ISRC-CN$^3$



## Ulster University

## Intelligent Systems Research Centre

# Computational Neuroscience, Neurotechnology and Neuro-inspired Artificial Intelligence (ISRC–CN$^3$ )

### Summer School

***26 - 30 August 2024***

# Background

There have been rapid advancements and investments in research and development in brain sciences, neurotechnology, neural data modelling and neuro-inspired artificial intelligence (AI). These advancements have not only led to deeper understanding of brain functions and disorders, but also the development and application of powerful AI and machine-learning algorithms that affect our everyday life. In fact, historically, AI was inspired by how intelligence arises from the brain.

The Computational Neuroscience, Neurotechnology and Neuro-inspired AI (CN3) Summer School (https://www.ulster.ac.uk/faculties/computing-engineering-and-the-built-environment/computing-engineering-intelligent-systems/isrc-cn3-summer-school) aims to train the next generation of researchers on these state-of-the-art developments. This short course will touch on the areas of computational neuroscience, neural data science and signal processing, neurotechnology and neuro-inspired AI. The School is unique in that important and timely topics either not delivered in other Schools or taught courses, or delivered only individually, will be delivered here in an integrated way, from pedagogical to advanced levels. These topics include computational modelling of neural-glial systems, neuromodulators, cognition, neurotechnology, self-repaired intelligent machines, lifelong learning and large language models. Mathematical foundations, coding exercises, ethics and entrepreneurship will also be covered. Moreover, although neural computation and neuro-inspired AI research are conducted in the island of Ireland, there is very little relevant training and taught courses, especially for early career researchers, in the region; this School aims to bridge this gap.

On this note, the organising committee warmly welcome you for attending the Summer School!

# ISRC-CN$^3$ Summer School

The Summer School will be held at the Intelligent Systems Research Centre (ISRC: https://www.ulster.ac.uk/research/topic/computer-science/intelligent-systems-research-centre), a major research unit within the School of Computing, Engineering and Intelligent Systems at Ulster University in Derry ∼ Londonderry, Northern Ireland. This is the fourth ISRC-CN$^3$ Summer School. The ISRC is dedicated to developing a bio-inspired computational basis for AI to power future cognitive technologies. This is achieved through understanding how the brain works at multiple levels, from cells to cognition and apply that understanding to create models and technologies that solve complex issues that face people and society. To accomplish this, a variety of research strategies and applications is used, including big data and machine learning, brain imaging and neural interfacing, human-computer interaction and neuromorphic computing.

The ISRC is housed in a large, purpose-built facility, with state-of-the-art resources, including neuroimaging, neurotechnology and robotic facilities, and high-performance computing (HPC) facility for big data analytics and large-scale computational simulations. There will be a tour of labs for in-person attendees. The ISRC is multidisciplinary, with arguably the largest cluster of computational neuroscientists and neuro-inspired AI researchers in the island of Ireland, with strong collaborations with many clinical, biomedical, neuroscience, AI and mental health centres, and industrial partners, allowing its research output to quickly translate into applications.

Academic researchers at the ISRC and invited external speakers will contribute to the delivery of this 5-day School, which consists of lectures, mini-projects and labs. Labs will consist of modelling and analysing data related to the lectures, resulting in 'mini' student projects to consolidate the lectures' content and encourage active and creative participation. Attendees will have the opportunity to present and share their research work on the final day, and awards will be given to the top presenters. Class materials will be made available in advance of the event. Required software (Python and MATLAB) should be downloaded and configured before the event. Foundational

topics in mathematical techniques and computer programming will be provided.

## Summer School Structure

This booklet and pre-school materials, including mathematical and programming notes, have been made available in advance of the event for attendees to review (GitHub links will be sent by separate e-mail).

Required software (Python and MATLAB) can be downloaded and configured before the event.

Web links to attend the lecture and lab sessions will be sent to all applicants closer to the dates of the summer school. Hence, please check your email regularly. Information on joining the guest wi-fi accounts will be provided on Day 1 for online access to materials while on-campus.

Unless mentioned for a last-minute change, the location of lecture room will be in the rooms MU301 and MU302 within the MU building. Computer lab sessions will be held in MG122 (MG building) at Magee campus. Directions to these locations will be sent to all applicants closer to the date of the event.

Online attendees are themselves responsible for the access of reliable internet. When not speaking online, please remember to turn off the microphone and video camera to avoid echo effects and hanging up during video streaming. During the end of the lecture/talk, for questions and answers, you may turn on your microphone and video camera to ask questions or speak to the lecturer/speaker. You can also ask through the chat platform. During lab sessions, you can ask Tutors questions throughout the lab session either verbally or through chat. But please be mindful that we have limited Tutors per lab session. Both lecture sessions and lab sessions will be recorded for attendees' viewing.

Towards the end of the Summer School, feedback from attendees will be requested. Anonymity of feedback is optional. This will be used in reviews and reporting, and for improving future versions of the Summer School. Certificate of participation can be requested upon completion of the Summer School.

***Lectures:***

Lectures, including external speakers, will be delivered during the day, from about 9am to 5pm, with several breaks within this period. Each day of lectures will be categorised based on general themes.

Day 1 lectures will be on general topics such as introductory neuroscience, introductory cognitive neuroscience, mathematical techniques and programming.

Day 2 will be focused on modelling biological neurons and neuronal networks, neuron-glial systems, and neuroscience-based theories of cognition e.g. decision-making and learning.

Day 3 will discuss topics on lifelong learning, neural signal processing and data science, neuroimaging and neurotechnology.

Day 4 will be focused on neuro-inspired artificial intelligence algorithms, especially spiking neural networks, application of AI in neuro-rehabilitation and medicine, neuromorphic computing and their applications.

On Day 5, attendees will commence by presenting their micro-talks (approximately 10 minutes each) on their individual projects, and awards will be bestowed for the top presentations. Details anmd requirements of the project submission will be sent out soon. The day will also encompass research translation and entrepreneurship through industry talks.

Attendees are encouraged to attend as many of the lectures as possible, as the content of the presentations may be built on that of previous presentations. Lectures will be delivered both physically and online (live streaming). Physical lectures will be broadcast live to those attending the fully online version. Those attending online may ask questions via their own computer's video camera, microphone or type in the chat box in the web link. Lectures will be recorded to allow those who were unable to attend (e.g. due to different time zones, work-related or other personal responsibilities) or for revisits. We will provide the video clips' information on our GitHub link (see below).

***Lecture Room:***

- **Room MU301 and MU302 - MU Building**

***Labs:***

Each computer lab session aims to consolidate and reinforce the topics delivered during the lectures of that day. Lab sessions will take place in room MG122 from 5:30 PM and they will be led by Tutors. These sessions will consist of 'mini' project-like assignments that involve computational modelling and data analysis. Attendees are highly encouraged to explore additional aspects, and their findings may be presented during the project pitches on the final day.

Computer labs will be conducted in Python and MATLAB. If MATLAB is not available, students joining online can download MATLAB's 30-day free trial version or MATLAB's online version (https://uk.mathworks.com/products/matlab-online.html). Codes will be provided by the Tutors and available on GitHub (see below). Data will be provided when needed. See Day 1 lab notes (provided in advance) for further details. We recommend attendees, especially online attendees, to download the relevant software to their own personal computer before the Summer School. Attendees with limited mathematics and computer programming experience should check out the prepared mathematical notes or other sources such as https://www.datacamp.com/ before the Summer School.

Attendees are recommended to attend as many of these lab sessions as possible. Labs will be delivered physically and broadcast online live. It will also be recorded. Those who are attending physically will be able to access our computer lab's machines and other computing facilities. Guest accounts will be provided for in-person attendees.

Physical lab sessions will be broadcast live to those attending online. Those who are attending online will be able to join live via Blackboard Learn and may ask questions via their own computer's videocam, microphone or type in the chat box of Blackboard

Learn. Online attendees can also use Slack (see the link below) to for questions and discussions after the talks.

Lab sessions will be partially recorded (especially at the beginning and during demonstrations) to allow those who were unable to attend (e.g. due to time zone differences, work-related or other personal responsibilities) or for revisits. We will provide the video clips' information on our GitHub link (see below).

***Computer Lab:***

- Room MG122 - MG Building

***ISRC-CN$^3$ GitHub link:***

Notes, codes, datasets and video clips will be made available at our ISRC-CN$^3$ GitHub link https://github.com/ISRC-CN3 .

For those who are not familiar with computer programming or mathematics, it is advisable that they read, refresh or practise the provided materials (see Day 1 and References in GitHub) prior to the start of the Summer School.

