

Research Role Profile

Job Title:	Research Engineer
Responsible to:	Head of research group, or principal investigator
Responsible for:	Responsibility for staff within own research group

Job Summary and Purpose
To plan, deliver and develop research in accordance with the specified research project

Main Responsibilities/Activities
<p>To contribute to the development of the research of the Faculty, by planning and carrying out research activity within a specified area, often in collaboration with colleagues.</p> <p>To take a significant role in planning, co-ordinating and implementing research programmes and, where appropriate, commercial and consultancy activities. To take lead responsibility for a small research project or identified parts of a large project. To make decisions about research programmes and methodologies, often in collaboration with colleagues, and to resolve the problems of meeting research objectives and deadlines.</p> <p>To develop new concepts and ideas to extend intellectual understanding. Assess, interpret and evaluate the outcomes of research, and develop ideas for the application of research outcomes.</p> <p>Lead and collaborate with the research project team across multiple University and industry partners on joint research challenges and integration to develop new tools and technologies.</p> <p>Pursue and advocate responsible and open research and innovation to ensure ethical, fair and inclusive advances in science, technology and use of data.</p> <p>Continually update knowledge and develop skills. To extend, transform and apply knowledge acquired from scholarship to research and appropriate external activities.</p> <p>To carry out management and administrative tasks associated with specified research funding, including managing and developing staff within their projects; risk assessment of project activities; organisation of project meetings and documentation; management of resources, preparation of annual reports, and monitoring of research budgets. To oversee and implement procedures to ensure accurate and timely reporting and financial control.</p> <p>To undertake liaison with external organisations including equipment manufacturers, steering committees, associated academic facilities and commercial users.</p>

Person Specification
<p>The post holder must have:</p> <p>Master's degree in electronic engineering, computer science or a related subject, or equivalent professional experience</p>

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Relationships and Contacts

The post holder will have a key responsibility to the principal investigator, and contribute to reporting and liaison with external funding bodies, industry partners or sponsors.

Special Requirements

To be available to participate in fieldwork as required by the specified research project.

All staff are expected to:

- Positively support equality of opportunity and equity of treatment to colleagues and students in accordance with the University of Surrey Equal Opportunities policy.
- Help maintain a safe working environment by:
 - Attending training in Health and Safety requirements as necessary, both on appointment and as changes in duties and techniques demand
 - Following local codes of safe working practices and the University of Surrey Health and Safety Policy
- Undertake such other duties within the scope of the post as may be requested by your Manager.

Addendum to Role Profile

Job Title:	Research Engineer in Computer Vision and Audio-Visual AI (Research Engineer)
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Job Summary and Purpose:

This information sheet should be read in conjunction with the accompanying generic Research Engineer Role Profile and will be used for shortlisting processes. More specifically the post holder will be expected to:

Contribute to the EPSRC Prosperity Partnership in Future Personalised Object-Based Media Experiences led by the University of Surrey with the BBC and Lancaster University.

- (i) Develop novel methods for automatic understanding and reconstruction of real-world audio-visual scenes for transformation of video to audio-visual objects.
- (ii) Develop methods to advance computer vision, audio analysis, machine learning and audio-visual AI for object-based audio-visual content capture, representation and neural rendering.
- (iii) Pro-actively engage with responsible and open research to ensure ethical, fair and inclusive design of computer vision, audio and AI technologies for personalised media experiences.

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- (iv) Initiate, plan and lead collaboration with other staff on the project to develop pilot and proof-of-concept systems for object-based capture, representation and neural rendering of personalised media experiences.
- (v) Design and plan the development of tools and technologies to support object-based production of personalised experiences and support their use in production with industry partners and collaborators.
- (vi) Collaborate with other partnership researchers and creative professionals on the research, production and user evaluation of personalised media experiences.
- (vii) Work with other researchers on the partnership to develop research software libraries and systems to facilitate reproducible research and public engagement.
- (viii) Publish and present research in high-quality international journals and conferences.
- (ix) Onsite collaboration with project partners as required to conduct research and integrate tools and technologies for personalised object-based media capture, production and delivery.
- (x) Contribute to participative research engagement events and activities with stakeholders.
- (xi) Meet on a weekly basis with partnership staff, contribute to partnership meetings and present results at other sites as required.
- (xii) Pro-actively organise and manage your own time and research-related activities.
- (xiii) Report orally and prepare papers reporting progress and delivery of project outcomes, and be able to communicate at both technical and high-level for example with project research partners.
- (xiv) Perform any other duties associated with the project, as deemed appropriate to the grade by the Principal Investigator.
- (xv) Promote the research and activities of the partnership and the Centre for Vision, Speech and Signal Processing (CVSSP) in national and international forums.

