

Computing, Engineering and Intelligent Systems



August 2020 – July 2021

Annual Report
for Research & Impact



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1. Foreword:

Professor Damien Coyle

Research Director

In presenting the Annual Report for the School of Computing, Engineering and Intelligent Systems (SCEIS) for the academic year 2020-2021, I am pleased to record a very successful year with many major accomplishments by our staff and graduate researchers. Notwithstanding it being another challenging year for research, the achievements highlighted here show substantial progress in our research growth plans at the Intelligent Systems Research Centre (ISRC).

I was awarded a prestigious UKRI Turing Artificial Intelligence (AI) Acceleration Fellowship, one of only fifteen awarded to the UK's top AI researchers to develop world-leading outputs. This fellowship, valued at £2.1m, will focus on AI for Intelligent Neurotechnology and trialing brain-computer interfaces with end-users on a large scale. Named after British AI pioneer, Alan Turing, the £20 million fellowship scheme is delivered by the Engineering and Physical Sciences Research Council (EPSRC), part of UK Research and Innovation (UKRI), in partnership with the Alan Turing Institute and the Office for Artificial Intelligence. Science Minister, Amanda Solloway is quoted as saying: "The UK is the birthplace of artificial intelligence, and we therefore have a duty to equip the next generation of Alan Turing's, like Ulster University's Professor Damien Coyle, with the tools that will keep the UK at the forefront of his remarkable technological innovation".

Our future growth plans took another major step forward this year with the Heads of Terms Agreement being signed off for the £250m Derry & Strabane City Deal package. The ISRC is leading on two major innovation projects within the City Deal. The Cognitive Analytics Research Laboratory (CARL, total value £16.5m) will establish a research and innovation centre dedicated to cognitive analytics and AI and enable our growth plans for CARL virtual established in 2017 as well as expansion of the ISRC's core research themes which underpin new AI developments for industry-led challenges in data analytics. The Centre for Industrial Digitization and Robotics Automation (CIDRA, total value £22.5m) will be a centre of excellence for Industry 4.0 with a focus on enabling innovation and advancements in productivity in the manufacturing sector through the adoption of emerging digital technologies and AI.

Our City Deal focus on building capacity in AI through CARL and CIDRA has been recognized by our involvement in the SmartNanoNI project consortium (<https://www.smartnanoni.com/>). SmartNanoNI is developing game-changing advanced prototyping and smart manufacturing methods to deliver new technologies and is aimed at driving self-sustaining local industry and economic growth through research and innovation. The consortium shares a niche capability around nano manufacturing and world-leading knowledge in photonics and has been awarded £42.4m by UK Research and Innovation's Strength in Places Fund. The total project value including leveraged funding from other sources is £63.9m. The ISRC will play a fundamental role in developing AI, analytics and robotic capability to address automation opportunities in advanced manufacturing at the Seagate Technologies facility in Springtown Derry.

Advances in AI require increasingly powerful computing systems and the skillsets to utilize these high-performance computing technologies and I am pleased that we have continued to develop capability in this area this year. In partnership with Queen's University Belfast, we have onboarded and trained new high performance computing users at the Northern Ireland High Performance Computing (NIHPC) Facility (<https://www.ni-hpc.ac.uk>) which is funded by the previously reported £2.1m award from the Engineering and Physical Research Council (EPSRC). The facility now has over 60 Ulster HPC users with over 40 users involved in projects at the Intelligent Systems Research Centre. As only one of seven such facilities in the UK, NI-HPC is enabling 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. The NIHPC facility can be accessed by any Ulster researchers, and we

provided training to support new and experienced users with a focus on increasing HPC adoption across research groups within the university who can benefit from access.

Other notable research grants this year include two US-Ireland R&D grants, one led by Dr Wong-Lin (£500,000) in partnership with Columbia University, New York and University College Dublin and the other by Prof McDaid (£389,995) in partnership with Kansas State University and NUI Galway. Continuation of work at our Legal Innovation Centre has been supported through a further investment of £500k by Allen and Overy Limited and is led by Prof Curran in partnership with School of Law. Dr Bucholc (£354,637) in partnership with colleagues at the Centre for stratified Medicine and Trinity College Dublin has continued our efforts to address COVID-19 related research questions with the support of a Department for Economy – Science Foundation Ireland Phase 2 research grant (£354,637). In total, staff have been involved in more than 60 externally funded projects valued at over £4.6m this year, have published 109 papers in high impact journals, books and conferences and we have graduated 6 new PhD graduates this year.

Activities this year have contributed to our submission to the research excellence framework 2021 (REF2021). REF is the system for assessing the quality of research in UK higher education institutions and we submit within Computer Science and Informatics subject area. A selection of research outputs published by 33 research active members of academic staff within the school along with case studies detailing the significance and reach of the impact of our research and a detailed report of our research environment development over the past 7 years was submitted for assessment. This was a significant undertaking, and we appreciate the contributions made by all staff in preparing an impressive submission in partnership with colleagues within the School of Computing on the Jordanstown campus.