***Project pitches:***

On the final day (30th August, Friday), attendees will have the opportunity to present their group projects. Awards will be given to the best project.

***Reimbursements, claims and refunds:***

If you are seeking (e.g. travel) reimbursements and claims, or refunds, please remember to save hard copies of your receipts. Then contact Elaine Duffy (see below) for a claim form to be filled.

Please note that in-person attendees who are attending only for a few days will still be paying the full fee.

***Food and social activities:***

Lunch and coffee/tea will be provided every day. On Day 1 (26th August), a city walking tour (social activities) will be provided. On Day 4 (29th August), a formal dinner will be provided at the nearby Bishop's Gate Hotel in the city centre.

In-person and online participants will be invited to join the ISRC-CN$^3$ Slack (https://join.slack.com/t/isrccn32024/shared_invite/zt-2ohou3y42-BzpMftB~hW7GIMTzyAspDQ) to interact and network with fellow attendees and lecturers/speakers. In-person attendees may use the Slack platform for planning share accommodation.

***Certification:***

Certificate of Attendance will be emailed to attendees after the end of the Summer School.

***Organising committee and contacts:***

- Dr. Saugat Bhattacharyya (Chair) (s.bhattacharyya@ulster.ac.uk)
- Dr. Cian O'Donnell (Co-chair) (c.odonnell2@ulster.ac.uk)
- Prof. Liam McDaid (Scientific) (lj.mcdaid@ulster.ac.uk)
- Prof. KongFatt Wong-Lin (Scientific) (k.wong-lin@ulster.ac.uk)
- Dr. Muskaan Singh (Scientific) (m.singh@ulster.ac.uk)
- Louise Gallagher (Secretary, Treasurer) (l.gallagher@ulster.ac.uk)
- Michelle Stewart (Secretary) (m.stewart@ulster.ac.uk)
- Elaine Duffy (Secretary) (e.duffy@ulster.ac.uk)
- Gerarld Hasson (Secretary) (g.hasson@ulster.ac.uk)
- Cheryl Mullan (Secretary) (c.mullan@ulster.ac.uk)
- Eoghan Tucker (Secretary) (e.tucker@ulster.ac.uk)
- Abdoreza Asadpour (a.asadpour@ulster.ac.uk)

***ISRC-CN$^3$ logo design:***

- Niall McShane
- KongFatt Wong-Lin

***Web design and development:***

- Dorothy Mcllroy
- Cheryl Mullan
- Mark Millar
- Roger James
- Saugat Bhattacharyya

***IT Support***

- Chrisotpher Hasson
- Chris O'Connell

## Lecturers and speakers:

- Prof. Madeleine Lowery (University College Dublin)
- Dr. Daniela Tropea (Trinity College Dublin)
- Dr. Barry Dillon (ISRC, Ulster University)
- Dr. Athena Akrami (Sainsbury Wellcome Centre, University College London)
- Dr. Cian O'Donnell (ISRC, Ulster University)
- Dr. Marinus Toman (ISRC, Ulster University)
- Prof. KongFatt Wong-Lin (ISRC, Ulster University)
- Dr. Shirin Dora (Loughborough University)
- Dr. Saugat Bhattacharyya (ISRC, Ulster University)
- Dr. Javier Minguez (University of Zaragoza)
- Prof. Damien Coyle (University of Bath & ISRC, Ulster University)
- Prof. Nikola Kasabov (Auckland University of Technology)
- Prof. Girijesh Prasad (ISRC, Ulster University)
- Dr. Chiara Bartolozzi (Italian Institute of Technology)
- Prof. KC Santosh (University of South Dakota)
- Slobodan Tanackovic (g.tec medical engineering GmbH)

*See web links and later in the document for profiles.*

## Tutors (ISRC, Ulster University):

- Day 1 - Dr. Amin Azimi & Dr. Sahil Sharma
- Day 2 - Dr. Oleg Senkevich & Brendan Lenfesty
- Day 3 - Dr. Abdoreza Asadpour & Kaniska Samanta
- Day 4 - Senhui Qiu & Ravi Jha

*See later in the document for profiles.*

## DAY 1 (26TH AUGUST 2024, MONDAY)

**Morning Session**

| | |
|---|---|
| 08:30 - 09:00 | Registration, Welcome package and information at MU building's lobby |
| 09:00 - 09:10 | Welcome – *Saugat Bhattacharyya (Organiser)* |
| 09:10 - 09:30 | Opening address – *Professor Liam Maguire (Pro-Vice Chancellor, Ulster University)* |
| 09:30 - 10:30 | Keynote – *Prof. Madeleine Lowery* |
| 10:45 - 12:45 | Introduction to Neuroscience – *Dr. Daniela Tropea* |

**Afternoon Session**

| | |
|---|---|
| 12.45 - 13:30 | Lunch (provided at MS building) |
| 13:30 - 15:00 | Derry~Londonderry walking tour |
| 15:15 - 17:15 | Mathematics for neuroscience - *Dr. Barry Dillon* |
| 17:30 - 19:00 | Lab session 1 (at MG122) – Fundamentals of Python & MATLAB programming (notes provided in advance) – *Dr. Amin Azimi & Dr. Sahil Sharma* |

## DAY 2 (27TH AUGUST 2024, TUESDAY)

**Morning Session**

| | |
|---|---|
| 09:00 - 10:00 | Keynote – *Dr. Athena Akrami* |
| 10:00 - 11:30 | Computational modelling of plasticity and learning in brains – *Dr. Cian O'Donnell* |
| 11:30 - 12:30 | Ionostasis at the Tripartite Synapse – *Dr. Marinus Toman* |

**Afternoon Session**

| | |
|---|---|
| 12:30 - 14:30 | Lunch followed by **ISRC Lab Tour** |
| 14:30 - 16:00 | Modelling the dynamics of decision-making – *KongFatt Wong-Lin (UU)* |
| 16:15 - 17:00 | Panel Discussion |
| 17:30 - 19:00 | Lab session 2 (at MG122) – Modelling neurons, neural networks & cognition – *Dr. Oleg Senkevich & Brendan Lenfesty* |

## DAY 3 (28TH AUGUST 2024, WEDNESDAY)

**Morning Session**

| | |
|---|---|
| 09:00 - 10:30 | Introduction to Lifelong Learning – *Dr. Shirin Dora* |
| 10:45 - 12:30 | Neural Signal Processing & Connectivity Analysis – *Saugat Bhattacharyya* |

**Afternoon Session**

| | |
|---|---|
| 12:15 - 14:15 | Lunch and Networking |
| 14:15 - 15:15 | Keynote – *Dr. Javier Minguez* |
| 15:30 - 16:30 | Decoding mental imagery from electroencephalography (EEG) and applications of AI-enabled wearable neurotechnology for communication and rehabilitation – *Damien Coyle (UOB & UU)* |
| 16:30 - 17:00 | NeuroCONCISE Industry Talk – *Damien Coyle (UOB & UU)* |
| 17:30 - 19:00 | Lab session 3 (at MG122) – Neural signal processing – *Dr. Abdoreza & Kaniska Samanta* |

## DAY 4 (29TH AUGUST 2024, THURSDAY)

**Morning Session**

| | |
|---|---|
| 09:00 - 10:00 | Keynote: Brain-inspired spiking neural network models for life-long and explainable learning – *Prof. Nikola Kasabov* |
| 10:15 - 11:45 | Non-invasive brain-computer interfaces: Enhancing applicability using computational intelligence and technological advances – *Girijesh Prasad (UU)* |
| 11:45 - 13:30 | Lunch (provided at MS building) and ISRC Lab Tour (in MS building) |

**Afternoon Session**

| | |
|---|---|
| 13:30 - 15:00 | Neuro-inspired cognitive robotics & neuromorphic computing – *Dr. Chiara Bartolozzi* |
| 15:00 - 16:00 | Keynote – *Prof. KC Santosh* |
| 16:15 - 17:00 | Panel Discussion |
| 17:30 - 18:30 | Lab session 4 (at MG122) - *Senhui Qiu & Ravi Jha* |
| 19:30 - | Social activity - Banquet Dinner |

## DAY 5 (30TH AUGUST 2024, FRIDAY)

**Morning Session**

| | |
|---|---|
| 09:30 - 12:30 | Participant presentation |
| 12:30 - 14:00 | Lunch (provided at MS building) |

**Afternoon Session**

| | |
|---|---|
| 14:00 - 15:30 | Industry Talks<br>• *Dr Javier Minguez (Bitbrain Technologies)*<br>• *Slobodan Tanackovic (g.tec medical engineering GmbH)* |
| 15:30 - 16:00 | Prize-giving ceremony and closing remarks |

