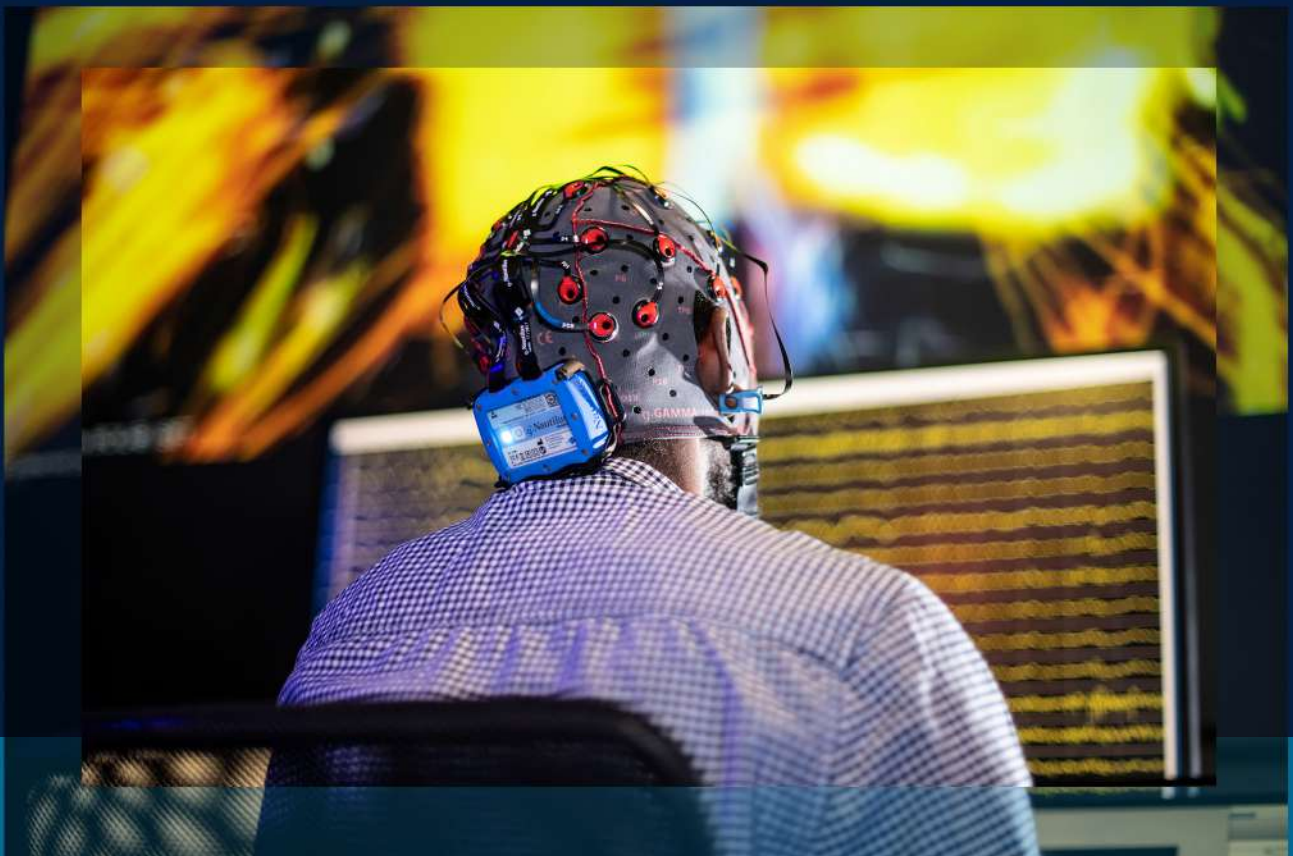# School of Computing, Engineering and Intelligent Systems

Annual Report
1st August 2019 -31st July 2020

Contents

1. Foreword:

Research Director
Professor Damien Coyle

In presenting the Annual Report for the School of Computing, Engineering and Intelligent Systems for the academic year 2019-2020, in spite of the unanticipated challenges for research, I am happy to present a number of highlights of another very successful year, with many major achievements of our staff and postgraduate researchers and substantial enhancement to our research infrastructure and resources at the Intelligent Systems Research Centre (ISRC).

We partnered with Queen's University Belfast to establish the Northern Ireland High Performance Computing (NIHPC) Facility (https://www.ni-hpc.ac.uk). A grant of £2.1 million was awarded from the Department for Business, Energy and Industrial Strategy (BEIS) via the Engineering and Physical Research Council (EPSRC) and its national Tier-2 HPC initiative for the state-of-the-art computing facility. The Tier-2 HPC services are an interfacing layer of supercomputing provision between the highest capability national and international HPC services and local computing provision in individual research institutions. Only one of seven such facilities in the UK, NI-HPC will enable researchers to conduct largescale data analytics, simulation and optimization of AI technologies to significantly enhance research productivity and quality, and to address some of society's biggest challenges. An aim of the project is to develop the HPC software engineering knowledge and skills in Northern Ireland by providing hands-on technical training, coaching sessions and promoting the adoption of best practices. We expect this to have a huge impact across a range of disciplines at both universities and industry sectors across Northern Ireland. The funding also enabled us to recruit Ulster's first dedicated Research Software Engineer, Dr Jose Sanchez-Bornot, who is based at the ISRC.

We were honored to welcome HRH Princess Anne to the Magee campus to officially open another new facility established at the ISRC, the Spatial Computing and Neurotechnology Innovation-Hub (SCANi-hub). The SCANi-hub builds on award-winning neurotechnology research at the ISRC and enables research in the next wave of human-computer and human-machine interaction for able-bodied and physically impaired people. The facility sits alongside the Northern Ireland Functional Brain Mapping Facility (NIFBM) and houses multiple neurotechnologies for brain imaging, an advanced car/flight simulator, various new extended reality and spatial computing technologies, vibrotactile stimulation, ultrasonic haptic interfaces, technologies that enable walking in virtual environments (virtual treadmills) as well as a state-of-the-art Smartglass façade to adapt the room for various experimental situations and public engagement activities. The SCANi-hub will equip the next generation of graduates and researchers with the skills and knowledge to merge bio-inspired computing and AI and SCAN technologies to address many research and industry-led challenges that help define how humans interact with technology in the future.