Despite the busy year and challenges associated with the COVID-19 health emergency the commitment of all our researchers and excellent support provided by administrative staff has been exceptional. As we publish this report, we look forward to another exciting year that builds on the major funding secured this year and delivers new high quality research capacity that can positively impact the wider region, and of course we look forward to the REF2021 results to be announced in May 2022.

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](tel:+442871675148).



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 2020-21.

Name	Thesis title
Ahmed, Salman	Natural Language Processing for Speech Tagging, Sentiment analysis and Predictive analytics.
Burns, Kelli	The impact of the analytical performance of laboratory tests on clinical decision making.
Chavan, Sayali	Computer vision for advertising analytics.
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	Open-Ended Continuous Reinforcement Learning For Mobile Robots.
Doherty, John	Autonomous Object Recognition for Robots.
Gillespie, James	Learning of bio-inspired movement in highly noisy environments.
Gorman, Mark	Utilising multivariate high frequency time series datasets for real-time decision making applications.
Hamilton, Natasha	Exploiting Brain Inspired Information Processing in Hardware to Develop Highly Reliable, Always-on Smart Sensor Systems.
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.
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	Algorithmic Approaches to Energy Market Price Prediction.
McShane, Niall	Augmented Reality Brain-computer Interface .
Millar, Christopher	Kinaesthetic learning for robotic object manipulation.
Murray, Cathal	Creating opportunities for growth within the circular economy - predicting and minimising food waste.
Osinski, Mateusz	Deep-learning assisted tele-medicine for the delivery of diabetic retinopathy screening in low- and middle-income countries.
Poshtkohl, 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 plausibility 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 2020

Name	Thesis title
Haji-Karim, Shvan	AstroByte: Programmable and scalable multi-FPGA interconnect infrastructure for accelerated simulations of self-repairing spiking astrocyte neural networks.
Duffy, William	Unobtrusive activity detection using a single wearable sensor.
Bigirimana, Alain	Affective state and emotion inducing imagery classification for brain-computer interfaces.

Graduated Summer 2021

Name	Thesis title
Harrigan , Shane	Neuromorphic Vision Processing.
Behera, Chandan	Neural Network Modelling and Analysis of Serotonergic System.
Fegan, John	A Square-spiral Framework for Fast Image Processing.

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

Akhand, MAH, Habib, MA, Kamal, MAS & Siddique, N 2021, 'Physarum-Inspired Bicycle Lane Network Design in a Congested Megacity', *Applied Sciences*, vol. 11, no. 15, pp. e6958.
<https://doi.org/10.3390/app11156958>

Al-Aswad, H, El-Medany, WM, Balakrishna, C, Ababneh, N & Curran, K 2021, 'BZKP: Blockchain-based zero-knowledge proof model for enhancing healthcare security in Bahrain IoT smart cities and COVID-19 risk mitigation', *Arab Journal of Basic and Applied Sciences*, vol. 28, no. 1, pp. 154-171.
<https://doi.org/10.1080/25765299.2020.1870812>

Ankita, Rani, S, Babbar, H, Coleman, S, Singh, A & Aljahdali, HM 2021, 'An Efficient and Lightweight Deep Learning Model for Human Activity Recognition Using Smartphones', *Sensors*, vol. 21, no. 11, e3845. <https://doi.org/10.3390/s21113845>

Ballin, M, Nordstrom, P, Niklasson, J, Alamäki, A, Condell, J, Tedesco, S & Nordström, A 2020, 'Daily Step Count and Incident Diabetes in Community-Dwelling 70-Year-Olds: A Prospective Cohort Study', *BMC Public Health*, vol. 20, 1830, pp. 1-20.
<https://doi.org/10.1186/s12889-020-09929-2>

Behera, C, Condell, J, Dora, S, Gibson, D & Leavey, G 2021, 'State-of-the-Art Sensors for Remote Care of People with Dementia during a Pandemic: A Systematic Review', *Sensors*, vol. 21, no. 14, 4688.
<https://doi.org/10.3390/s21144688>

Bucholc, M, McClean, P, Bauermeister, S, Todd, S, Ding, X, Ye, Q, Wang, D, Huang, W & Maguire, L 2021, 'Association of the use of hearing aids with the conversion from mild cognitive impairment to dementia and progression of dementia: a longitudinal retrospective study', *Alzheimer's and Dementia: Translational Research and Clinical*

Interventions, vol. 7, no. 1, e12122, pp. e12122.
<https://doi.org/10.1002/trc2.12122>