*See link (https://www.ulster.ac.uk/faculties/computing-engineering-and-the-built-environment/computing-engineering-intelligent-systems/isrc-cn3-summer-school) and below for synopses of lectures and talks.*

# Profiles of speakers

## Prof. Madeleine Lowery

**Bio: Madeleine Lowery** is a Professor in the School of Electrical and Electronic Engineering, University College Dublin and the Head of Subject for Biomedical Engineering at UCD. Her research focuses on the application of engineering methods to understand the human nervous system as it relates to movement, in health and disease, and to design therapies and technologies to improve impaired motor function. She leads an interdisciplinary research team at UCD in the area of Neuromuscular Systems and Neural Engineering. Her research interests include electromyography, bioelectromagnetics, myoelectric control of artificial limbs, electrical stimulation, deep brain stimulation and neural control of movement. Professor Lowery received the BE and PhD degrees from the Department of Electronic and Electrical Engineering, University College Dublin, in 1996 and 2000, respectively. Between 2000 and 2005, she was a Postdoctoral Fellow then a Research Assistant Professor at the Rehabilitation Institute of Chicago and the Department of Physical Medicine and Rehabilitation, Northwestern University, Illinois. She is the current President of the International Society of Electrophysiology and Kinesiology (ISEK) and was the Congress Chair for the 22nd ISEK Congress held in Dublin in 2018. Recognition for her work includes the 2018 Royal Academy of Medicine in Ireland Graves Medal and the Delsys International Prize for Innovation in Electromyography 2010. Professor Lowery is a Principal Investigator in the Insight Centre for Data Analytics and Funded Investigator in the CURAM Centre for Research in Medical Devices. She was awarded a Consolidator grant by the European Research Council (ERC) in 2015, an ERC Proof of Concept Grant in 2019, and is a partner in the DOMINO-HD study funded under the EU Joint Programme on Neurodegenerative Disease Research. Professor Lowery is actively involved in undergraduate and graduate teaching and curriculum development, and is Programme Director for the BE and ME Programmes in Biomedical Engineering at UCD. She is a member of the editorial board of the Journal of Physiology, IEEE Open Journal of Engineering in Medicine and Biology, the Journal of Electromyography and Kinesiology and of the executive editorial board of the Journal of Neural Engineering.

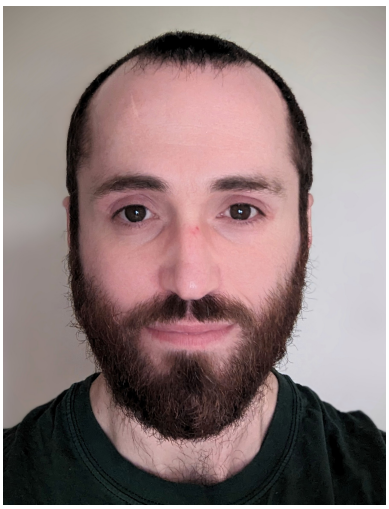
## Dr. Daniela Tropea

**Bio: Daniela Tropea** is an Associate Professor of Molecular Psychiatry at Trinity College Dublin. Her lab studies the molecular mechanisms involved in brain function and plasticity in health and disease, with a particular interest in growth factors. She was the first to study the effects of insulin-like growth factor 1 (IGF1) and its derivatives on brain plasticity and their role in the treatment of neuro-developmental disorders. One of the IGF1-related compounds, Trofinetide, was approved by the FDA in 2023 as the first treatment for Rett Syndrome. In her laboratory, she continues to explore the function of IGF1 and its derivatives in both basic research and clinical studies. She also studies biomarkers for patient stratification and functional outcomes in drug discovery.

She is a committed educator for both undergraduate and graduate studies and received the Innovation in Teaching Award in 2019 and the Mentor Award in 2022. She has been a member of the Education and Training Committee in the American College of Neuro-psychopharmacology and now serves as a mentor in the program for Underrepresented Minorities. She created the international series "Biology of Brain Disorders" (2016, 2019, 2022) and actively pursues the dissemination of science to students with disadvantaged backgrounds (Trinity Access Program) and to the general public.

**Lecture Title:** Introduction to Neuroscience

**Synopsis:** This session will provide an overview of the structure and function of the nervous system. The lecture will start with a review of the divisions of the nervous system and the main cell types, neurons and glia. An introduction to basic neuroanatomy will follow covering key external and internal structures of the brain and the main components of systems controlling movement, learning and memory, and emotional regulation. To understand neuronal processes and pathologies it is important to understand how neurons work. An overview of the action potential, the electrical signal used by neurons to carry information to their target, will be provided. Finally, the main steps involved in synaptic transmission, including the neurotransmitters responsible for chemical signalling in the nervous system, will be reviewed.



## Dr. Barry Dillon

**Bio:** In 2016, Barry completed his PhD in theoretical physics, where he studied the phenomenology of beyond the standard model physics scenarios. He then held three postdoctoral research positions at the University of Plymouth (2017-2018), Jozef Stefan Institute (2018-2020), and the University of Heidelberg (2020-2023). Since 2018, his research has focused on the application of machine-learning tools to particle physics phenomenology, particularly in the search for new physics at the Large Hadron Collider. In 2023, he worked in machine-learning research and development at AllstateNI, before taking up a position at Ulster University this year as a Lecturer in Mathematics.

**Lecture Title:** Mathematics for neuroscience - An introduction

**Synopsis:** Despite the immense complexity of the brain, mathematical modelling has allowed for major advances to be made towards understanding behaviour, consciousness and disease. Mathematical models can be used to describe processes from the level of single cell voltage dynamics, through emergent behaviour of neural networks to activity patterns in tissue level models. Underlying nearly all of these models are differential equations describing how various quantities (e.g. voltage, firing rate) change in time and space. This lecture introduces some of the mathematical tools needed to understand and analyse solutions of these models. We will see how to describe neural systems using differential equations, how model simplifications can be made whilst retaining essential features and how we can understand solutions both through simulation and using techniques from dynamical systems theory. Along the way we will review any necessary concepts from linear algebra and vector calculus.

## Dr. Athena Akrami

**Bio: Dr. Athena Akrami** grew up in Iran and obtained her BA in Biomedical Engineering from Tehran Polytechnic (Amirkabir University of Technology) in Tehran, Iran. She pursued her PhD in Computational Neuroscience at the International School for Advanced Studies (SISSA) in Trieste, Italy, with Dr. Alessandro Treves. She continued at SISSA as a postdoctoral fellow, but she switched gears towards experimental neuroscience working with Dr. Mathew Diamond. She then moved to the US to pursue another postdoctoral fellowship at Princeton University where she was a Howard Hughes Medical Institute fellow in the lab of Dr. Carlos Brody, focusing on parametric working memory. Dr. Akrami joined the faculty at Sainsbury Wellcome Centre (SWC) at University College London in UK in November 2018. Her Learning, Inference & Memory laboratory at SWC focuses on understanding the fundamental principles of statistical learning – the ability of the brain to discover and exploit relevant regularities and structures in the world in an unsupervised manner. In all her research programs, experiments are intertwined with hypotheses drawn from theoretical investigations and computational modeling. Since April 2020, Dr. Akrami has also become an accidental advocate and researcher of Long COVID, due to personal circumstances.

**Lecture Title:** Circuits and computations for learning and exploiting sensory statistics

**Synopsis:** A defining feature of animal intelligence is the ability to discover and update knowledge of statistical regularities in the sensory environment, in service of adaptive behaviour. This allows animals to build appropriate priors, in order to disambiguate noisy inputs, make predictions and act more efficiently. Despite decades of research in the field of human cognition and theoretical neuroscience, it is not known how such learning can be implemented in the brain. By combing sophisticated cognitive tasks in humans, rats, and mice, as well as neuronal measurements and perturbations in the rodent brain and computational modelling, we seek to build a multi-level description of how sensory history is utilised in inferring regularities in temporally extended tasks. In this talk, I will specifically focus on a cross-species model to study learning and exploiting statistical prior distributions in working memory and sensory discrimination behaviours.

## Dr. Cian O'Donnell

**Bio: Cian O'Donnell** did a B.Sc. in Applied Physics at Dublin City University, followed by an M.Sc. and Ph.D. in Neuroinformatics at University of Edinburgh where he studied biophysical models of electrical noise and synaptic plasticity in single neurons. He then worked for 3 years as a postdoc in the Salk Institute in La Jolla, California modelling synaptic plasticity in neural circuits, and analysing neural population activity data from mouse models of autism. From 2015-2021 he was a lecturer at the University of Bristol, then in October 2021 he joined Ulster University at Magee as a Lecturer in Data Analytics. His research group has 3 postdoctoral RAs and 6 PhD researchers, working on three topics: 1) learning and memory in the brain; 2) neural circuit dysfunction in autism; 3) statistical methods for neuroscience data. Website here: https://odonnellgroup.github.io.