Staff have been involved in over 60 externally funded projects valued at over £17m, securing an additional ~£2.3m funding this year, and published 67 papers in high impact journals and conferences. Notable achievements in impactful research include:- Dr Magda Bucholc's involvement in the C-TRIC COVID-19 Task Force and appointment as Ulster rep on the NI Department of Health COVID-19 Modelling Group, which subsequently led to Dr Bucholc developing the NI COVID tracker app (https://nicovidtracker.org/); a number of researchers securing funding in the iCURE programme to investigate the commercial potential of new innovation emerging from our research, for example, smart energy analytics (Mr McElhom, Dr Harkin) and stroke rehabilitation (Dr Charles), and spinout company, Airbrio Ltd, winning the Life and Health Category of the 2019 Invent Competition; Mr Michael

Callaghan winning a Co-founder award and our NeuroCONCISE Cybathlon Team winning 3rd place at the Cybathlon Series event in Graz, Austria, with spinal injured pilot, Mr Owen Collumb. Dr Black hosted the 'Big Data for Health Policy Symposium' and we again opened the centre up to the public for Discovery Day as part of the Northern Ireland Science Festival.

Notable appointments to external committees and advisory boards include:- Dr Wong-Lin becoming founding chair of British Neuroscience Association (BNA) Chapter for Northern Ireland and Co-Lead for the DEMON Network, focusing on AI and dementia research, with Dr Bucholc appointed to early career research rep of the DEMON Network, Prof Sonya Coleman appointed associated editor of the IEEE Transactions in Neural Network and Learning Systems (a leading AI journal), Prof Prasad appointed to the Senate of the Indian Institute of Information Technology Pune and Prof Coyle appointed to the IEEE Brain Initiative Core Team by the President of the IEEE CIS and also appointed to the advisory board of the KTN Neurotechnology Innovation Network.

Notable achievements of our graduate researchers and contract research staff include Sujit Roy, Przemyslaw Cichy, Jose Sanchez-Bornot and Vinay Vibhakar winning 2nd Prize at the AI NI Datathon 2019, Ciaran Cooney being nominated for the IEEEBrain Best Paper award at IEEE SMC 2019, Dr Nadim Atiya winning the Convocation Postgraduate Doctoral Student of the Year for 2019 and both Shane Harrigan and Shane Reid reaching the finals of the 3-minute thesis (3MT) competition.

We were delighted to host visits from renowned researchers including Prof Viktor Jirsa (INS Director, France), Prof Simon Kelly (UCD) and Dr Sarah Bauermeister (Oxford University) and that Derry native, Prof Scott Kelso from Florida Atlantic University, was reappointed to a Professor position and Prof Nikola Kasabov (Aukland University, New Zealand) was appointed to the Dr George Moore Chair in Data Analytics. These strategic appointments will support key research areas, the development of our early career researchers and our implementation plans for the two City Deal innovation projects which are being led by Prof Liam Maguire and Prof Martin McGinnity from the Intelligent Systems Research Centre.

Despite the challenges this year has held because of the pandemic we are very pleased with progress and level of commitment of all our researchers and excellent support staff. As we publish this report, we look forward to another exciting year, as we capitalize on major funding secured this year for new research infrastructure and develop plans for further investment in our researchers and expansion of the school and university campus which will positively impact the wider region.

Further details of our research, facilities, staff profiles and research expertise can be found at Intelligent Systems Research Centre - Ulster University

Or by contacting Louise Gallagher (Academic Excellence Executive Assistant) at Email: l.gallagher@ulster.ac.uk; Ph: +44 28 7167 5148.

Professor Damien Coyle
Research Director, School of Computing, Engineering and Intelligent Systems.

2. Research Students

The following research students were registered on research degree programmes during 2019-20.

Surname	Thesis title
Ahmed, Salman	Natural Language Processing for Speech Tagging, Sentiment analysis and Predictive analytics
Atiya, Nadim	Computational modelling of decision uncertainty
Behera, Chandan	Neuronal circuit model of emotional learning
Bigirimana, Alain	Affective state and emotion inducing imagery classification for a brain-computer interface
Bonham-Noyle, Kyrsti	Home health monitoring
Boyle, Juanita	Intelligent Identity Authentication
Cichy, Przemyslaw	Data Analytics: Deep learning – Combining Reinforcement Learning and Evolutionary Strategies
Cooley, Christopher	Bio-KIP: Bio-inspired Kinect Image Processing
Cooney, Ciaran	Decoding imagined semantic, syntactic and phonological speech processes from EEG
Dhakan, Paresh	Motivated reinforcement learning in robots
Duffy, William	Unobtrusive activity detection using a single wearable sensor
Fegan, John	Multimodal robotic object recognition system
Flanagan, Bronac	A new glial based model of epileptic activity
Gillespie, James	Learning of bio-inspired movement in highly noisy environments
Gorman, Mark	Utlising multivariate high frequency time series datasets for real-time decision making applications
Haji Karim, Shvan	Brain inspired self repairing electronic systems
Harrigan, Shane	Neuromorphic vision processing
Henderson, Benn	Automated Classification of Autism Spectrum Disorder in Children using Gait Analysis
Henderson, Jeffrey	Artificial Intelligence for Smart Sensing to facilitate better health
Javed, Aqib	Intelligent hot-spot prediction in networks-on-chip (NoC)
John Bensam, Christina Sherly	IDENTIFY: Robot Object Identification using Vision and Touch
Johnston, Vivien	Big Data for MIDAS (Meaningful integration of data, analytics and services
Khodadadzadeh, Massoud	Intelligent data analytics
Lees, Stephanie	Assessing and optimising human-machine symbiosis through neural signals for big data analytics
Liu, Shuo	Intelligent Data Analytics - novelty detection in critical systems
Madden, Kyle	Secure Networks-on-Chip (NoC) for cyber-physical systems
McBrearty, Shaun	Result ranking for searchable symmetric encryption
McCombe, Niamh	Data analytics and modelling in dementia (CPM-CLINICAL Decision Making Project)
McHugh, Catherine	Computational approaches to real-time energy trading
McKinney, Joseph	VR/AR Upper Arm Rehabilation: Personalised Upper Arm Rehabilitation within Virtual and Augmented Reality
Melaugh, Ryan	Human-machine emotion interaction
Millar, Christopher	Kinaesthetic learning for robotic object manipulation
Miller, Shane	Securing the internet through detection of anonymous proxy usage
Murray, Cathal	Creating opportunities for growth within the circular economy - predicting and minimising food waste