Caffrey, A, McNulty, H, Rollins, M, Prasad, G, Gaur, P, Talcott, J, Witton, C, Cassidy, T, Marshall, B, Dornan, J, Moore, AJ, Ward, M, Strain, S, Molloy, A, McLaughlin, M, Lees Murdock, D, Walsh, CP & Pentieva, K 2021, 'Effects of maternal folic acid supplementation during the second and third trimesters of pregnancy on neurocognitive development in the child: an 11-year follow-up from a randomised controlled trial', *BMC Medicine*, vol.19, no. 1, 73.
<https://doi.org/10.1186/s12916-021-01914-9>

Chaurasiaa, P, McClean, SI, Nugent, CD, Cleland, I, Zhang, S, Donnelly, MP, Scotney, B, Sanders, C, Smith, K, Norton, MC & Tschanz, J 2021, 'Modelling mobile-based technology adoption among people with dementia', *Personal and Ubiquitous Computing*, pp. 1-20.
<https://doi.org/10.1007/s00779-021-01572-x>

Cheng, Y, Jia, Z, Lai, H, Yang, J & Kasabov, N 2020, 'A Fast Sand-Dust Image Enhancement Algorithm by Blue Channel Compensation and Guided Image Filtering', *IEEE Access*, vol. 8, pp. 196690-196699.
<https://doi.org/10.1109/ACCESS.2020.3034151>

Chowdhury, A, Dutta, A & Prasad, G 2020, 'Corticomuscular Co-Activation Based Hybrid Brain-Computer Interface for Motor Recovery Monitoring', *IEEE Access*, vol. 8, pp. 174542 - 174557.
<https://doi.org/10.1109/ACCESS.2020.3026037>

Cooney, C, Korik, A, Raffaella, F & Coyle, D 2020, 'Evaluation of Hyperparameter Optimization in Machine and Deep Learning Methods for Decoding Imagined Speech EEG', *Sensors*, vol. 20,

no. 16, 4629, pp. 1-22.

<https://doi.org/10.3390/s20164629>

Doborjeh, M, Doborjeh, Z, Kasabov, N, Barati, M & Wang, G 2021, 'Deep Learning of Explainable EEG Patterns as Dynamic Spatiotemporal Clusters and Rules in a Brain-Inspired Spiking Neural Network.', *Sensors (Switzerland)*, vol. 21, no. 14, 4900, pp. 1-21.

<https://doi.org/10.3390/s21144900>

Doborjeh, Z, Doborjeh, M, Crook-Rumsay, M, Taylor, T, Wang, G, Moreau, D, Krageloh, C, Wrapson, W, Siegert, R, Kasabov, N, Searchfield, G & Sumich, A 2020, 'Interpretability of Spatiotemporal Dynamics of the Brain Processes Followed by Mindfulness Intervention in a Brain-Inspired Spiking Neural Network Architecture', *Sensors*, vol. 20, no. 24, 7354, pp. 1-29.

<https://doi.org/10.3390/s20247354>

Dodel, S, Tognoli, E & Kelso, JAS 2020, 'Degeneracy and Complexity in Neuro-Behavioral Correlates of Team Coordination', *Frontiers in Human Neuroscience*, vol. 14, 328.

<https://doi.org/10.3389/fnhum.2020.00328>

Donnellan, E, Coulter, J, Mathew, C, Choynowski, M, Flanagan, L, Bucholc, M, Johnston, A & Sugrue, M 2020, 'A Meta-Analysis of the use of Intraoperative Cholangiography; Time to revisit our approach to Cholecystectomy?', *Surgery Open Science*.

<https://doi.org/10.1016/j.sopen.2020.07.004>

Dora, S, Bohte, SM & Pennartz, CMA 2021, 'Deep Gated Hebbian Predictive Coding Accounts for Emergence of Complex Neural Response Properties Along the Visual Cortical Hierarchy', *Frontiers in computational Neuroscience*, vol. 15, 666131, pp. 1-20.

<https://doi.org/10.3389/fncom.2021.666131>

Durai, M, Sanders, P, Doborjeh, Z, Doborjeh, M, Kasabov, N & Searchfield, G 2020, 'Prediction of tinnitus masking benefit within a case series using a spiking neural network model', *Progress in Brain Research*, vol. 260, pp. 129-165.

<https://doi.org/10.1016/bs.pbr.2020.08.003>

Fernandez-Vargas, J, Tremmel, C, Valeriani, D, Bhattacharyya, S, Cinel, C, Citi, L & Poli, R 2021, 'Subject- and task-independent neural correlates and prediction of decision confidence in perceptual decision making', *Journal of Neural Engineering*, vol. 18, no. 4, 046055.

<https://doi.org/10.1088/1741-2552/abf2e4>

Flanagan, B, McDaid, LJ, Wade, J, Toman, M, Wong-Lin, K & Harkin, J 2021, 'A Computational Study of Astrocytic GABA Release at the Glutamatergic Synapse: EAAT-2 and GAT-3 Coupled Dynamics', *Frontiers in Cellular Neuroscience*, vol. 15, 682460.