**Lecture Title:** Computational modelling of plasticity and learning in brains

**Synopsis:** This lecture will introduce the basics of how we think learning works in the brain, and common computational models of synaptic plasticity at the single synapse, single neuron, and neural circuit levels. It will cover classic models of Hebbian plasticity, spike-timing-dependent plasticity, and attractor networks. Finally, we will briefly discuss modern attempts to link brain learning to backpropagation and deep learning in artificial neural networks.

## Dr. Marinus Toman

**Bio: Marinus Toman** received the B.Sc. (Hons.) degree in Cloud Computing from Letterkenny Institute of Technology, Donegal, Ireland in 2018 and the PhD degree in Computational Neuroscience as part of the Computational Neuroscience and Neuromorphic Engineering Research Team at Ulster University, Derry, Northern Ireland in 2022. His primary research interests include modelling of glial and neuronal cells in the brain to investigate how memory and learning occurs at a cellular level in the brain. His other research interests include computer science, specifically indoor positioning and localisation.

**Lecture Title:** Ionostasis at the Tripartite Synapse

**Synopsis:** Computational models of neuro-glia interactions are an important tool for researchers studying different levels of the central nervous system; from network level to single cell and sub-cellular. Astrocytes are the most abundant glial cell in the brain and in many brain regions, they come in close proximity to synapses and provide supporting roles like homeostasis. The tripartite synapse is a recent concept that acknowledges both the proximity and the important contribution of astrocytes to neuronal synapses. The tripartite synapse is currently too small a region for experimentalists to probe, therefore, computational models of the tripartite synapse can provide an insight, and possibly predictions, into the signalling dynamics between astrocytes and neurons at the point of information transfer between neurons.

During this lecture, students will learn about astrocyte homeostasis at the tripartite synapse. During the accompanying tutorial, students will learn how to construct computational models of neuro-glia interactions using systems of ordinary differential equations. For the lecture and tutorial, it is assumed students have very little prerequisite knowledge of these topics, and by the end of both sessions, students will have the knowledge and tools they can take away to start building their own computational models of neuro-glial signalling dynamics.

## KongFatt Wong-Lin

**Bio: Prof. KongFatt Wong-Lin** is based at the Intelligent Systems Research Centre, School of Computing, Engineering and Intelligent Systems, in Ulster University, UK. His research interests lie at the interface of computational modelling and mathematical analysis of systems and cognitive neuroscience, psychology, brain disorders, neural computation and engineering, AI and data science. He is Editorial Member for the Journal of Neuroscience Methods, and Associate Editor for Frontiers in Integrative Neuroscience. Before joining Ulster University, he was a research associate at Princeton University, USA, with affiliation to The Program in Applied and Computational Mathematics, Center for the Study of Brain, Mind and Behavior, and Princeton Neuroscience Institute. Prior to that, he received his Ph.D. in Physics with focus on Computational Neuroscience at Brandeis University, USA, with affiliation to the Volen National Center for Complex Systems. He received the 2011 IJCNN Best Paper Award, the 2016 Ulster University's Distinguished Research Fellowship Award, and the 2019 Ulster University Research Excellence Award. In 2017, he received the Moore Institute Visiting Research Fellowship at the National University of Ireland Galway, and in 2020, a Visiting Fellowship at the University of Oxford.

**Website:** https://www.ulster.ac.uk/staff/k-wong-lin

**Lecture Title:** Modelling the dynamics of decision-making

**Synopsis:** This lecture will first discuss neural network models that are conducive for theoretical analysis and conceptual understanding. Then examples of how different neural network dynamics can lead to different cognitive functions will be discussed. A primary focus of this lecture is on understanding the network mechanism of decision-making, and it shall be demonstrated how neural network models can be adapted to produce different decision-making behaviour.

## Shirin Dora

**Bio: Shirin Dora** is currently a Lecturer in Computer Science in the Department of Computer Science at Loughborough University. He completed his PhD from Nanyang Technological University in Singapore on the topic of developing biologically plausible learning approaches for spiking neural networks. During his PhD, he developed a keen interest in the mechanisms of perception and cognition in the brain. This led him to pursue a post-doctoral research in computational neuroscience at the cognitive and systems neuroscience group at the University of Amsterdam. In his postdoctoral research, he collaborated with experimentalists in building deep biologically plausible models of perception and multisensory integration in the brain. From October, 2019 to September, 2021, he was a Lecturer of Data Analytics in the Intelligent Systems Research Centre at Ulster University in United Kingdom.

**Lecture Title:** Introduction to Lifelong learning

**Synopsis:** To be added.

## Dr. Saugat Bhattacharyya

**Bio: Saugat Bhattacharyya** is a Lecturer in Computer Science in the School of Computing, Engineering & Intelligent Systems. His research interests are in the area of Brain-Computer Interfacing, Neurotechnology, Human Cognitive Augmentation, Artificial Intelligence, Data Analytics and Machine Learning and its application in Human-Machine Interaction and Neuro-Rehabilitation. His research is primarily focused on developing brain-computer interfacing systems based on robust signal processing, quantitative and machine learning algorithms to draw inference into an users' state of mind through their neural and other physiological signals. He has over 60 publications in form of peer-reviewed journals and international conferences. He is a recipient of US-Ireland RD Partnership Programme (Centre-to-Centre Mechanism), MRC Equipment Grant and GCRF pump-priming as co-investigator and two PhD fellowships by CSIR, India and Erasmus Mundus. He is also an associate editor/section board member in Frontiers in Medical Technology and MDPI Brain Sciences, and served as guest editors in Frontiers in Neuroscience, MDPI Sensors and International Conference on Intelligent Robots and Systems (IROS).

**Lecture Title:** Neural Signal Processing and Connectivity Analysis

**Synopsis:** Recent advances in neuroscience technologies have paved the way to innovative applications in healthcare, rehabilitation, biometrics and brain-computer interfacing. These technologies are tuned to observe and influence brain activity to augment or assist in human motor or cognitive development. The neural activities are recorded using invasive or no-invasive technologies, albeit non-invasive technologies, such as electroencephalography (EEG), magnetoencephalography (MEG), functional near-infrared spectroscopy (fNIRS) and functional magnetic resonance imaging (fMRI) are the most popular form of recording amongst researchers and users. Non-invasive neural signals recorded from EEG or MEG devices are non-stationary, complex signals. Hence, it is vital to follow standard experimental design practices to evoke or induce the necessary task response among users and apply time-/frequency-/time-frequency domain processing methods to extract meaningful information about those task responses from the neural signals (EEG/MEG). In this lecture, you will be introduced to some standard practices to carry out necessary pre-processing methods including temporal and spatial filtering, and artefact removal, and finally signal processing using time-frequency techniques. In the second part, this lecture will discuss the theoretical basis of functional connectivity, the fundamentals of effective connectivity and different methodologies across fMRI, EEG and MEG. All neural processing methodologies will be reviewed with a focus on neuro-degenrative disorder such as Amyotropic Lateral Sclerosis.