Poshtkohi, Alireza	Correlation between Synchronised Neuronal Burst Firing and Brain Seizures: A Biophysical Model
Reid, Shane	Social signal processing
Robinson, Tony	FPGA Computational Acceleration in Genomics – bringing personalised medicine closer to clinical practice for healthy communities
Roy, Sujit	Advanced MEG based brain-computer interface supported upper limb post-stroke rehabilitation
Saranirad, Vahid	George Moore PhD scholarship in Intelligent Data Analytics :Enhancing biological plausability of deep learning for computer vision
Sharma, Pratikshya	Early Detection of Autistic Spectrum Disorder using Computer Vision Techniques
Sweeney, Terence	Machine vision for automated inspection of hard drive components CAST
Tahernezhadjavazm, Farajollah	Evolutionary strategies for optimising signal and text classification
Toman, Marinus	A Computational Model of Regulating Neuronal Excitability by GABA Neurons

Graduated December 2019

Student name	Thesis title
Alderson, Thomas	Dynamical complexity of large-scale neurocognitive networks in healthy and pathological brain states
Atiya, Nadim Abd Al-Haleem	Computational modelling of decision uncertainty'
Flanagan, Bronac	A new glial based model of epileptic activity
Miller, Shane	Securing the internet through detection of anonymous proxy usage

3.   Publications

Details of all Publications by the School Computing, Engineering and Intelligent Systems are on the Ulster University's Institutional Repository- PURE https://pure.ulster.ac.uk/. This section reports those outputs published over the period of this report and classified as either journal articles, books/chapters in books and published conference papers.

3.1 Journal Articles

Atiya, N., Zgonnikov, A., O'Hora, D., Schoemann, M., Scherbaum, S., Wong-Lin, K., 2020, Changes-of-mind in the absence of new post-decision evidence, PLoS Computational Biology, vol. 16, no. 2.

Balint, P., Kasabov, N., Kiss, R., 2020, Selection and Optimization of Temporal Spike Encoding Methods for Spiking Neural Networks, IEEE Transactions on Neural Networks and Learning Systems, vol. 31, no. 2, pp. 358-370.

Bhattacharyya, S., Clerc, M., Hayashibe, M., 2019, Augmenting Motor Imagery Learning for Brain-Computer Interfacing Using Electrical Stimulation as Feedback, IEEE Transactions on Medical Robotics and Bionics, vol. 1, no. 4, pp. 247-255.

Bigirimana, A. D., Siddique, N., Coyle, D., 2020, Emotion-Inducing Imagery versus Motor Imagery for a Brain-Computer Interface, IEEE Transactions on Neural Systems and Rehabilitation Engineering, vol. 28, no. 4, pp. 850-859.

Boyce, W., Lindsay, A., Zgonnikov, A., Rano, I., Wong-Lin, K., 2020, Optimality and limitations of audio-visual integration for cognitive systems, Frontiers in Robotics and AI, vol. 7.

Bucholc, M., Ding, X., Wang, H. /. H., Glass, D. H., Wang, H., Prasad, G., Maguire, L., Bjourson, A., McClean, P., Todd, S., Finn, D., Wong-Lin, K., 2019, A practical computerized decision support system for predicting the severity of Alzheimer's disease of an individual, Expert Systems with Applications, vol. 130, pp. 157-171.

Cheng, Y., Jia, Z., Lai, H., Yang, J., Kasabov, N., 2020, Blue Channel and Fusion for Sandstorm Image Enhancement, IEEE Access, vol. 8, no. 1, pp. 66931-66940.

Dumas, G., Moreau, Q., Tognoli, E., Kelso, J. A. S., 2020, The Human Dynamic Clamp reveals the fronto-parietal network linking real-time social coordination and cognition, Cerebral Cortex, vol. 30, no. 5, pp. 3271-3285.

Furey, E., Davies, M., Curran, K., 2019, Improving Compliance with Bluetooth Device Detection, TELKOMNIKA (Telecommunication, Computing, Electronics and Control), vol. 17, no. 5, pp. 2355-2369.

Gallagher, C., Furey, E., Curran, K., 2019, The Application of Sentiment Analysis and Text Analytics to Customer Experience Reviews to Understand What Customers Are Really Saying, International Journal of Data Warehousing and Mining (IJDWM), vol. 15, no. 4, pp. 21-47.

Gaur, P., Pachori, R. B., McCreadie, K., Wang, H., Prasad, G., 2019, Tangent space features-based transfer learning classification model for two-class motor imagery brain-computer interface, International Journal of Neural Systems (IJNS), vol. 29, no. 10.

Gaur, P., Pachori, R. B., Wang, H., Prasad, G., 2019, An Automatic Subject Specific Intrinsic Mode Function Selection for Enhancing Two-Class EEG based Motor Imagery-Brain Computer Interface, IEEE Sensors Journal, vol. 19, no. 16, pp. 6938-6947.

Gomez, A., Rano, I., Coleman, S., McGinnity, T. M., 2019, Reliable robotic handovers through tactile sensing, Autonomous Robots, vol. 43, no. 7, pp. 1623-1637.

Hossain, S. I., Akhand, M. A. H., Shuvo, M. I. R., Siddique, N., Adeli, H., 2019, Optimization of University Course Scheduling Problem using Particle Swarm Optimization with Selective Search, Expert Systems with Applications, online available, vol. 127.

Kasabov, N., Doborjeh, M., Doborjeh, Z., Enayatollahi, R., Tu, E., Gandomi, A., 2019, Personalised modelling with spiking neural networks integrating temporal and static information, Neural Networks, vol. 119, , pp. 162-177.

Kasabov, N., Ren, R., Guo, Z., Jia, Z., Yang, J., Li, C., 2019, Speckle Noise Removal in Image-based Detection of Refractive Index Changes in Porous Silicon Microarrays, Scientific Reports, vol. 9.

Kelly, D., Condell, J., Curran, K., Caulfield, B. M., 2020, A multimodal smartphone sensor system for behaviour measurement and health status inference, Information Fusion, vol. 53, pp. 43-54.