<https://doi.org/10.3389/fncel.2021.682460>

Gaur, P, Gupta, H, Chowdhury, A, Mc Creadie, K, Pachori, RB & Wang, H 2021, 'A Sliding Window Common Spatial Pattern for Enhancing Motor Imagery Classification in EEG-BCI', *IEEE Transactions on Instrumentation and Measurement*, vol. 70, 9326392.

<https://doi.org/10.1109/TIM.2021.3051996>

Geehan, G, Edelduok, I, Bucholc, M, Watson, A, Bodnar, Z, Johnston, A & Sugrue, M 2021, 'Systematic Review and Meta-Analysis of Wound Bundles in Emergency Midline Laparotomy Identifies That It Is Time for Improvement: Special Issue: Trauma and Emergency: Beyond Damage Control Surgery', *Life*, vol. 11, no. 2, 138, pp. 1-14.

<https://doi.org/10.3390/life11020138>

Harkin, R, Wu, H, Nikam, S, Quinn, J & McFadden, S 2021, 'Analysis of spatter removal by sieving during a powder-bed fusion manufacturing campaign in grade 23 titanium alloy', *Metals*, vol. 11, no. 3, 399, pp. 1-13.

<https://doi.org/10.3390/met11030399>

Harkin, R, Wu, H, Nikam, S, Quinn, JP & McFadden, S 2020, 'Reuse of Grade 23 Ti6Al4V Powder during the Laser-Based Powder Bed Fusion Process', *Metals*, vol. 10, no. 12, 1700, pp.1-14.

<https://doi.org/10.3390/met10121700>

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Henderson, J, Condell, J, Connolly, J, Kelly, D & Curran, K 2021, 'Review of Wearable Sensor-Based Health Monitoring Glove Devices for Rheumatoid Arthritis', *Sensors*, vol. 21, no. 5, 1576, pp. 1-32.

<https://doi.org/10.3390/s21051576>

Huang, Y, Liu, J, Harkin, J, McDaid, L & Luo, Y 2021, 'An memristor-based synapse implementation using BCM learning rule', *Neurocomputing*, vol. 423, pp. 336-342.

<https://doi.org/10.1016/j.neucom.2020.10.106>

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Kaur, D, Bucholc, M, Finn, D, Todd, S, Wong-Lin, K & McClean, P 2020, 'Multi-time-point data preparation robustly reveals MCI and dementia risk factors', *Alzheimer's & Dementia: Diagnosis, Assessment & Disease Monitoring (DADM)*, vol. 12, no. 1, e12116, pp. 1-13.

<https://doi.org/10.1002/dad2.12116>

Kelly, D, Munoz Esquivel, K, Gillespie, J, Condell, J, Davies, RJ, Karim, S, Nevala, E, Alamäki, A, Jalovaara, J, Tedesco, S, Barton, J & Nordström, A 2021, 'Feasibility of Sensor Technology for Balance Assessment in Home Rehabilitation Settings', *Sensors*.

<https://doi.org/10.3390/s21134438>

Kelsen, B, Sumich, A, Kasabov, N, Liang, S & Wang, G 2020, 'What has social neuroscience learned from hyperscanning studies of spoken communication? A systematic review', *Neuroscience and Biobehavioral Reviews*, pp. 1-41.

<https://doi.org/10.1016/j.neubiorev.2020.09.008>

Kelso, JAS 2021, 'Unifying Large- and Small-Scale Theories of Coordination', *Entropy*, vol. 23, no. 5, 537. <https://doi.org/10.3390/e23050537>

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<https://doi.org/10.1016/j.eswa.2021.114781>

Kumarasinghe, K, Kasabov, N & Taylor, D 2021, 'Brain-Inspired Spiking Neural Networks for Decoding and Understanding Muscle Activity and Kinematics from Electroencephalography Signals During Hand Movements', *Scientific Reports*, vol. 11, no. 1, 2486, pp. 1-19.

<https://doi.org/10.1038/s41598-021-81805-4>

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<https://doi.org/10.4209/aaqr.2020.05.0247>

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<https://doi.org/10.1016/j.neucom.2021.01.010>

Luo, Y, Liu, Y, Liu, J, Tang, S, Harkin, J & Cao, Y 2021, 'Counteracting dynamical degradation of a class of digital chaotic systems via Unscented Kalman Filter and perturbation', *Information Sciences*, vol. 556, no. 2021, 556, pp. 49-66.