## Dr. Javier Minguez

**Javier Minguez** received the physics science degree in 1996 from the Universidad Complutense de Madrid, Madrid, Spain, and the Ph.D. degree in computer science and systems engineering in 2002 from the University of Zaragoza, Zaragoza, Spain. During this period, in 1999 he was with the Robotics and Artificial Intelligence Group, LAASC-NRS, Toulouse, France, for eight months. In 2000, he visited the Robot and Computer Vision Laboratory (ISR-IST), Technical University of Lisbon, Lisbon, Portugal, for ten months. In 2001, he was with the Robotics Laboratory, Stanford University, Stanford, CA, for five months. From 2003 to 2008 he was Ramón y Cajal researcher in the University of Zaragoza. In 2008 he was visiting professor at the Institute of Medical Psychology and Behavioural Neurobiology, Tubingen, Germany for six months. Since 2008, he is an associate professor in the Computer Science and Systems Engineering in the University of Zaragoza. His research activity is framed within the Robotics and Real Time Group of the University of Zaragoza and the Instituto de Investigación en Ingeniería de Aragón. His research interests are mobile robot navigation and brain-computer interfaces

**Lecture Title:** To be added.

**Synopsis:** To be added.

## Prof. Damien Coyle

**Bio: Prof. Damien Coyle** is a Professor of Neurotechnology and Director of the Bath Institute for the Augmented Human, University of Bath. He is a UKRI Turing AI Acceleration Fellow 2021-25, and was previously director of the Intelligent Systems Research Centre, Ulster University (2017-2022). His research focuses on developing AI to address challenges associated with translating electrophysiological signals into control signals in brain-computer interfaces (BCI) to enable movement-independent communication/interaction targeting assistive and augmentative communication devices, cognitive and physical rehabilitation technology, and human augmentation. He has won several prestigious international awards including the 2008 IEEE Computational Intelligence Society (CIS) Outstanding Doctoral Dissertation Award, the 2011 International Neural Network Society (INNS) Young Investigator of the Year Award and the IET and E&T Innovation of the Year Award 2018. He was an Ulster University Distinguished Research Fellow in 2011, a Royal Academy of Engineering/The Leverhulme Trust Senior Research Fellow in 2013, a Royal Academy of Engineering Enterprise Fellow in 2016-2017 and an Ulster Senior Distinguished Research Fellow in 2021. He is a founding member of the International Brain-Computer Interface Society, an IEEE Brain Technical Community Steering Committee member, and an Advisory board member for the UK Neurotechnology Innovation Network. He is the Founder and CEO of NeuroCONCISE Ltd, an award-winning, AI-enabled, wearable neurotechnology company.

More information: https://pure.ulster.ac.uk/en/persons/damien-coyle

**Lecture Title:** Decoding mental imagery from electroencephalography (EEG) and applications of AI-enabled wearable neurotechnology for communication and rehabilitation

**Synopsis:** Research in the field of brain–computer interfaces (BCIs) and neurotechnology has proven that electrical signals in the brain, modulated intentionally by mental imagery, can relay information directly to a computer, where it is translated by intelligent algorithms (some inspired by the brain's neural networks) into control signals that enable communication and control without movement or can improve self- regulation of brain activity. This talk will present results from research at Intelligent Systems Research Centre that shows people with restricted abilities resulting from disease, injury or trauma may benefit from neurotechnology, including those who have prolonged disorders of consciousness or locked-in syndrome following traumatic brain injury, spinal injury, stroke and post-traumatic stress disorder. Neural activity can be modulated by many kinds of mental imagery e.g., classical motor imagery BCIs distinguish between imagined hand/arm movements. This presentation will also show recent results in decoding imagined three-dimensional limb movements, imagined primitive shapes, emotion inducing

imagery and silent/imagined speech from EEG. The presentation will attempt to address the question is it feasible to expect high and robust performance with these types of imagery in EEG-based BCIs and will highlight results which indicate user proficiency in BCI control is a matter of training time, machine learning/AI ability, application of the technology and maintenance of stable affective states. A number of neurogaming applications that enhance BCI user training will be demonstrated.

## Prof. Nikola Kasabov

**Bio:** **Nikola Kasabov** is Life Fellow of IEEE, Fellow of the Royal Society of New Zealand, Fellow of the INNS College of Fellows, DVF of the Royal Academy of Engineering UK. He is George Moore Chair Professor of Data Analytics at the University of Ulster UK and the Founding Director of KEDRI and Professor at the School of Engineering, Computing and Mathematical Sciences at Auckland University of Technology, New Zealand. He is a Guest Professor of the IICT Bulgarian Academy of Sciences and Dalian University, China and also an Honorary Professor at the Teesside University UK, the University of Auckland and Peking University in Shenzhen. Kasabov is Past President of the Asia Pacific Neural Network Society (APNNS) and the International Neural Network Society (INNS). He has been a chair and a member of several technical committees of IEEE Computational Intelligence Society and Distinguished Lecturer of IEEE (2012-2014). He is Editor of Springer Handbook of Bio-Neuroinformatics, EIC of Springer Series of Bio-and Neuro-systems and co-EIC of the Springer journal Evolving Systems. He is Associate Editor of several journals, including Neural Networks, IEEE TrNN, Tr CDS, Information Sciences, Applied Soft Computing. Kasabov holds MSc and PhD from TU Sofia, Bulgaria. His main research interests are in the areas of neural networks, intelligent information systems, soft computing, bioinformatics, neuroinformatics. He has published more than 700 publications, highly cited internationally. He has extensive academic experience at various academic and research organisations in Europe and Asia, including: TU Sofia Bulgaria; University of Essex UK; University of Otago, NZ; Shanghai Jiao Tong University and CASIA China, ETH/University of Zurich. Kasabov has received a number of awards, among them:; INNS Ada Lovelace Meritorious Service Award; NN journal Best Paper Award for 2016; APNNA 'Outstanding Achievements Award'; INNS Gabor Award for 'Outstanding contributions to engineering applications of neural networks'; EU Marie Curie Fellowship; Bayer Science Innovation Award; APNNA Excellent Service Award; RSNZ Science and Technology Medal; 2015 AUT NZ Medal; Medal "Bacho Kiro" of the SU Pavlikeni and an Honorary Citizen of Pavlikeni, Bulgaria. He is an Honorary Member of the Bulgarian, the Greek and the Scottish Societies for Computer Science. More information: https://academics.aut.ac.nz/nkasabov

**Lecture Title:** Brain-inspired Spiking Neural Network Architectures and Applications for AI

**Synopsis:** The talk discusses briefly current challenges in artificial intelligence (AI), including: efficient learning of data (interactive, adaptive, life-long; transfer); interpretability and explainability; personalised predictive modelling and profiling; multiple modality of data (e.g. genetic, clinical, behaviour, cognitive, static, temporal, longitudinal); computational complexity; energy consumption; human-machine interaction. Opportunities to address these challenges are presented through advancement in Neuroinformatics, Neural networks and Neurocomputers (the 3N). Neuroinformatics offer a

tremendous amount of data and knowledge about how the human brain and the nervous system work. Many brain information processing principles can be now implemented in novel Neural network computational models, such as spiking neural networks (SNN) . The latter ones have inspired the development of neuromorphic hardware chips and Neurocomputers, characterised by much low power consumption, massive parallelism and fast processing. The talk presents the main principles of evolving connections systems (ECOS) [1,2] and spiking neural networks (SNN) [3,4] along with a brain-inspired computational architecture based on SNN- NeuCube, to address the above AI problems. NeuCube is first used for brain data modelling and then developed as a generic spatio-temporal data machine and an open source development environment for a wide scope of applied computational intelligence. Some experimental results include: modelling EEG, fMRI and other multimodal brain data; predicting dementia; predicting response to treatment; early diagnosis of psychosis; personalised prediction of stroke; brain-computer interfaces; on-line learning of multisensory data for pollution and earthquake prediction; integrating financial time series and on-line news; and other.

In future, a fast development of novel Neural network models for the now available massively parallel and low power consuming Neurocomputers is expected, along with successful applications in Neuroinformatics, and in all areas of AI, to overcome the current challenges in AI.

[1] N.Kasabov, Evolving Connectionist Systems, Springer, 2007

[2] NeuCom: https://theneucom.com

[3] N.Kasabov, Time-Space, Spiking Neural Networks and Brain-Inspired Artificial Intelligence, Springer, 2019, https://www.springer.com/gp/book/9783662577134.

[4] NeuCube: https://kedri.aut.ac.nz/neucube

## Prof. Girijesh Prasad

**Bio: Prof. Girijesh Prasad** is Professor of Intelligent Systems in the School of Computing, Engineering and Intelligent Systems, Ulster University (UU), UK. He is Director of Northern Ireland Functional Brain Mapping (NIFBM) facility at UU's Intelligent Systems Research Centre, where he leads the Cognitive Neuroscience and Neurotechnology research team.

He received a BTech in Electrical Engineering from Regional Engineering College (now National Institute of Technology) Calicut, India in 1987, an MTech in Computer Science and Technology from University of Roorkee (now Indian Institute of Technology Roorkee), India in 1992, and a PhD in Electrical Engineering from Queen's University of Belfast, UK in 1997. He is a Chartered Engineer, a Fellow of IET, a Fellow of Higher Education Academy, a Senior Member of IEEE, and a founder member of IEEE Systems, Man, and Cybernetics society's Technical Committee on Brain-Machine Interface Systems. In 2017, he was awarded the Fellowship of International Academy of Physical Sciences (IAPS) India, and the Senior Distinguished Research Fellowship of Ulster University. Prof. Prasad joined Ulster University, as a Lecturer in 1999; he was promoted to Senior Lecturer in 2007, Reader in 2008, and Professor in 2011. Previously he worked in industry first as a Digital Systems Engineer and then as a Power Plant Engineer in India, and as a Research Fellow on an EPSRC/industry project at Queen's University of Belfast, UK.