Korik, A., Sosnik, R., Siddique, N., Coyle, D., 2019, Decoding Imagined 3D Arm Movement Trajectories from EEG to Control Two Virtual Arms - A Pilot Study, Frontiers in Neurorobotics, vol. 13.

Kumarasinghe, K., Kasabov, N., Taylor, D., 2020, Deep learning and deep knowledge representation in Spiking Neural Networks for Brain-Computer Interfaces, Neural Networks, vol. 121, pp. 169-185.

Lennon, O., Tonellato, M., Del Felice, A., Di Marco, R., Fingleton, C., Korik, A., Guanziroli, E., Molteni, F., Guger, C., Otner, R., Coyle, D., 2020, A Systematic Review Establishing the Current State-of-the-Art, the Limitations, and the DESIRED Checklist in Studies of Direct Neural Interfacing With Robotic Gait Devices in Stroke Rehabilitation, Frontiers in Neuroscience, vol. 14.

Liu, Y., Zhang, Y., Coleman, S., Bhanu, B., Liu, S., 2020, A new patch selection method based on parsing and saliency detection for person re-identification, Neurocomputing, vol. 374, pp. 86-99.

Lobo, J., Del Ser, J., Bifet, A., Kasabov, N., 2020, Spiking Neural Networks and online learning: An overview and perspectives, Neural Networks, vol. 121, pp. 88-100.

Maciag, P., Kasabov, N., Kryszkiewicza, M., Bembenika, R., 2019, Air pollution prediction with clustering-based ensemble of evolving spiking neural networks and a case study for London area, Environmental Modelling and Software, vol. 118, pp. 262-280.

McGinnity, T. M., Gault, R., Coleman, S., 2020, Perceptual Modeling of Tinnitus Pitch and Loudness, IEEE Transactions on Cognitive and Developmental Systems, vol. 12, no. 2, pp. 332-343.

McIntyre, C., Johnston, A., Foley, D., Lawler, J., Bucholc, M., Flanagan, L., Sugrue, M., 2020, Readmission to Hospital Following Laparoscopic Cholecystectomy; A Meta-analysis, Anaesthesiology Intensive Therapy, vol. 52, no. 1, pp. 47-55.

Meena, Y., Cecotti, H., Wong-Lin, K., Prasad, G., 2019, Design and evaluation of a time adaptive multimodal virtual keyboard, Journal on Multimodal User Interfaces, vol. 13, pp. 343-361.

Munoz Esquivel, K., Aranda-Valera, I. C., Cuesta-Vargas, A., Garrido-Castro, J. L., Gardiner, P., Lopez-Medina, C., Machado, P. M., Condell, J., Connolly, J., Williams, J., O'Dwyer, T., Castro-Villegas, M. C., Gonzalez-Navas, C., Collantes-Estevez, E., 2020, Measuring spinal mobility using an inertial measurement unit system: a validation study in axial spondyloarthritis, Diagnostics, vol. 10, no. 6.

Munoz Esquivel, K., Gardiner, P., Small, D., Condell, J., Cuesta-Vargas, A., Williams, J., Machado, P. M., Garrido-Castro, J. L., 2020, Validity and Reliability of a Sensor Based Electronic Spinal Mobility Index for Axial Spondyloarthritis, Rheumatology, vol. 2020.

Nikam, S., Jain, N. K., Sawant, M. S., 2020, Optimization of parameters of micro-plasma transferred arc additive manufacturing process using real coded genetic algorithm, The International Journal of Advanced Manufacturing Technology, vol. 106, pp. 1239-1252.

Pang, L., Zhang, Y., Coleman, S., Cao, H., 2020, Efficient Hybrid-Supervised Deep Reinforcement Learning for Person Following Robot, Journal of Intelligent and Robotic Systems: Theory and Applications, vol. 97, no. 2, pp. 299-312.

Pennartz, C., Dora, S., Muckli, L., Lorteije, J., 2019, Towards a Unified View on Pathways and Functions of Neural Recurrent Processing, Trends in Neurosciences, vol. 42, no. 9, pp. 589-603.

Rampun, A., LÃ³pez-Linares, K., Morrow, P., Scotney, B., Wang, H., Garcia OcaÃ±a, I., Maclair, G., Zwiggelaar, R., GonzÃ¡lez Ballester, M. A., MacÃa, I., 2019, Breast pectoral muscle segmentation in mammograms using a modified holistically-nested edge detection network, Medical Image Analysis, vol. 57.

Rankin, D., Black, M., Bond, R., Wallace, J., Mulvenna, M., Epelde, G., 2020, Reliability of Supervised Machine Learning Using Synthetic Data in Health Care: Model to Preserve Privacy for Data Sharing, JMIR Medical Informatics, vol. 8, no. 7.

Rathee, D., Raza, H., Prasad, G., Cecotti, H., 2019, Current Source Density Estimation Enhances the Performance of Motor-Imagery Related Brain-Computer Interface, IEEE Transactions on Neural Systems and Rehabilitation Engineering, vol. 25, no. 12, pp. 2461-2471.

Samima, S., Sarma, M., Samanta, D., Prasad, G., 2019, Estimation and quantification of vigilance using ERPs and eye blink rate with a fuzzy model-based approach, Cognition, Technology and Work, vol. 21, , pp. 517-533.

Sawant, M. S., Jain, N. K., Nikam, S. H., 2019, Theoretical modeling and finite element simulation of dilution in micro-plasma transferred arc additive manufacturing of metallic materials, International Journal of Mechanical Sciences, vol. 164.

Siddique, N., Akhand, M. A. H., Ayon, S. I., Shahriyar, S. A., Adeli, H., 2020, Discrete Spider Monkey Optimization for Travelling Salesman Problem, Applied Soft Computing Journal, vol. 86.

Taherkhani, A., Belatreche, A., Li, Y., Cosma, G., Maguire, L., McGinnity, T. M., 2020, A Review Of Learning In Biologically Plausible Spiking Neural Networks, Neural Networks, vol. 122, pp. 253-272.

Wingfield, B., Coleman, S., McGinnity, T. M., Bjourson, A., 2019, Robust Microbial Markers for Non-Invasive Inflammatory Bowel Disease Identification, IEEE/ACM Transactions on Computational Biology and Bioinformatics, vol. 16, no. 6, pp. 2078-2088.