<https://doi.org/10.1016/j.ins.2020.12.065>

Madden, K, Ramsey, E, Loane, S & Condell, J 2021, 'Trailgazers: A Scoping Study of Footfall Sensors to Aid Tourist Trail Management in Ireland and Other Atlantic Areas of Europe', *Sensors*, vol. 21, no. 6,

2038, pp. 1. <https://doi.org/10.3390/s21062038>

McCombe, N, Liu, S, Ding, X, Prasad, G, Bucholc, M, Finn, DP, Todd, S, McClean, PL & Wong-Lin, K 2021, 'Practical Strategies for Extreme Missing Data Imputation in Dementia Diagnosis', IEEE Journal of Biomedical and Health Informatics.

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<https://doi.org/10.4018/ijdcf.20211101.0a8>

Moore, K, O'Shea, E, Kenny, L, Barton, J, Tedesco, S, Sica, M, Crowe, C, Alamaki, A, Condell, J, Nordstrom, A & Timmons, S 2021, 'Older adults' experiences with using wearable devices: Qualitative systematic review and meta-synthesis', JMIR mHealth and uHealth, vol. 9, no. 6, e23832. <https://doi.org/10.2196/23832>

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3.2 Books/Chapters in Books

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3.3 Published Conference Papers

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Davies, RJ, McCullagh, P, Zheng, H & Condell, J 2021, Exploratory Gait Analysis using Wearable Technology. in H Afli, U Bleimann, D Burkhardt, R Loew, S Regier, I Stengel, H Wang & H Zheng (eds), Exploratory Gait Analysis using Wearable Technology. 2815 edn, vol. 1, Collaborative European Research Conference, Belfast, pp. 335-345. http://ceur-ws.org/Vol-2815/CERC2020_paper21.pdf

Epelde, G, Álvarez, R, Beristain, A, Arrúe, M, Arangoa, I & Rankin, D 2020, Enhancing the interactive visualisation of a data preparation tool from in-memory fitting to Big Data sets. in 3rd Workshop on Quality of Open Data (QOD 2020).

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Kerr, D & Coleman, S 2021, Improving The Student Experience: Self- And Peer-Assessment In Group Projects. in EDULEARN 21.

Kerr, D & Coleman, S 2021, 'Self- And Peer-Assessment To Enhance Student Engagement In Undergraduate Group Projects', Paper presented at International Conference on Education and New Developments 2021, 26/06/21 - 28/06/21.

Lindsay, L, Coleman, S, Kerr, D, Taylor, B & Moorhead, A 2020, 'Gendered Data in Falls Prediction Using Machine Learning', Paper presented at Data Analytics 2020, Nice, France, 25/10/20 - 29/10/20 pp. 67-71.

Lu, Y, Kasabov, N & Lu, G 2021, Multi-view Geometry Consistency Network for Facial Micro-Expression Recognition From Various Perspectives. in IEEE Proceedings of the International Joint Conference on Neural Networks IJCNN 2021 ., 1640, IEEE Computational Intelligence Society , pp. 1-8.

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Millar, C, Siddique, N & Kerr, E 2021, 'LSTM Classification of Functional Grasps Using sEMG Data from Low-Cost Wearable Sensor', Paper presented at 7th Annual International Conference on Control, Automation and Robotics, 23/04/21 - 26/04/21 pp. 213-222. <https://doi.org/10.1109/ICCAR52225.2021.9463477>

Rano, I, Khamassi, M & Wong-Lin, K 2021, 'Stability Analysis of Bio-Inspired Source Seeking with Noisy Sensors', Paper presented at 2021 European Control Conference (ECC), Rotterdam, Netherlands, 29/06/21 - 2/07/21.

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Sweeney, T, Kerr, D & Coleman, S 2020, 'SEMICONDUCTOR DEFECT CLASSIFICATION', pp. 7-13.

Tian, R, Zhang, Y, Zhu, D, Liang, S, Coleman, S & Kerr, D 2021, 'Accurate and Robust Scale Recovery for Monocular Visual Odometry Based on Plane Geometry', Paper presented at 2021 IEEE International Conference on Robotics and Automation (ICRA), China, 30/05/21 - 5/06/21.

Toman, M, Wade, J, McDaid, LJ & Harkin, J 2020, 'Computational Study of Astroglial Calcium Homeostasis in a Semi-isolated Synaptic Cleft', Paper presented at IEEE World Congress on Computational Intelligence 2020, Glasgow, United Kingdom, 19/07/20 - 24/07/20 <https://doi.org/10.1109/IJCNN48605.2020.9206981>

Vijayan , V, Connolly, J, Condell, J, Gardiner, P & McKelvey, N 2021, Pattern matching techniques to automatically detect standardised functional tests from wearable sensors: -. in Irish Signals & Systems Conference 2021., pp. 1-7.

Wu, Y, Zhang, Y, Zhu, D, Feng, Y, Coleman, S & Kerr, D 2020, 'EAO-SLAM: Monocular Semi-Dense Object SLAM Based on Ensemble Data Association', Paper presented at 2020 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), United States, 25/10/20 - 29/10/20 pp. 4966.