His research interests are in intelligent systems, data engineering, brain modelling, brain-computer interface (BCI) & neuro-rehabilitation, and assistive technology. Under his supervision, an advanced rehabilitation protocol has been developed incorporating an active physical practice stage followed by a mental practice stage, using a neuro-rehab system consisting of a robotic hand exoskeleton and an EEG/EEG-EMG based BCI, which has been trialled on groups of chronic stroke patients in UK as well as India, resulting in transformative change in patients' quality of life. He has published over 285 research papers in journals, edited books, and conference proceedings. He has supervised to completion 22 PhD students. His research has attracted 18 research grant awards amounting to over £10M funding from national and international agencies including Invest Northern Ireland, Department of Employment and Learning, Research Councils UK (RCUK), Leverhulme Trust, Royal Society, UK India Education and Research Initiative (UKIERI), UK Research and Innovation (UKRI) and Irish industry.

**Websites:** https://pure.ulster.ac.uk/en/persons/girijesh-prasad ; https://scholar.google.com/citations?view_op=list_works&hl=en&hl=en&user=xPw66a0AAAAJ

**Lecture Title:** Non-invasive brain-computer interfaces: Enhancing applicability using computational intelligence and technological advances

**Synopsis:** A Brain-Computer Interface (BCI), also known as Brain-Machine Interface (BMI), utilizes neuro-physiological correlates of voluntary mental tasks to facilitate direct communication between human brain and computing devices without the involvement of neuro-muscular pathways. The BCI research is, in general, progressing in two main areas: augmentative & alternative communication (AAC) by replacing neuromuscular pathways and neuro-rehabilitation by helping to activate desired cortical areas for targeted brain plasticity. Current BCI systems however, lack sufficient robustness and performance variability among users is quite high. One of the critical limitations is because of the non-stationary characteristics of brain's neurophysiological responses, which makes it hard to extract time-invariant stable features unique to voluntary mental tasks. In this talk, the presentation will first briefly review state-of-the-art BCI research and then discuss our computational intelligence supported R&D towards robust BCI design using multi-modal neuroimaging techniques and our current application focus in post-stroke neuro-rehabilitation. In particular, it will be discussed how integrating an EEG-EMG based BCI and hand exoskeleton results into a personalized post-stroke neuro-rehabilitation system that ensures active and engaging exercises and leads to enhanced recovery of the paralyzed upper limbs. Also to take advantage of MEG's highest spatiotemporal resolution (306 channels, Elekta Neuromag TRIUX, recorded at 1k Hz) of all neuroimaging modalities, the development of an MEG-based BCI controlling an MEG compatible hand exoskeleton located in a magnetically shielded room (MSR) will be discussed. It will be discussed how using multi-modal neuroimaging modalities facilitates understanding the neuronal mechanisms involved in motor recovery of stroke patients. Finally the remaining R&D challenges will be highlighted.

## Dr. Chiara Bartolozzi

**Bio: Chiara Bartolozzi** is senior researcher tenured at the Istituto Italiano di Tecnologia. She earned a degree in Engineering (with honors) at University of Genova (Italy) and a Ph.D. in Neuroinformatics at ETH Zurich, developing analog subthreshold circuits for emulating biophysical neuronal properties onto silicon and modelling selective attention on hierarchical multi-chip systems. She is currently principal investigator of the Event Driven Perception for Robotics group (www.edpr.iit.it), mainly working on the application of the "neuromorphic" engineering approach to the design of sensors and algorithms for robotic perception.

Chiara has participated in a number of EU funded projects, she coordinated the H2020 MSCA-ETN "NeuTouch" and FP7 FET "eMorph", and is PI in VOJEXT, APRIL, and PRIMI Research and Innovation Actions. As leader of the educational activities of the coordination and support action NEUROTECH, she co-organised the Neuromorphic Colloquium, a series of online events to build up educational material for the next generation of neuromorphic researchers. She is in the scientific board of the Capocaccia Workshop on Neuromorphic Intelligence. She is Editor for NPJ Robotics, IOP Neuromorphic Computing and Engineering, Frontiers in Neuroscience, IEEE JETCAS and TCASI.

She is an IEEE member, actively supporting the CAS and RAS societies, chair of WiCAS committee. In 2020, she was general chair of "AICAS2020", on Circuits and systems for efficient embedded AI.

**Lecture Title:** Neuromorphic sensing and computing for robots

**Synopsis:** Since the first prototypes of neuromorphic vision sensors and computing devices, part of the community focused its efforts in deploying neuromorphic devices in practical applications, to exploit their intrinsic compression, low latency, high temporal resolution, high dynamic range.

The quest to find the best strategy to exploit neuromorphic engineering is still open, but a lot of progress has been made. In this talk, I'll describe possible approaches towards the development of neuromorphic perception for robots and discuss the relevance of the development of neuromorphic sensing for touch and other modalities.

## Prof. Kc Santosh

**Prof. KC Santosh**, a highly accomplished AI expert, is the chair of the Department of Computer Science at the University of South Dakota (USD). He is also the founding director of the Center for AI Research & Enginneering at USD. He served the National Institutes of Health (NIH) as a research fellow. Before that, he worked as a postdoctoral research scientist at the LORIA research centre, Universite de Lorraine in direct collaboration with industrial partner, ITESOFT, France. He earned his PhD in Computer Science - Artificial Intelligence from the INRIA Nancy Grand Est research centre (France).

Prof. Santosh has demonstrated expertise in artificial intelligence, machine learning, pattern recognition and computer vision with various application domains such as healthcare informatics and medical imaging, document imaging, biometrics, forensics, speech/audio analysis, and Internet of Things. Having secured substantial funding totaling over $2.1 million from sources like SDCRGP, SDBOR, DOE, NSF, and the Asian Office of Aerospace Research and Development (AOARD), which notably includes a $1 million grant from DOD in 2023 for AI/ML capacity building at USD, he has authored 10 books and more than 250 peer-reviewed research articles in reputed venues such as IEEE Trans. on PAMI, IEEE Trans. on Medical Imaging, IEEE Trans. on Instrumentation and Measurement, and IEEE J of Biomedical Health Informatics. He is an associate editor of multiple prestigious journals such as IEEE Transactions on Artificial Intelligence, Int. J of Machine Learning & Cybernetics, and Int. J of Pattern Recognition & Artificial Intelligence.

To name a few, Prof. Santosh is the proud recipient of the Visionary Leadership Award (University of Derby - UK, 2023) Cutler Award for Teaching and Research Excellence (USD, 2021), the President's Research Excellence Award (USD, 2019), and the Ignite Award from the U.S. Department of Health & Human Services (HHS, 2014).

As the founder of AI programs at USD, he has taken significant strides to increase enrollment in the graduate program, resulting in over 3,000% growth in just three years. He has helped build multiple inter-disciplinary AI/Data Science related academic programs, including collaborations with Biology, Physics, Biomedical Engineering, Sustainability and Business Analytics departments. Prof. Santosh is highly motivated in academic leadership, and his contributions have established USD as a pioneer in AI programs within the state of SD.

**Lecture Title:** To be added.

**Synopsis:** To be added.

## Slobodan Tanackovic

**Bio: Slobodan Tanackovic** has an engineering and clinical neurophysiology technical background and has been part of g.tec medical engineering since 2018. He was a member of an epilepsy surgery program at the University Hospital of Coimbra. He has extensive experience in intra-operative neuromonitoring.

Slobodan is a brain-computer interface (BCI) and neuroscience enthusiast who continuously participates in the g.tec's education plan. He is currently developing a solution optimised for ERP acquisition.

# Profiles of Tutors

## Dr. Amin Azimi

**Bio: Dr. Amin Azimi**, is a Postdoctoral Research Associate specializing in Computational Neuroscience. He has contributed significantly to the field by developing neural network models to elucidate the coordination of slow oscillations, thalamic spindles, and hippocampal ripples, and their role in memory consolidation. Additionally, Dr. Azimi has expertise in analyzing local field potential (LFP) data during sleep, exploring the effects of endogenous electric fields on neuronal activity through ephaptic coupling.

Currently, Dr. Azimi is working on computational modelling of decision-making processes. His interdisciplinary expertise and innovative computational approaches aim to advance the understanding of neural communication and information transfer, bridging theoretical models with practical insights into memory consolidation and cognitive functions. Dr. Azimi is eager to participate as a tutor for lab sessions at the ISRC-CN3 Summer School.