Yang, S., Sanchez Bornot, J., Wong-Lin, K., Prasad, G., 2019, M/EEG-Based Bio-Markers to Predict the MCI and Alzheimer's Disease: A Review From the ML Perspective, IEEE Transactions on Biomedical Engineering, vol. 66, no. 10, pp. 2924-2935.

Zhang, M., Beetle, C., Kelso, J. A. S., Tognoli, E., 2019, Connecting empirical phenomena and theoretical models of biological coordination across scales, Journal of The Royal Society Interface, vol. 16, no. 157.

Zhang, M., Kalies, W. D., Kelso, J. A. S., Tognoli, E., 2020, Topological portraits of multiscale coordination dynamics, Journal of Neuroscience Methods, vol. 339.

Zhi, L., Jia, Z., Luyang, L., Yang, J., Kasabov, N., 2020, A method to improve the accuracy of SAR image change detection by using an image enhancement method, ISPRS Journal of Photogrammetry and Remote Sensing, vol. 163, pp. 137-151.

Zuo, J., Jia, Z., Yang, J., Kasabov, N., 2019, Moving Target Detection Based on Improved Gaussian Mixture Background Subtraction in Video Images, IEEE Access, vol. 7, pp. 152612-152623.

3.2 Books/Chapters in Books

Munoz Esquivel, K., Alamaki, A., Nevala, E., Barton, J., Condell, J., Nordstrom, A., Tedesco, S., Kelly, D., Heaney, D., 2019, Wearable Technology Supported Home Rehabilitation Services in Rural Areas, Karelia University of Applied Sciences, 58.

3. 3 Published Conference Papers

Bhattacharyya, S., Valeriani, D., Cinel, C., Citi, L., Poli, R., 2019, Collaborative Brain-Computer Interfaces to Enhance Group Decisions in an Outpost Surveillance Task.

Bigirimana, A. D., Dayan, N., Coyle, D., McCann, A., Stow, J., McElligott, J., 2019, TOWARDS ANSWERING QUESTIONS IN DISORDERS OF CONSCIOUSNESS AND LOCKED-IN SYDROME WITH A SMR-BCI, The 8th Graz BCI Conference, 2019.

Calero de Torres, J., Gardiner, B., Dahi, I., Moffett, S., Herbst, M., Condell, J., 2019, An Efficient Approach to Automatic Generation of Time-lapse Video Sequences, pp. 198, Irish Machine Vision Image Processing Conference.

Cecotti, H., Meena, Y., Bhushan, B., Dutta, A., Prasad, G., 2019, A multiscript gaze-based assistive virtual keyboard, IEEE, 2019 41st Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC).

Cooley, C., Coleman, S., Gardiner, B., Scotney, B., 2019, An Investigation of Gradient as a Feature Cue for Saliency Detection, pp. 13-17, 2019 2nd International Conference on Artificial Intelligence and Pattern Recognition.

Cooley, C., Coleman, S., Gardiner, B., Scotney, B., 2019, Multi-Scale Saliency using Local Gradient and Global Colour Features, pp. 28-32.

Cooney, C., Korik, A., Raffaella, F., Coyle, D., 2019, Classification of imagined spoken word-pairs using convolutional neural networks, Verlag der Technischen Universitat Graz, pp. 338-343, The 8th Graz BCI Conference, 2019.

Gillespie, J., Rano, I., Siddique, N., Santos, J. A., Khamassi, M., 2019, Using Reinforcement Learning to Attenuate for Stochasticity in Robot Navigation Controllers, IEEE, pp. 704.

Haji Karim, S., Harkin, J., McDaid, L., Gardiner, B., Liu, J., 2020, AstroByte: A multi-FPGA Architecture for Accelerated Simulations of Fault-tolerant Spiking Astrocyte-Neuron Networks, IEEE, pp. 1568-1573.

Harrigan, S., Coleman, S., Kerr, D., Pratheepan, Y., Fang, Z., Wu, C., 2020, Neural Coding Strategies for Event-Based Vision Data, 2020 IEEE International Conference on Acoustics, Speech and Signal Processing.

Harrigan, S., Coleman, S., Kerr, D., Pratheepan, Y., Zheng, F., Wu, C., 2019, Neuromorphic Event-based Action Recognition, Irish Pattern Recognition and Classification Society, pp. 218 - 221.

Harrigan, S., Coleman, S., Kerr, D., Yogarajah, P., Fang, Z., Wu, C., 2020, Neural coding strategies for event-based vision data, Institute of Electrical and Electronics Engineers Inc., pp. 2468-2472, 2020 IEEE International Conference on Acoustics, Speech, and Signal Processing, ICASSP 2020.

Henderson, B., Pratheepan, Y., Gardiner, B., McGinnity, T. M., Forster, K., Nicholas, B., Wimpory, D., Wanigasinghe, J., 2020, Effects of Intra-Subject Variation in Gait Analysis on ASD Classification Performance in Machine Learning Models, ISSC 2020 - 31st Irish Signals and Systems Conference.

Joshi, A., Rhodes, O., Sharp, T., Furber, S., Wong-Lin, K., 2020, Long- and short-range connectivity and neuronal types affect prefrontal dorsal raphe circuit dynamics differently, Neuromatch.

Liu, J., McDaid, L., Harkin, J., Haji Karim, S., Johnson, A. P., Halliday, D. M., Tyrrell, A., Timmis, J., Millard, A. G., Hilder, J., 2019, Autonomous Learning Paradigm for Spiking Neural Networks, pp. 737-744.

Mc Hugh, C., Coleman, S., Kerr, D., McGlynn, D., 2020, Forecasting Day-Ahead Electricity Prices With A SARIMAX Model, Institute of Electrical and Electronics Engineers Inc., pp. 1523-1529, 2019 IEEE Symposium Series on Computational Intelligence, SSCI 2019.

Pratheepan, Y., Wijesinghe, A., Samarasinghe, P., Seneviratne, S., Pulasinghe, K., 2019, Machine Learning Based Automated Speech Dialog Analysis Of Autistic Children, IEEE.

Sharma, P., Coleman, S., Pratheepan, Y., Taggart, L., 2019, Micro Expression Classification Accuracy Assessment, Irish Pattern Recognition and Classification Society, pp. 21-28.