<https://ras.papercept.net/proceedings/IROS20/1991.pdf>.

Yogarajah, P & Bhushan, B 2020, 'Deep Learning Approach to Automated Detection of Dyslexia-Dysgraphia', Paper presented at The 25th IEEE International Conference on Pattern Recognition, Milan, Italy, 10/01/21 - 15/01/21.

4. Research Funding

Ongoing and Active Research Projects, notably:

Unit of Assessment Member	Title of Award	Funding Body	Value	Project Dates
Prof D Coyle Prof LP Maguire Dr F Lotte	Human Machine Symbiosis	UK Government	£ 215,535	20/01/14 – 31/01/21
Prof S Coleman Mr AJ McCaughey	Capital Markets Engineering Studentships - CME Group	CME Technology & Support Services Ltd	£60,000	01/05/15 – 31/12/22
Dr JG Harkin Prof LP Maguire	iTEMPO	Invest NI - Proof of Concept	£ 105,993	03/04/17 – 01/05/21
Dr JV Condell Mr M Callaghan Dr I Rano Dr SM Moffett	CINE	CEC NPP Northern Periphery & Arctic Pro	£ 131,258	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	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	01/04/17 – 30/12/20

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	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	01/04/17 – 31/03/22
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	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	11/04/17 – 10/01/21
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	01/09/17 – 30/06/22
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	24/05/18 – 15/01/22
Prof LP Maguire	Dr George Moore Chair in Data Analytics	Mrs Angela Moore	£3,000,000	01/08/18 – 31/07/35

Prof LP Maguire	Dr George Moore Research Fellowship in Data	Mrs Angela Moore	£2,000,000	01/09/18 – 31/08/35
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	01/09/19 – 31/07/21
Prof E Ramsey Dr S Loane Dr JV Condell Michael Carty, Sligo County Council Jose Maria Costa, Camara Municipal de Giancarlo 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	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 BigData and Internet of Things Sensors	INTERREG VB NWE	£348,209	10/01/19 – 09/07/22
Prof S Coleman Dr D Kerr	KTP Programme between University of Ulster and Metro Surveillance Group Ltd	Innovate UK/INI and Metro Surveillance G	£271,676	01/08/19 – 31/07/22
Dr JV Condell Dr Shirin Dora Prof G Leavey Dr D Gibson Marcus Sauer, CGT Rens Brankaert, Technische Univer Vincent Kraus, KRG	Certification of technological products for people with dementia to support SMEs in innovationand business growth	INTERREG VB NWE	£221,035	26/09/19 – 25/03/23

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, RegionaleStichting Jawad Hajam, CENTICH Michel Borteks, OCMW Genk				
Prof S Coleman Dr D Kerr	Digital Natives - PhD Studentship	Digital Natives Ltd BVI	£94,590	29/09/19 – 30/09/23
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 Carolyn 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	01/11/19 – 31/10/23
Dr JG Harkin Mr M McElholm	iTEMID - Intelligent Total Management in Dairying	NI Agricultural R&D Council - AgriSearch	£59,339	01/01/20 – 31/12/20

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	01/01/20 – 31/12/23
Prof N Hewitt Prof LP Maguire	Foyle River Gardens	Invest NI via ase	£172,135	30/03/20 – 30/09/21
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	01/05/20 – 30/04/22

Prof E Ramsey Dr S Loane Dr JV Condell Ana Maria Brito Botin, GRAFCAN Giancarlo 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	01/04/09 – 30/11/22
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	10/01/19 – 09/07/22
Prof S Coleman Dr D Kerr	KTP Programme between University of Ulster and Metro Surveillance Group Ltd	Innovate UK/INI and Metro Surveillance G	£271,676	01/08/19 – 31/07/22
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	01/10/19 – 30/09/22
Dr X Ding Dr Li Su, University of Cambridge Prof Qinyong Ye, Fujian Medical Uni	Data extraction for dementia diagnosis	Alzheimer's Research UK	£5,000	01/10/19 – 31/12/21
Dr D Rankin Dr M Black Prof S Coleman Elaine Duffy	Reimagining Recruitment Workshop	EPSRC via University of Bath	£15,000	01/01/20 – 01/12/20

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 Stichting Marcus Sauer, CGT Michel borteks, OCMW Genk Niels Hendriks, LUCA Sch of Arts Ralf Ihl, Alexianer Forschungszenentrum Rens Brankaert, Technische Uni Vincent Kraus, KRG Corporate	Certification of technological products for people with dementia to support SMEs in innovation and business growth	INTERREG VB NWE	£221,035	26/09/19 – 25/03/23
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	01/01/20 – 31/12/23
Prof N Hewitt Prof LP Maguire	Foyle River Gardens	Invest NI via Case	£172,135	30/03/20 – 30/06/22
Dr JV Condell Prof G Leavey Dr D Rankin Dr P Chaurasia Carolyn 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	IT4Anxiety: Managing anxiety via innovative technologies for better mental health	Interreg VB North West Europe	£273,348	01/11/19 – 31/10/23

