Luke Tait
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Address
CUBRIC
Maindy Road
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Luke Tait

PhD

Research My research interests invole the use of computational techniques such as time series analysis, graph theory, and non-linear dynamical systems to understand brain dynamics during cognitive processes and in neurodegenerative disorders. I joined the Cardiff University Brain Research Imaging Centre in July 2019 as a Research Associate in Dr Jiaxiang Zhang's lab, integrating functional imaging (fMRI, MEG) and computational modelling to understand the neuronal mechanisms underpinning decision making. Prior to this, the focus of my PhD research was using similar techniques to understand alterations to brain dynamics in Alzheimer's disease.

Research Positions

July 2019 - present, *Research Associate,* Cardiff University
Post-doctoral research with Dr Jiaxiang Zhang and the Cognition and Computational Brain Lab at Cardiff University Brain Research Imaging Centre. Using computational techniques to study the neuronal mechanisms underpinning cognitive processes such as perceptual decision making.

Education

2015 - 2019, Univeristy of Exeter (Alzheimer's Society Doctoral Training Centre)
Multi-scale Mathematical Modelling of Brain Networks in Alzheimer's Disease
Supervisors: Dr Marc Goodfellow (Mathematics), Dr Jon T Brown (Medical School)
The primary focus during my PhD was on characterising and modelling alterations to brain dynamics in Alzheimer's disease in order to gain mechanistic insight into the relationship between pathology, function, and phenotype. This work ranged from dynamics of individual or local networks of neurons in animal models of dementia pathologies, to whole brain oscillatory dynamics recorded by EEG. During my PhD, I developed tools to study EEG microstates of the brain as a biomarker to aid with early diagnosis of Alzheimer's disease. This work additionally included a three month secondment from seed-corn funding modelling neuronal dynamics in the spatial navigation systems of the brain.

2011 - 2015, *MMath Mathematical Physics,* University of Liverpool
First Class Honours

Key Skills

Programming
I am an experienced user of Matlab, and also have experience with Python, R, and Maple. This has predominantly been applied to computational data analysis, statistical techniques, and numerical simulations.

Mathematical expertise
Time series analysis, graph theory, bifurcation theory dynamical systems, numerical/ computational modelling, statistical analysis, model parameter fitting, inverse problems. Multi-scaled brain modelling including biophysical and phenomenological point neuron models, neuronal network models, neural mass/field models, and coupled oscillators.

Neuroimaging
My primary area of expertise is non-invasive human neuroimaging such as EEG, MEG, MRI, and fMRI. I am experienced with software such as Fieldtrip, Brainstorm, SPM, and Freesurfer for analysis of these data. I additionally have experience working with two-photon calcium imaging data in rodents, and spent six months performing whole cell patch clamp experiments from slice.

Funding and Awards

Travel Grant
Guarantors of Brain, £600

NA Software Honours Prize for Best Project in the Field of Mathematical Software
Awarded for my undergraduate dissertation.

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Publications and Presentations

Preprints

Cortical source imaging of resting-state MEG with a high resolution atlas: An evaluation of methods
Tait L, Ozkan A, Szul MJ, Zhang J
bioRxiv 2020.01.12.903302 (2020)

EEG microstate complexity for aiding early diagnosis of Alzheimer's disease
Tait L, Tamagnini F, Stothart G, Barvas E, Monaldini C, Frusciante R, Volpini M, Guttmann S, Coulthard E, Brown JT, Kazanina N, Goodfellow M
bioRxiv 833244 (2019)

Journal Articles

Computational modelling in source space from scalp EEG to inform presurgical evaluation of epilepsy surgery
Lopes M, Junges L, **Tait L**, Terry JR, Abela E, Richardson MP, Goodfellow M
Clinical Neurophysiology 131(1):225-234 (2020)

Network Substrates of Cognitive Impairment in Alzheimer's Disease
Tait L, Stothart G, Coulthard E, Brown JT, Kazanina N, Goodfellow M
Clinical Neurophysiology 130(9):1581-1595 (2019)

Control of clustered action potential firing in a mathematical model of entorhinal cortex stellate cells
Tait L, Wedgwood K, Tsaneva-Atanasova K, Brown JT, Goodfellow M
Journal of Theoretical Biology 449:23-34 (2018)

Conference Proceedings

Graph-theoretical measures provide translational markers of large-scale brain network disruption in human dementia patients and animal models of dementia
Stothart G, Petkov G, Kazanina N, Goodfellow M, **Tait L**, Brown JT
International Journal of Psychophysiology 108:71 (2016)

Oral Presentations

AlzSM: Using EEG to understand Alzheimer's disease and develop biomarkers. Alzheimer's Society Annual Conference, London, May 2019.