Sweeney, T., Coleman, S., Kerr, D., 2019, A Machine Learning Approach to Wafer Defect Classification using Bag of Visual Words, pp. 183 - 189.

Wang, F., Xu, Z., Zhang, W., Wu, S., Zhang, Y., Coleman, S., 2020, An Adaptive Control Approach for Intelligent Wheelchair Based on BCI Combining with QoO, Institute of Electrical and Electronics Engineers Inc., , 2020 International Joint Conference on Neural Networks, IJCNN 2020.

## 3.	Research Funding

Ongoing and Active Research Projects, notably:

Unit of Assessment Member	Title of Award	Funding Body	Value	Project Dates
Dr D Kerr **Prof S Coleman** **Dr P Vance** **Prof TM McGinnity**	BIONICS	Invest NI - Proof of Concept	£ 96,938.00	01/04/17 – 01/08/19
Prof D Coyle Prof A Duffy	Feasibility of Cognitive CAED	EPSRC	£ 147,142.00	01/07/15 – 30/11/19
Dr JG Harkin **Prof LP Maguire**	iTEMPO	Invest NI - Proof of Concept	£ 105,993.00	03/04/17 – 01/05/21
Dr Michaela Black **Dr D Rankin** Prof MD Mulvenna Brian Murphy Dr R Bond Prof JG Wallace Dr D Weston Dr P Carlin Mr M Van Gils Mr J Paakkonen Mr D Bryce Mr R Kaikkohen Prof J Millar Dr I Macia Dr A Tanney Prof B De Moor Mr R Bilbao Dr P Davis Dr P O Sullivan Mr M Grobelnik	H2020 -MIDAS	CEC-H2020-SC Health	£ 660,325.00	01/01/17 – 29/02/20
Dr K Wong-Lin Prof T Sharp Prof D Bannerman	Midbrain Raphe Microcircuitry	BBSRC	£ 192,572.00	01/10/16 – 30/06/20
Dr JV Condell **Mr M Callaghan** Dr I Rano Dr SM Moffett	CINE	CEC NPP Northern Periphery & Arctic Pro	£ 131,258.00	01/09/17 – 31/12/20

Dr JV Condell Mr RJ Davies **Dr D Kelly** Ms M Saastmoinen Mr J Barton Ms S Timmons Ms A Nordstrom Mr J Connolly Mr A Niemi Ms AM Ulrik	SENDOC	CEC NPP Northern Periphery & Arctic Pro	£ 329,035.00	01/09/17 – 31/12/20
Prof G Prasad Prof SM McDonough Dr H Cecotti Prof A Dhutta	Advancing MEG-based BCI	UKIERI	£ 144,546.00	01/04/17 – 30/12/20
Prof D Coyle **Prof LP Maguire** Dr F Lotte	Human Machine Symbiosis	UK Government	£ 215,535.00	20/01/14 – 31/01/21
Dr M Black Mrs J Allison Dr AA Moore Prof MET McKinney	IM HAPPY (Improving Hopes, Aspirations, Potential and Prospects in Youth)	Department of Social Development	£360,768.00	01/09/13 – 31/03/20
Prof B Scotney **Prof S Coleman** **Dr D Kerr** **Prof TM McGinnity**	SLANDAIL - Security System for Language and Image Analysis	C.E.C. - Framework 7 - SEC-2013-1.6-3	£296,820.00	01/04/14 – 31/12/19
Prof S Coleman **Mr AJ McCaughey**	Capital Markets Engineering Studentships - CME Group	CME Technology & Support Services Ltd	£60,000.00	01/05/15 – 31/12/22
Dr M Black Mrs J Allison Dr AA Moore Prof MET McKinney	I'M HAPPY Extension	Department of Social Development	£114,413.00	01/04/15 – 31/03/20
Dr M Black Prof MET McKinney	BUS STOP	Coleraine Borough Council	£74,859.00	12/03/14 – 31/03/20
Prof Eugene McNamee **Prof LP Maguire** **Prof KJ Curran**	Ulster Centre for Legal Innovation	Allen and Overy Foundation	£250,000.00	01/07/16 – 31/01/20

Dr M Black Mrs J Allison Dr AA Moore Prof MET McKinney	IM HAPPY Project - Extension 2016/17	Department of Social Development	£121,440.00	01/04/16 – 31/03/20
Prof P McKevitt **Prof KJ Curran**	BLISS: Broadcast Language Identification and Subtitling Systems	Invest NI - Proof of Concept	£105,922.00	01/10/16 – 31/08/19
Prof KJ Curran **Dr D Kelly**	KTP Programme between University of Ulster and Sentel Independent Ltd	TSB/INI and Sentel Independent Ltd	£123,167.00	15/12/16 – 14/09/19
Prof AJ Bjourson Dr PL McClean **Dr K Wong-Lin** Dr V McGilligan **Prof G Prasad** **Prof D Coyle** **Prof LP Maguire** Prof VE Coates Dr R Bond Dr A Peace, WHSCT Mr P Gillespie, NUI Galway	Centre for Personalised Medicine: Clinical Decision Making and Patient Safety (CPM)	INTERREG VA	£2,664,871.00	01/04/17 – 31/03/22
Prof AJ Bjourson Dr PL McClean **Dr K Wong-Lin** Dr V McGilligan **Prof G Prasad** **Prof D Coyle** **Prof LP Maguire** Prof VE Coates Dr R Bond Dr A Peace, WHSCT Mr P Gillespie, NUI Galway	Centre for Personalised Medicine: Clinical Decision Making and Patient Safety (CPM) PhD Costs	INTERREG VA	£978,057.00	01/04/17 – 31/03/22
Prof Eugene McNamee **Prof KJ Curran** Catrina Denvir	Baker McKenzie Research Project	Baker McKenzie	£183,356.00	01/04/17 – 31/03/20
Prof S Coleman **Dr D Kerr**	KTP Programme between University of Ulster and Project Plug Limited	TSB/INI and Project Plug Ltd	£129,935.00	16/02/17 – 15/11/19
Dr JV Condell	Can Inertial Movement Sensors (IMUS) provide a valid and reliable way of measuring spinal movement in Axial Spondyloarthritis	Foundation for Research in Rheumatology	£91,523.00	14/03/17 – 31/05/21