Main Responsibilities/Activities

- Undertake research and development in computer vision, audio analysis, audio-visual AI of video to object-based representations.
- Lead the design, development and evaluation of deep learning approaches to automated audio-visual understanding of real-world dynamic scenes.
- Meet on a weekly basis on campus with CVSSP staff.
- Attend project meetings and present results at other sites as required.
- Lead collaboration with partners in design and development of tools, production, user-testing and evaluation of technologies for personalised object-based media experiences.
- Give oral and written reports on project progress and outcomes. Report at both a technical low-level and conceptual high-level to a range of audiences including the public and industry.
- Lead the organisation, take part and deliver demonstrations of project progress and outcomes to a range of different audiences at events in-person and online
- Lead and pro-actively engage with open, responsible and inclusive AI research and data.
- Continually update knowledge and develop skills.
- Carry out routine administrative tasks associated with a specified research project, for example risk assessment of research tasks, organisation of project meetings and documentation. This will entail planning own day-to-day research activity within the framework of the agreed programme, dealing with problems that may affect achievement of research objectives and implementing procedures to ensure accurate and timely delivery.

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The post holder must have:

- Masters degree in computer vision, audio, machine learning or a related subject
- Track-record of publication in academic forums in computer vision, audio and/or machine learning
- Experience in software development in topics such as computer vision, audio signal processing, machine learning, deep learning, and/or sensor systems.
- Experience of collaboration and technology transfer to partners outside academia.
- Ability to work independently or in a team, excellent organisation and time management.
- Excellent writing and communication for varying levels of technical/non-technical audience.

The post holder would ideally have:

- Skills and experience of development using languages such as Python and C++ with relevant computer vision, signal processing, machine learning and/or deep learning tools (TensorFlow, PyTorch, Keras, OpenCV etc.).
- Experience in securing funding for research in computer vision, audio or machine learning
- A track record of publishing academic papers, open-source software tools and/or datasets.

Relationships and Contacts

Direct responsibility to Principal Investigator Prof Adrian Hilton and Prosperity Partnership Research Stream Leaders. Informal enquiries are welcome and should be directed to Prof Adrian Hilton a.hilton@surrey.ac.uk

Additional Background Information

This post is part of an **EPSRC Prosperity Partnership “Future Personalised Object-Based Media Experiences Delivered at Scale Anywhere”**, led by Prof Adrian Hilton in the Centre for Vision, Speech and Signal Processing (CVSSP), University of Surrey, with the BBC and Lancaster University.

The goal of the EPSRC Prosperity Partnership is to realise a transformation to future personalised content creation and delivery at scale for the public a home or on the move.

Personalised media experiences have the potential to transform the way content is created and consumed. Our research will address the key challenges for personalised content creation and delivery at scale using AI and Object-Based Media (OBM). The ambition is to enable media experiences which adapt to individual preferences, accessibility requirements, devices and location. The partnership builds on the BBC’s pioneering work in OBM and its ability to run large-scale trials with its audience and programme content. University of Surrey’s expertise in audio-visual AI for machine understanding of captured content will allow efficient creation of personalised OBM experiences. Lancaster University’s expertise in software-defined networking will develop adaptive systems for delivery of personalised experiences to millions of people whilst maintaining cost and energy efficiency (see further details below).

The postholder will be responsible for leading research in computer vision, audio and audio-visual AI software to understand and transform video of real-world dynamic scenes to object-based representations allowing production and rendering of audio-visual content for personalised media experiences at scale. The postholder will design and develop novel algorithms and software to be used for production of personalised object-based media

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experiences. The postholder will be based in CVSSP and work under the direction of Prof Adrian Hilton (Principal Investigator) and the Research Stream Leads (Co-Investigators).

Centre for Vision Speech and Signal Processing (CVSSP) at the University of Surrey

The Centre for Vision, Speech and Signal Processing (CVSSP), part of the Department of Electronic and Electrical Engineering at the University of Surrey, is an International Centre of Excellence for research in Audio-Visual AI and Machine Perception, with 180 researchers, a grant portfolio of £30M (£21M EPSRC) from EPSRC, EU, InnovateUK, charity and industry, and a turnover of £7M/annum. The Centre is internationally unique in bringing together expertise in both audio and visual machine perception, with the central goal of creating machines that can see and hear to understand the world around them. The Centre has state-of-the-art multi-camera UltraHD visual and spatial audio capture and analysis facilities supporting research in real-time audio-visual processing and visualisation. CVSSP has an AI compute facility with 240GPUs for deep learning and >1PB of high-speed secure storage. National standing is evidenced by sustained EPSRC investment, including two Programme Grants (2013-19, 2015-21), Prosperity Partnership(2021-25), Digital Economy Centre DECade (2020-25), three Platform Grants in Audio-Visual Research (2003-08, 2008-14, 2017-22), and as a lead partner of the BBC Data Science and Audio Research partnerships. The centre has an outstanding track record of pioneering research leading to successful technology transfer with UK industry and spin-out companies. CVSSP also leads the AI@Surrey interdisciplinary network of over 300 research in AI and machine learning across the University of Surrey.

