuals do not need a visa for the UK, but do still have to prove their right to work before employment can commence:

- **British Citizens or Irish Nationals**
- **EU/EEA/Swiss nationals with Settled or Pre-settled status under the EU Settlement Scheme**
- **Non-EEA nationals with Indefinite Leave to Remain/Settlement in the UK**

The main routes available for those who need a visa to work in the UK are **Skilled Worker**, **Global Talent** and the **Graduate Route**.

You can find further information about each of these visa routes on our candidate immigration page.

If you will conduct research in your role, you may need to apply for and obtain ATAS clearance before Aston can issue a Certificate of Sponsorship for your visa application. Please see below for further details.

Academic Technology Approval Scheme (ATAS):
If you will conduct research in your role and you apply for a Skilled Worker or Temporary

Worker GAE visa, you may need to apply for and obtain ATAS clearance before Aston can issue a Certificate of Sponsorship for your visa application.

This process can take at least 6 weeks to process, and Aston will consider this when confirming your expected start date. Processing times will increase between April and September and can longer to complete.

There is no fast-track option available. ATAS certificates will be processed in order of receipt.

You can find more information about ATAS on our candidate immigration page.

Before you start and Right to Work

90-day entry vignette

If you have applied for your visa outside of the UK, you will receive a vignette in your passport which is usually valid for 90 days. Please make sure to travel to the UK within the 'valid from' and 'valid to' dates on this visa. If you entered the UK before or after these dates, you would not 'activate' the visa and you would need to leave and re-enter the country.

You will also receive a decision letter confirming details about your immigration permission and where to collect your Biometric Residence Permit.

Cost of Living - Estate and Letting Agents

There are numerous Estate and Letting Agents in and around Birmingham that can help you find suitable accommodation. The Midland Landlord Accreditation Scheme provides a list of professional agencies and landlords who have applied with them for accreditation. Whilst accreditation is not a guarantee of quality, it provides some reassurance about the standard of the service they provide.

You can also use property search websites such as Rightmove or Zoopla.

Equal Opportunities

Aston University promotes equality and diversity in all aspects of its work. We aim to ensure, through our admissions policies for students, and our staff recruitment and selection processes that we encourage applications from all groups represented in the wider community at a local, national and international level.

The University will endeavour not to discriminate unfairly or illegally, directly or indirectly, against student or potential students, staff or potential staff. This commitment applies to all functions of the University and to any stage of an individual's career.

An Equal Opportunities Monitoring Form is included within the application form. Data you provide on the Equal Opportunities Monitoring Form will be included in a general database, for statistical monitoring purposes, enabling the University to monitor the effectiveness of its Policy, Codes of Practice and Guidelines on Equal Opportunities in Employment. Individuals will not be identified by name.

Data Protection

Your personal data will be processed in compliance with the Data Protection Act 2018 and the General Data Protection Regulation ((EU) 2016/679) ("GDPR"). The University's Data Protection Policy and Privacy Notices, including the Job Applicant Privacy Notice can be found at https://www2.aston.ac.uk/data-protection. Your application will only be used to inform the selection process, unless you are successful, in which case it will form the basis of your personal record with the University which will be stored in manual and/or electronic files. Information in statistical form on present and former employees is given to appropriate outside bodies.

Full details of our terms and conditions of service and associated policies and procedures are available online at https://www2.aston.ac.uk/staff-public/hr/policies

Aston University
Birmingham
B4 7ET, UK.
+44 (0)121 204 3000

www.aston.ac.uk