Prof S Coleman **Dr D Kerr** **Dr B Gardiner**	KTP Programme between the University of Ulster and Axis Bioservices Ltd	TSB/INI and Axis Bioservice Ltd	£211,501.00	11/04/17 – 10/01/21
Dr S Wilson Justin Magee	KTP Programme between University of Ulster and Axial Medical Printing Ltd	TSB/INI and Axial Medical Printing Ltd	£147,840.00	11/04/17 – 10/01/20
Prof GA Armstrong **Prof LP Maguire** Mr M Pogue Mr P Devine Prof PK Humphreys	CME Group Foundation PhD/Postgraduate Studentships	CME Group Foundation	£148,543.00	01/09/17 – 30/06/22
Dr M Black	I'm HAPPY project - Extension 2017/18	Department for Communities NI	£121,440.00	01/04/17 – 31/03/20
Dr M Black	I'm HAPPY 2018-19	Department for Communities NI	£102,110.00	01/04/18 – 31/03/20
Prof JG Wallace Prof MF McTear **Dr M Black**	KTP Programme between University of Ulster and Kraydel Limited	Innovate UK/INI and Kraydel Limited	£242,280.00	24/05/18 – 15/01/22
Prof LP Maguire	Dr George Moore Chair in Data Analytics	Mrs Angela Moore	£3,000,000.00	01/08/18 – 31/07/35
Prof LP Maguire	Dr George Moore Research Fellowship in Data	Mrs Angela Moore	£2,000,000.00	01/09/18 – 31/08/35
Dr R Price **Dr K Wong-Lin** Dr L Dowey Dr F Duffy, NHSCT Mr B Crossey, Nightingale Analytics Mrs S Casey, AgeNI	Dementia Data Analytics Project	HSC R&D Public Health Agency	£100,000.00	01/11/18 – 31/10/19

Dr M Black Prof AJ Moore Dr CIR Gill Dr C Hughes **Dr D Rankin** Prof HM McNulty Dr L Hoey Prof JG Wallace Paul Carlin, SEHSC, Research	DARUG	NHSCT (HSC)	£99,904.81.00	01/09/19 – 31/07/21
Prof D Coyle **Dr K McCreadie**	Spatial Computing & Neurotechnology Innovation Hub (Scan i-hub)	Department for the Economy-HERC Funding	£266,277.00	01/11/18 – 31/07/20
Prof E Ramsey Dr S Loane **Dr JV Condell** Michael Carty, Sligo County Council Jose Maria Costa, Camara Municipal de Giancario Fedeli, Glasgow Caledonian Loretta McNicholas, Donegal County Cou Ryan Barry, Merthyr Tydfil County Boroug Ana Maria Brito Botin, GRAFCAN Idoia Madariaga Lopez, Nusuvinsa	TrailgazersBid	CEC-INTERREG V - Atlantic Area Programme	£191,579.00	01/04/19 – 30/11/22
Dr JV Condell **Dr D Kelly** **Dr B Gardiner** Prof E Ramsey	REAMIT - Improving Resource Efficiency of Agri-business supply chain by Minimizing Waste using Big Data and Internet of Things Sensors	INTERREG VB NWE	£348,209.00	10/01/19 – 09/07/22
Prof S Coleman **Dr D Kerr**	KTP Programme between University of Ulster and Metro Surveillence Group Ltd	Innovate UK/INI and Metro Surveillance G	£271,676.00	01/08/19 – 31/07/22

Dr R Price **Dr K Wong-Lin** **Dr M Bucholc** Dr L Dowey Mr B Crossey, Nightingale Analytics Dr F Duffy, NHSCT	Enhanced decision support tool for timely diagnosis of dementia	HSC R&D Public Health Agency	£90,470.76	01/11/19 – 31/03/20
Dr JG Harkin **Mr M McElholm**	iTEMID - Intelligent Total Management in Dairying	NI Agricultural R&D Council - AgriSearch	£59,339.00	01/01/20 – 31/12/20
Dr JV Condell **Dr Shirin Dora** Prof G Leavey Dr D Gibson Marcus Sauer, CGT Rens Brankaert, Technische Univer Vincent Kraus, KRG Corporate Niels Hendriks, LUCA Sch of Arts Joan Condell, ActionSpace Ltd Henk Herman Nap, Vilans Guido Gabriel, Climax Deutschland Ralf Ihl, Alexianer Forschungszenentrum Karin Heezen, Regionale Stitchting Jawad Hajam, CENTICH Michel borteks, OCMW Genk	Certification of technological products for people with dementia to support SMEs in innovation and business growth	INTERREG VB NWE	£221,035.00	26/09/19 – 25/03/23
Prof D Coyle Prof V Molkov Prof JAD McLaughlin Prof AJ Bjourson Mr S Orr, Catalyst Inc Mr S Trotter, Dell Corporation Ltd Prof R Woods, QUB	Northern Ireland HPC - Kelvin-2	EPSRC	£494,698.00	01/01/20 – 31/12/23
Prof N Hewitt **Prof LP Maguire**	Foyle River Gardens	Invest NI via Case	£172,135.00	30/03/20 – 30/09/21

Dr JV Condell Prof G Leavey **Dr D Rankin** **Dr P Chaurasia** Jean-Charles Minier, INNO TSD Natacha Straus, Namur-Europe-Wallonie Cecile Thioux, Haute Ecole de la Provinc Deborah Sebbanem EPSM Lille Metropole Marc Meddens, Brainscan BV Guy Tanonkou, Agence pour la Cooperation Heleen Riper, Vrije Universiteit Amsterd Carolin Steuwe, Evangelisches Klinikum Martin Malcolm, Nat Health Services Jocely Deloyer, CNP Saint-Martin Gerard Vincent, Live-Out	IT4Anxiety: Managing anxiety via innovative technologies for better mental health	Interreg VB North West Europe	£273,348.00	01/11/19 – 31/10/23
Dr M Black	IM HAPPY 2019-20	Department for Communities NI	£82,222.00	01/04/19 – 31/03/20
Prof S Coleman **Dr D Kerr**	Digital Natives - PhD Studentship	Ditigal Natives Ltd BVI	£94,590.00	29/09/19 – 30/09/23