Prosperity Partnership Summary: Future Personalised Media Experiences

Personalisation of media experiences for the individual is vital for audience engagement of young and old, allowing more meaningful encounters tailored to their interest, making them part of the story, and increasing accessibility. The goal of the BBC Prosperity Partnership is to realise a transformation to future personalised content creation and delivery at scale for the public at home or on the move.

Evolution of mass-media audio-visual 'broadcast' content is moving to Internet delivery; this creates exciting potential for hyper-personalised media experiences delivered at scale to mass audiences. This radical new user-centred approach has the potential to disrupt the media landscape by directly engaging individuals at the centre of their experience, rather than predefining the content as with existing fixed 'one-size-fits-all' media formats (radio, TV, film). This will allow a new form of user-centred media experience which dynamically adapts to the individual, their location, the media content and producer storytelling intent, together with the user device and network compute resources available for rendering personalised content. The BBC Prosperity Partnership will position the BBC at the forefront of this 'Personalised Media' revolution enabling the creation and delivery of new services and positioning the UK creative industry to lead future personalised media creation and intelligent network distribution to render personalised experiences for everyone anywhere. Leading this advance beyond fixed media to personalisation is critical for the future of the BBC and the UK creative industry, opening new horizontal markets.

Realisation of personalised experiences at scale presents three fundamental research challenges: capture of object-based representations of the content to enable dynamic adaptation for personalisation at the point of rendering; production to create personalised experiences which enhance the perceived quality of experience for each user; and delivery at scale with intelligent utilisation of the available network, edge and device resources for mass audiences. The BBC Prosperity Partnership will address the major technical and creative challenges to delivering user centred personalised audience experiences at scale.

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Advances in audio-visual AI for machine understanding of captured content will enable the automatic transformation of captured 2D video streams to an object-based media (OBM) representation. OBM will allow adaptation for efficient production, delivery and personalisation of the media experience whilst maintaining the perceived quality of the captured audio-visual content. To deliver personalised experiences to audiences of millions requires transformation of media processing and distribution architectures into a distributed low-latency computation platform for flexible deployment of OBM and compute intensive tasks across the network. This will achieve efficiency in terms of cost, time and energy use, while providing optimal quality of experience for the audience within the system constraints.

Personalisation is expected to be the primary driver for growth in the \$2.3tn global media industry over the next decade. The UK media industry is worth over £100billion annually to the UK economy (6% GVA) and employs over 3.2million people. Personalised media has the potential to provide a significant boost to the UK's media industry and is projected to drive growth by £2billion/annum by 2030 with 100k additional jobs. This partnership aims to position the UK media industry as the global leader in delivering personalised media experiences to audiences across the globe.

Example Use Cases to drive research which will deliver business impact and demonstrate the potential of personalised media to renew the BBC mission of Public Service for ALL include:

News/Documentary - Individuals consume news according to personal interest, location, activity, device, language and time availability. Personalisation will dynamically adapt the content and rendering to the individual to intelligently prioritise information to their requirements. This will provide future news services tailored to the individual from a trusted source maintaining the integrity of the BBC whilst adapting to individual audience preferences. Mass-user trusted personalisation requires network services at scale to intelligently prioritise and render content for the individual.

Drama - User-centred personalisation of TV and radio drama aims to enhance the storytelling experience to engage the individual. Prioritisation based on the narrative importance of the audio and visual cues together with accessibility of the content (i.e. intelligibility of speech according to individual hearing requirements, spatial layout/contrast of visual cues for understanding the story). Requirements may change dynamically according to the individual, device, location, and activity. Dynamic rendering of OBM at scale will maximise individual engagement in the story.

Education - Intelligent personalisation of content tailored to individual understanding, interest, learning style and pace will support improved educational experiences in the classroom and at home. Collaboration with BBC Education will create and evaluate personalised interactive educational experiences using OBM to adapt according to individual learning requirements for each topic.

Live Events (Sports and Music) - Creating the sense of 'being there' at a live sports or music event is the ultimate goal of personalised immersive content production. The potential for future network media to transform a live event into objects and dynamically render personalised content for individual audience members is a key enabler for future immersive experiences of live events. OBM will enable user-centred rendering to maximise the sense of immersion. Achieving this at scale requires intelligent utilisation of network/device compute and transmission resources to transform the raw video to objects and dynamically adapt the rendering for individual users and their devices.

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Other use cases of interest include: **Multiplayer interaction at live events**; and **Legacy content**

Project partners

BBC; Lancaster University; AudioScenic; BT; Charisma AI; Dimension Studios; Fgment Productions; Foundry; Framestore; Imagination Technologies; Imagineer; Intel; Mirriad; NetworkMedia; SalsaSound; Sony; Synthesia; Telefonica.