## Dr. Sahil Sharma

**Bio: Dr. Sahil Sharma** is a postdoctoral research associate at Ulster University's School of Computing, Engineering, and Intelligent Systems, working on predicting therapeutics in blood for epilepsy patients and explainable AI since August 2023. With over a decade of AI and ML experience, Sahil has authored over 10 SCI journal publications.

He has a robust background in teaching and research, having served as a lecturer and assistant professor at Thapar Institute of Engineering and Technology, India, from January 2018 to August 2022, and at Jaypee University, India and Punjab Engineering College, India, until May 2023. During his Masters and PhD, he worked as a Teaching Assistant, Project Associate, and Teaching Associate. Sahil's industry experience includes a brief stint as an AI-ML Consultant at a startup in Mohali, India, where he contributed to developing a 3D Generative-AI product. His current research focuses on improving therapeutic predictions for epilepsy patients, combining his expertise in AI, ML, and XAI for impactful healthcare solutions.

## Dr. Oleg Senkevich

**Bio: Oleg Senkevich** is a postdoc at Ulster University working with Dr. Cian O'Donnell on modelling synaptic noise caused by the stochasticity of molecular dynamics in neurons. My PhD and MSc projects were related to Ising models and random graphs, and my BSc was in physics. I have highly diverse scientific interests, primarily revolving around computing and intelligence, both natural and artificial.

## Brendan Lenfesty

**Bio: Brendan Lenfesty** received his B.Sc. in Computer Science in 2021 from Ulster University, Magee campus. He is currently studying for a Ph.D. in Computational Modelling and Machine Learning in Decision Neuroscience at Ulster University's Magee

campus. His research focuses on using computational modelling and machine learning to gain further knowledge of abstract decisions and the mechanistic processes that underly perceptual decisions.

## Dr. Abdoreza Asadpour

**Bio: Dr. Abdoreza Asadpour**, a Postdoctoral Research Associate at Ulster University's Intelligent Systems Research Centre, holds a strong foundation in Electrical Engineering, earned from Sharif University of Technology, Iran. Specialising in Computational Neuroscience, AI, and Biomedical Signal Processing, he has made contributions to the neuroscience of tinnitus and computational modelling of decision-making in species. His interdisciplinary expertise is complemented by noteworthy collaborations with esteemed institutions such as Trinity College Dublin and Columbia University. Dr. Asadpour is enthusiastic about fostering learning and will contribute as a tutor for lab sessions at the ISRC-CN3 Summer School.

## Kaniska Samanta

**Bio: Kaniska Samanta** is a second-year PhD researcher at the Intelligent Systems Research Centre, Ulster University. He completed his Master's degree in Electrical Instrumentation from Techno India University, India, and His Bachelor's in Technology

from Maulana Abul Kalam Azad University of Technology, India, with a specialization in Instrumentation and Control Engineering. His research primarily focuses on Brain-Computer Interfacing and neural signal processing using non-invasive neuro-imaging techniques such as EEG and MEG. With 9 journal papers, book chapters, and participation in 7 national and international conferences to his credit, he is deeply committed to advancing BCI technology. Beyond the academic realm, he is an avid traveller and hiking enthusiast, constantly seeking new adventures and experiences in the great outdoors.

## Senhui Qiu

**Bio: Senhui Qiu** received his B.Sc. in Physics from Guangxi University for Nationalities, China in 2010. He received his M.Sc. in Circuits and Systems from Guangxi Normal University, China in 2013. He is currently a PhD researcher at Ulster University's School of Computing, Engineering, and Intelligent Systems in the UK. His research focuses on predictive coding, image classification, reconstruction and generation.

## Ravi Jha

**Bio: Ravi Kumar Jha**, currently a second-year Ph.D. researcher at Ulster University's School of Computing, Engineering, and Intelligent Systems, delves deep into the realm of quantum-enhanced algorithms for brain data analysis. A University of Delhi alumnus, Ravi graduated with a Bachelor's in Mathematical Sciences, securing the commendable

second rank. Further enriching his academic journey, he earned an M.Sc. with distinction in Applied Mathematics from South Asian University, New Delhi. His professional engagements have seen him at the forefront of research, from being a Research Intern at Universiti Teknologi Malaysia to a Project Scientist at India's esteemed INCOIS. With a keen interest in quantum computing, machine learning, and applied mathematics, Ravi's contributions have been recognised with significant accolades, including a best paper award and the prestigious Vice-Chancellor's Research Scholarship from Ulster University.

# City of Derry ∼ Londonderry in Northern Ireland

Located in the Northwest of Ireland where The Wild Atlantic Way meets the Causeway Coastal Route, the vibrant city of Derry ∼ Londonderry is renowned for one of the finest Walled Cities in Europe and home to award winning museums, some of the islands best cultural attractions and a variety of lively festivals and events; Derry ∼ Londonderry offers a vibrant social scene where your visitors are guaranteed the warmest of welcomes and hospitality. For delegates looking to experience the local culture, the city walls surround cosy pubs with live music, award-winning museums that tell stories from times past, and vibrant eateries that serve up LegenDerry Food.

This is a special wee place like no other. Our unique geography and diverse climate create the ideal conditions for our food and drink industry to flourish. Our produce harvested and crafted locally from both 'land and lough' is influenced by the latest food trends worldwide. The shores of Lough Foyle provide a vast array of shellfish with the Lough Foyle Irish Flat Oyster being the jewel in the Foyle's crown.

Derry ∼ Londonderry offers a plethora of choice when it comes to choosing where to stay, with options available to suit everyone's budget and taste. So, whether you want to stay in the heart of the city action, or somewhere a little quieter, you'll have plenty to choose from. From international hotel brands, boutique designer hotels right through to five-star self-catering accommodation, including comfortable Bed & Breakfasts and guest houses – we've got them in abundance.

There's so much to discover in the Walled City with bucket loads of activities to suit

all tastes. Derry is home to it all! Discover our 400-year-old City Walls, award-winning museums and theatres or why not try your hand at one of our water attractions, like Stand-Up Paddle-boarding. Take a step through history and go on a walking tour – we promise they won't disappoint. Or perhaps you would like to discover all things Derry Girls – no problem. If it's a Derry Girls themed afternoon tea, or screen walking tour you're after then we've got that on offer too. There really is something for everyone in the city; be inspired by the options below or build your own itinerary from our planner. Don't forget to buy our Visit Derry pass which means you can explore the city and enjoy access to several of the city's top tourist attractions.

***Further information:***

- Visit Derry (https://www.visitderry.com/)
- Discover Northern Ireland (https://discovernorthernireland.com/information/product-catch-all/visit-derry-information-centre-p689591)
- Derry City and Strabane (https://www.derrystrabane.com/What-s-On/Tourist-Information)

***Some nearby accommodations:***

As the Summer School is held in the middle of a semester, on-campus accommodation is usually no longer available. However, the city has ten 4-star hotels within a five-mile radius of the city centre, from award winning boutique hotels to larger hotel groups. For more information, please visit https://www.visitderry.com/accommodation

Ulster University has a subsidised rate with City Hotel, Derry for Bed & Breakfast. If you would like to book, please email Louise at l.gallagher@ulster.ac.uk to let us know and we will forward your name to City Hotel so that you can avail of this preferred rate.

The Art House and Jazz House (both Clarence property), besides the campus, can be booked and shared among attendees.

***Other nearby accommodation include:***

- Shipquay Hotel
- Holiday Inn Express Derry
- Maldron Hotel Derry
- Da Vinci's Hotel
- Bishop's Gate Hotel Derry
- Premier Inn Derry Hotel

and others. There are also several economical Bed and Breakfasts and Hostels.