Jean-Charles Minier, INNO TSD Jocely Deloyer, CNP Saint- Martin Marc Meddens, Brain scan BV Martin Malcolm, Nat Health Services Natacha Straus, Namur- Europe-Wallonie				
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Portfolio of Research Grants awarded during period 1 August 2020 - 31 July 2021

Unit of Assessment Member	Title of Award	Funding Body	Value	Project Dates
Dr D Charles Mr D Holmes	Magic Glass	Innovate UK via ICUR Programme	£24,212	15/06/20-14/01/21
Prof G Leavey Dr JV Condell Dr A Rizzo, Limerick City & County Council Dr J Jbilou, University of Moncton Dr L Kuosmanen, Uni of Eastern Finland Dr R O'Sullivan, Inst of Public Health Dr M Pahlberg, Skelleftea Kommun Dr T G Ingason, Icelandic Psychological Association Dr A Reneflot, Norwegian Inst of Public Health Dr A Helgadottir Davisen, Dept of Occupational Medicine Dr B Bonner, NI Public Health Agency Dr M Malcolm, NHS Western Isles	Re-Mind: Impact from COVID 19 isolation on mental health in NPA regions	Interreg NPA Prep	£15,254	01/09/20-31/12/20
Prof D Coyle Dr N du Bois Mr AD Bigirimana Stefan Jansen, University of Rwanda Leon Muteas, University of Rwanda	Strengthening the capacity of Rwandan-based cognitive neuroscience to study the etiology of Post-Traumatic Stress Disorder (PTSD) in Rwanda -Additional funding	Department for the Economy-GCRF	£15,534	23/04/20-31/07/20
Prof AJ Moore Mr J Lubinda Dr S Bhatti Dr Y Bi Dr R McNabb Dr D Rankin Prof JG Wallace	MalarInfo: A machine learning information toolset for predicting malaria risk, rates and trends in intervention planning - A pilot project in Zambia	Department for the Economy-GCRF	£37,125	01/10/20-31/12/21

Dr M Black Mr J Matoba, Macha ResearchTrust Prof J Wright, University of Southampton Prof C Schiff, Johns Hopkins University Dr B Hamainza, National MalariaElimination Prof J Rigby, Nat Centre for Geocomputation				
Dr K Wong-Lin Prof S Bickel, Institute for Bioelectron Prof S Kelly, Columbia University Prof R O'Connell, Trinity College Dublin	Uncovering the neural architectureunderlying decisions abstracted from movements	HSC R&D/MRC (US-Ireland Partnership)	£500,000	01/01/21- 31/12/25
Prof LJ McDaid Dr B Gardiner Dr JG Harkin Dr P Prakash, Kansas State University Dr M O'Halloran, National Uni of Oxford	Treating Primary aldosteronism-induced hypertension via microwave thermal therapy	HSC R&D/MRC (US-Ireland Partnership)	£389,995	01/10/21- 01/10/24
Dr JV Condell Prof G Leavey Dr A Williamson, Wyld NetworksLtd, Cambridge Dr G Fleming, Antrim Area Hospital Dr N Forsling, Centre for RuralMedicine Dr B Crossey, Healthcare AnalyticsLtd, Dr J Nordberg Egilstro, Nemlia Dr M Pahlberg, Skelleftea Kommun Dr P Kilpelainen, University of Oulu Mr Paul Moorhead, Kraydel LTd,NI Mr A White, Interactive Health Ltd Dr J Isohanni, Centria	Impact on COVID-19 from Technology Solutions in NPAREgions	Interreg NPA Prep	£18,904	01/09/20- 31/12/20

University of Applied Sciences Dr L Heaney, NHS Highlands Health Board, Dr R O'Sullivan, Institute of Public Health Dr A Fosse, University of Tromso Dr S E Sigurdsson, Akureyri Hospital Dr L Glynn, University of Limerick				
Prof AJ Bjourson Dr T Singh Rai Dr SD Zhang Dr D Gibson Dr M Bucholc Dr E Murray Dr P Shukla Prof CP Walsh Dr P Sharpe, SHSCT Dr L Zgaga, Trinity College Dublin Prof M Hennessy, Trinity College Dublin Prof R McManus, Trinity College Dublin Dr S Nakagome, Trinity College Dublin Dr D Fairley, BHSCT Dr J Kidney, -BHSCT	COVRES: Understanding the Host- Virus Response in Patients with Mild versus Serious Disease.	DfE SFI Covid-19 Phase 2 RR	£354,637	01/11/20-31/03/21
Dr JV Condell Mr M Callaghan Dr SM Moffett S B Gunnarsson, Gunnar Gunnarsson Institute Mr N Macleod, Taigh Chearsabhagh Museum Ms C O'Kane, Causeway Coast & Glens Her R Eilertsen, Aurora Borealis Multimedia Ms F Monaghan, Failte Ireland Mr R Lafferty, Finlaggan Trust Mr D O'Toole, Mayo County Council Mr A Millar, Court of Uni St	STRATUS Pushing the limits of VR in Cultural and Natural Heritage	Interreg Northern Periphery & Arctic Pro	£24,840	01/07/20-30/06/22