Dr JV Condell **Mr M Callaghan** **Dr P Chaurasia** Kajsa Aberg, Vasterbotten County Council Lesley Benfield, Lochaber Chamber of Com AleKsandra Lakovleva, Federal State Budg Steve Taylor, Uni of the Highlands and I Anna Insa Vermehren, Museum Nord Judith McCarthy, Donegal County Mus Mathias Lindstrom, Kvarken Council Irena Kernan, Craft Scotland Brenda Murphy, Tourism NI Carole O'Kane, Causeway Coast & Glens Tr Malcolm Roughhead, VisitScotland Jayne Taggart, Causeway Enterprise Agenc Jamie Andrews, Techstart NI Thorvardur Arnason, HRC, Uni of Iceland David Gray, Robert Gordon Uni	Storytagging 3: A digital platform to enhance the market reach of creative SMEs by collecting, mapping and bringing stories to life	Interreg NPA Prep	£102,157.00	01/05/20 – 30/04/22

Portfolio of Research Grants awarded during period 1 August 2019 - 31 July 2020

Unit of Assessment Member	Title of Award	Funding Body	Value
Prof E Ramsey Dr S Loane Dr JV Condell Ana Maria Brito Botin, GRAFCAN Giancario Fedeli, Glasgow Caledonian Idoia Madariaga Lopez, Nusuvinsa Jose Maria Costa, Camara Municipal de Loretta McNicholas, Donegal County Council Michael Carty, Sligo County Council Ryan Barry, Merthyr Tydfil County Borough	TrailgazersBid	CEC-INTERREG V - Atlantic Area	£191,579.00
Dr JV Condell Prof E Ramsey Dr B Gardiner Dr D Kelly	REAMIT - Improving Resource Efficiency of Agri-business supply chain by Minimizing Waste using Big Data and Internet of Things Sensors	INTERREG VB NWE	£348,209.00
Prof S Coleman Dr D Kerr	KTP Programme between University of Ulster and Metro Surveillence Group Ltd	Innovate UK/INI and Metro Surveillance G	£271,676.00
Dr M Bucholc Dr S Bauermeister, Ui of Oxford	The impact of hearing impairment and hearing-enhancing interventions on the risk of progression to dementia in mild cognitive impairment cases and the pace of disease progression in dementia cases: a preliminary analysis	Alzheimer's Research UK	£2,200.00
Dr M Bucholc Dr PL McClean Dr F Duffy, NHSCT Dr S Titarenko, Uni of Huddersfield	A semi-supervised machine learning framework for predicting conversion from mild cognitive impairment to Alzheimer's disease	Alzheimer's Research UK	£4,200.00
Dr X Ding Dr Li Su, University of Cambridge Prof Qinyong Ye, Fujian Medical	Data extraction for dementia diagnosis	Alzheimer's Research UK	£5,000.00

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Prof D Coyle Mr AD Bigirimana Prof G Prasad Dr N du Bois Leon Muteas, University of Rwanda Stefan Jansen, University of Rwanda	Strengthening the capacity of Rwandan-based cognitive neuroscience to study the etiology of Post-Traumatic Stress Disorder (PTSD) in Rwanda	Department for the Economy-GCRF	£32,500.00
Dr M Bucholc Dr PL McClean Dr X Ding Prof D Wang, Fujian Medical Uni Prof Y Qinyong, Fujian Medical Uni	Association between hearing impairment, use of hearing aids and risk of developing dementia in older adults: a pilot study in China - Funding to further develop the proposal	Department for the Economy-GCRF	£10,000.00
Dr JG Harkin Mr M McElholm	iTEMPO - Track. Analyse. Optimize - 2nd Phase	Innovate UK via ICURe Programme	£13,484.00
Dr R Price Dr L Dowey Dr K Wong-Lin Dr M Bucholc Dr F Duffy, NHSCT Mr B Crossey, Nightingale Analytics	Enhanced decision support tool for timely diagnosis of dementia	HSC R&D Public Health Agency	£90,470.76
Dr D Rankin Dr M Black Prof S Coleman Elaine Duffy	Reimagining Recruitment Workshop	EPSRC via University of Bath	£15,000.00
Dr JV Condell Prof G Leavey Dr D Gibson Dr Shirin Dora Guido Gabriel, Climax Deutschland Henk Herman Nap, Vilans Jawad Hajam, CENTICH Joan Condell, ActionSpace Ltd Karin Heezen, Regionale Stitchting Marcus Sauer, CGT Michel borteks, OCMW Genk Niels Hendriks, LUCA Sch of Arts Ralf Ihl, Alexianer	Certification of technological products for people with dementia to support SMEs in innovation and business growth	INTERREG VB NWE	£221,035.00

Forschungszenentrum Rens Brankaert, Technische Uni Vincent Kraus, KRG Corporate			
Prof D Coyle Prof AJ Bjourson Prof V Molkov Prof JAD McLaughlin Mr S Orr, Catalyst Inc Mr S Trotter, Dell Corporation Ltd Prof R Woods, QUB	Northern Ireland HPC – Kelvin- 2	EPSRC	£494,698.00
Prof N Hewitt Prof LP Maguire	Foyle River Gardens	Invest NI via Case	£172,135.00
Dr JV Condell Prof G Leavey Dr D Rankin Dr P Chaurasia Carolin Steuwe, Evangelisches Klinikum Cecile Thioux, Haute Ecole de la Provinc Deborah Sebbanem EPSM Lille Metropole Gerard Vincent, Live-Out Guy Tanonkou, Agence pour la Cooperation Heleen Riper, Vrije Universiteit Amsterd Jean-Charles Minier, INNO TSD Jocely Deloyer, CNP Saint-Martin Marc Meddens, Brainscan BV Martin Malcolm, Nat Health Services Natacha Straus, Namur-Europe-Wallonie	IT4Anxiety: Managing anxiety via innovative technologies for better mental health	Interreg VB North West Europe	£273,348.00
Dr D Rankin Dr M Black Dr R Bond Mr J Lubinda Prof JG Wallace Prof MD Mulvenna	MIDAS Symposium 2020	HSC R&D Workshop and Conference Scheme	£2,500.00
Dr M Black	IM HAPPY 2019-20	Department for Communities NI	£85,222.00