***On campus eateries (opened during daytime):***

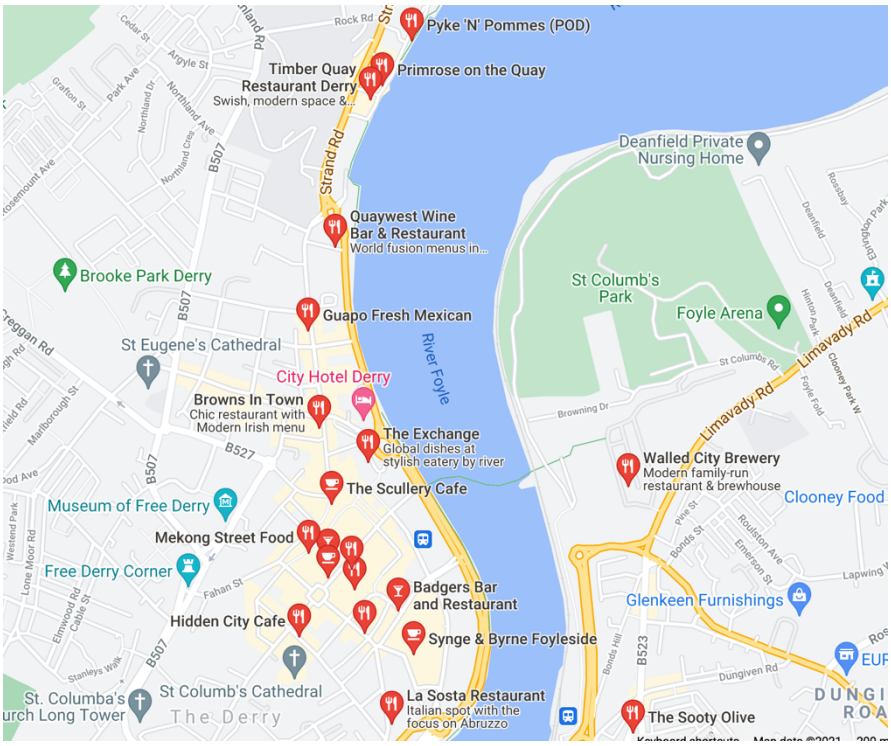
- Jitters (in MG building)
- Bunker Café (in MF building – entrance at the back)
- Scullery Magee (in MU building)

***Nearby restaurants and eateries:***

- Guapo (Fresh Mexican)
- Pyke 'N' Pommes (in a bus, along the Foyle River; or one along Strand Road)
- Florentini
- Quaywest
- Mama Masala
- Timber Quay Restaurant Derry
- Saffron Modern Indian Restaurant
- Mandarin Palace
- Browns in Town
- Browns Bonds Hill
- Primrose on the Quay (along Foyle River)

- Patricia's Coffee House (along Foyle River)
- Shipquay Restaurant
- The House / Entrada Restaurant
- Zora's
- Domino's Pizza (cityside)
- Mekong Street Food
- El Tapas Gra
- Walled City Brewery
- La Sosta Restaurant

etc.



***Bars and pubs:***

- Paedar O'Connell's
- Blackbird
- Sandino's Café Bar
- The Trinity Bar
- Guildhall Taphouse
- Bennigans Bar
- Granny Annie's
- Grand Central Bar
- The Diplomat Bar
- The Gweedore Bar

etc.

# Ulster University, Derry ~ Londonderry (Magee campus)


The Magee campus of Ulster University in the city of Derry ~ Londonderry, is one of four campuses in Northern Ireland: https://www.ulster.ac.uk/campuses/magee

It is the oldest campus with a history, dating back to the year 1865.

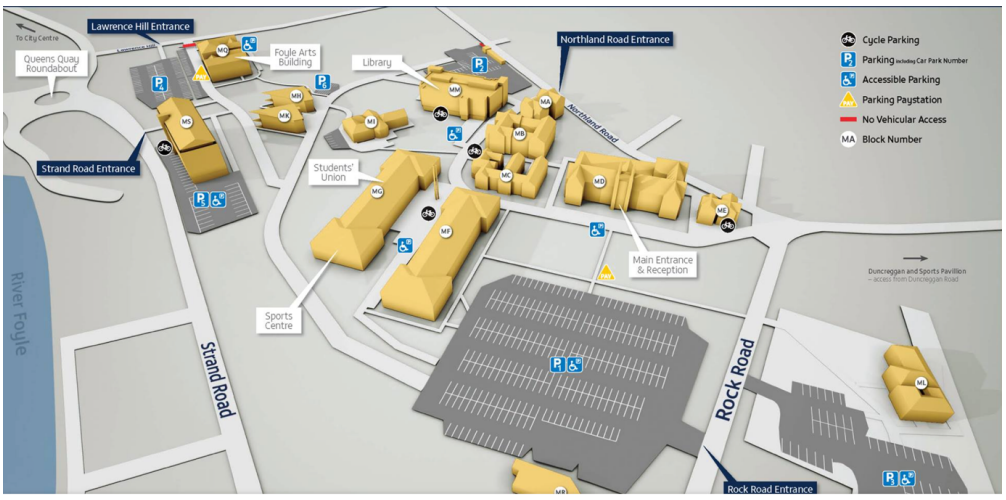
***Magee campus map:***

- https://www.ulster.ac.uk/pdf/campus-maps/magee-campus-map.pdf
- Google Map: https://www.google.com/maps/d/viewer?mid=1gdsugbd1SrO_vMTlhmyxvojrR-I&ie=UTF8&t=h&oe=UTF8&msa=0&ll=55.00240881516382%2C-7.321874999999995&z=16

***How to get to Derry ~ Londonderry campus?***

The MS building at Magee campus lies on Strand Road opposite the Derry City and Strabane District Council.

By Air: The City of Derry airport (https://www.cityofderryairport.com/) is the nearest airport. Or you may fly to Belfast International Airport (https://belfastairport.com/), the next closest airport, or George Best Belfast City Airport (https://www.belfastcityairport.com/). The City of Derry airport (https://www.cityofderryairport.c




om/destinations/) is only 7 miles from Derry ~ Londonderry city centre. Direct flights from London Stansted, Manchester, Liverpool, Glasgow and Edinburgh. From Belfast International Airport (https://belfastairport.com/) or George Best Belfast City Airport (https://www.belfastcityairport.com/), it is 1 hour 15 minutes and 1 hour 30 minutes from Derry ~ Londonderry city centre (see coach below), respectively. From Dublin airport (https://www.dublinairport.com), it is 2 hours 45 minutes to Derry ~ Londonderry by car or bus.

By rail: Take the Translink (https://www.translink.co.uk/) NI Railways (https://www.translink.co.uk/corporate/monitoringresults/nirailways) and stop at Derry ~ Londonderry train station. For example, from Belfast Great Victoria train station, to Derry ~ Londonderry train station, it takes about 2 hours. To go from Dublin (Dublin City, Connolly Rail Station) to Derry ~ Londonderry train station, you have to change trains at Belfast Lanyon Place (formerly Belfast Central) train station. There is (some) wifi service on the trains but no food service. It is better to consume or takeaway food at a train station.

By Bus: There are many buses. For example, bus 212 takes you from Belfast's Europa bus station (besides Belfast Great Victoria Station) to Derry ~ Londonderry bus station in about 1.5 hours. There are also buses (Dublin Coach Services https://www.translink.co.uk/usingtranslink/specialoffers/dublincoachwebsaver) straight from Dublin Airport to Derry ~ Londonderry bus station and back or from Dublin Busáras Bus (https://www.buseireann.ie/) to Derry ~ Londonderry bus station. This is about 4 hours of journey with a break halfway. There is also an economic coach (Aircoach https://www.aircoach.ie/ ) from Dublin Airport straight to Belfast city, near the Belfast

Great Victoria train station and Europa bus station (see above). Another option is the Aircoach service from Belfast International Airport (BFS) to Derry ∼ Londonderry Foyleside coach park.

Car hire and taxi service available from airports.

By taxi: Ask the taxi driver to stop at The Gatelodge, which is besides the MS building.

Driving from Strand Road/from Quayside roundabout

After turning in from Strand Road, please slow down and take a first turn on the left after the roundabout and after the traffic lights.

Driving from Foyle Bridge: Pass the Derry City and Strabane District Council, then do a U-turn at a roundabout and slow down and take the first turn on the left right after the traffic lights.

***On campus parking:***

To park at the ISRC / MS building (parking space P5 – see campus map), collect a parking ticket and use an available parking space underneath the MS building.

Go back to the front entrance, please press the disabled door opener and register at the reception someone. Please take a seat and one of our team members will be with you shortly.

There are also other parking spaces. The largest on campus parking space is P1 facing the neo-gothic-looking MD building.

***Off campus parking:***

To park outside the campus, nearby parking spaces include the Strand Road Car Park, Quayside Shopping Centre & Car Park, and Foyle Street Car Park. However, for the evening lab sessions, it is advisable to park on campus. For instance, if you happen to park outside campus e.g. due to lack of available on-campus parking space, then during dinner break, for convenience, you may wish to move your car and park on campus when it becomes less crowded.

## Intelligent Systems Research Centre & Summer School

Address of our Research Centre:

*Intelligent Systems Research Centre,*
*School of Computing, Engineering and Intelligent Systems,*
*Faculty of Computing, Engineering and the Built Environment,*
*Ulster University,*
*Magee campus*
*Northland Road,*
*Derry ∼ Londonderry,*
*BT48 7JL,*
*Northern Ireland, UK*

Note: The Intelligent Systems Research Centre is also the MS building on Magee campus.

## Sponsors





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