Andrews G Johannesson, Djupivogur Municipality				
Dr D Charles Mr D Holmes	Magic Glass - Phase 2	Innovate UK via ICURe Programme	£10,100	15/10/20- 14/01/21
Prof G Prasad Dr N du Bois Mr AD Bigirimana Braj Bhushan, Institute of Technology, Kanpur Dheeraj Rathee, University of Essex	Neurophysiological validation of a facial expression recognition database for devising a culturally relevant Autism Spectrum Disorders diagnosis tool	Department for the Economy- GCRF	£27,075	01/10/20- 31/12/21
Prof B Scotney Dr D Kerr Dr R McAlister Prof S Coleman Artur Degteariov Cyber Crime Moldova Programme Office Ana Revenco International Center La Strada Moldova Jorn van Rij Dutch Police, Den Haag	Supporting sustainable development in LMICs: a pilot study on human trafficking and organised crime in Moldova	Department for the Economy- GCRF	£29,775	01/10/20- 31/12/21
Prof D Coyle Mr AD Bigirimana Prof G Prasad Dr N du Bois Stefan Jansen, University of Rwanda Léon Mutesa, University of Rwanda	Building a network towards treatment of post-traumatic stress disorder (PTSD) using affordable neurotechnology - a rapid response to rising prevalence due to COVID- 19	Department for the Economy- GCRF	£20,000	01/10/20- 31/12/21
Prof Eugene McNamee Prof KJ Curran	Machine learning for more efficient data extraction in legal documents	Allen and Overy Foundation	£492,936	15/01/21- 14/01/23
Prof D Coyle	AI for Intelligent Neurotechnology and Human-Machine Symbiosis	UKRI EPSRC Turing AI Acceleration Fellow	£1,807,387	01/01/21- 31/12/25

Dr JG Harkin Mr M McElholm	iTEMID - Intelligent Total Energy Management in Dairying - Phase 2	NI Agricultural R&D Council – AgriSearch	£19,566	22/12/20-28/05/21
Prof G Leavey Dr SJP McKenzie Dr M Rosato Prof SM O'Neill Dr R Douglas Dr M Bucholc Prof D O'Reilly, QUB	ADR (Wave 3) 2021-2022	ESRC	£437,563	01/04/21-31/03/22
Dr JV Condell Prof JAD McLaughlin Prof D Finlay Lee Heaney, NHS Highland HealthBoard Tomas Gustafsson, Region Vasterbotten Jack Anderson, Capita IT Services, Glasgow Stephen Milne, GENSIS Uni, Glasgow Joannes Noroberg Poulson, Techcare	TESTED - IoT TestBed	Interreg Northern Periphery & Arctic Pro	£25,277	01/09/20-28/02/22
Dr JV Condell Nils Sandberg, Northlands University Alan White, Highland HealthVentures Ltd Outi Jolanti, Tampere University of Applied Sciences Jay Evans, Interactive Health Ltd	Analysing emerging themes in the "new" environment of living with COVID-19, through the twin lenses of care homes and University campuses	Interreg NPA Prep	£6,168	01/11/20-28/02/21
Prof AJ Bjourson Dr PL McClean Dr S Watterson Dr P Shukla Dr V McGilligan Prof LP Maguire Dr T Singh Rai Dr C Kelly Dr R Bond Dr D Gibson Dr E Murray Dr G Fleming, NHSCT	Northern Ireland Multimorbidity Research and Discovery (NIMRAD) Consortium	NIHR	£117,076	09/02/21-31/12/21

Prof M Scott, NHSCT Mrs J Rhodes, Health Innovation Research				
Prof D Coyle Dr M Bucholc	The Allstate NI/University AIResearch Partnership	Allstate Northern Ireland	£100,000	09/03/21- 30/06/22
Mr P Devine Prof D Coyle Prof LP Maguire Dr JG Harkin	NW Border Region ArtificialIntelligence Network	Letterkenny Institute of Technology	£75,000	01/06/21- 31/05/22
Prof AJ Bjourson Dr PL McClean Dr K Wong-Lin Dr V McGilligan Prof LP Maguire Dr M Bucholc Prof VE Coates Dr R Bond Prof G Prasad Prof D Coyle	Centre for Personalised Medicine	INTERREG VA	£66,737	01/04/17- 30/06/22