Analysis of the EEG of Alzheimer's Patients. Computational Biology Symposium, University of Exeter, July 2018.

Control of Clustered Action Potential Firing in a Mathematical Model of Entorhinal Cortex Stellate Cells. Alzheimer's Research UK South West and Wales Scientific Network Meeting, Bristol, May 2018.

Multi-scale functional network dysfunction in dementia. Computational Biology Symposium, University of Exeter, June 2017.

Reduced Frontal Lobe Delta Power and Increased Network Homogeneity in a Mouse Model of Frontotemporal Dementia. Network Biology Symposium, University of Exeter, June 2016.

Increased Network Homogeneity and Reduced Frontal Lobe Delta Power in a Mouse Model of Frontotemporal Dementia. Alzheimer's Research UK Annual Conference PhD Day, March 2016.

Poster Presentations

Control of Clustered Action Potential Firing in a Mathematical Model of Entorhinal Cortex Stellate Cells. International Conference on Mathematical Neuroscience, Juan-les-Pins, France, June 2018.

Control of Clustered Action Potential Firing in a Mathematical Model of Entorhinal Cortex Stellate Cells. Alzheimer's Research UK South West and Wales Scientific Network Meeting. Bristol, May 2018.

Control of Clustered Action Potential Firing in a Mathematical Model of Entorhinal Cortex Stellate Cells. Brain Networks and Neurological Disorders: From Theory to Clinic, University of Exeter, UK, April 2018.

Decreased Delta Synchrony, Reduced Frontal Lobe Delta Power, and Increased Network Homogeneity in a Mouse Model of Frontotemporal Dementia. Alzheimer's Society Annual Conference, Bristol , UK, June 2016.

Increased Network Homogeneity and Reduced Frontal Lobe Delta Power in a Mouse Model of Frontotemporal Dementia. Alzheimer's Research UK Annual Conference, Manchester, UK, March 2016.

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Teaching

Supervision

○ 2019-Present: Co-supervision of a PhD student at Reading University School of Pharmacology using EEG to aid with diagnosis of Alzheimer's disease

○ January-April 2019: Supervision of 4 month PhD training year project combining diffusion MRI data with whole brain computational models to test how structural connectivity reflects dynamics in memory disorders.

○ Summer 2018: Informal supervision of a 2nd year undergraduate summer project comparing 64 channel research grade and 14 channel "Emotiv" EEG headsets.

○ Summer 2018: Informal supervision of a M-level undergraduate summer project performing bifurcation analysis and numerical continuation of subthreshold oscillations and resonance in a neuronal model.

Demonstrating on undergraduate modules

○ Differential Equations: Responsibilities included planning and leading weekly additional support sessions for a small group (10 students) of 2nd year natural sciences students taking a course aimed at mathematics students.

○ Mathematics and Computing: Integrative Tools for Natural Sciences: I ran tutorial sessions on a range of topics in mathematics for 1st year natural sciences students.

○ Mathematical Modelling in Biology and Medicine: I assisted a series of lecturers in running tutorials for M level natural science students.

Impact and Networking

Conferences and Workshops Attended

○ Cognitive Computational Neuroscience, Berlin, German, September 2019.
○ Computational Biology Symposium, Exeter, UK, July 2018.
○ International Conference on Mathematical Neuroscience, Juan-les-Pines, France, June 2018.
○ Alzheimer's Research UK South West and Wales Scientific Network Meeting, Bristol, May 2018.
○ BioDynamics. Royal College of Physicians, London, UK, April 2018.
○ Brain Networks and Neurological Disorders: from Theory to Clinic. Exeter, UK, April 2018.
○ Network Dynamics: Bridging Theoretical Advances and Applications. Exeter, UK, April 2018.
○ Integrated Systems Neuroscience. Manchester, UK, September 2017.
○ Computational Biology Symposium, Exeter, June 2017.
○ Alzheimer's Research UK Annual Conference. Aberdeen, UK, March 2017.
○ Alzheimer's Research UK Annual Conference PhD Day. Aberdeen, UK, March 2017.
○ Symposia on Memory. Centre de Recerca Matematica, Barcelona, Spain, March 2017.
○ Computational Neurology. Newcastle, UK, February 2017.
○ Model Parameter Estimation for Predictive Medicine. Birmingham, UK, July 2016.
○ Alzheimer's Society Annual Conference. Bristol, UK, June 2016.
○ Network Biology Symposium. Exeter, June 2016.
○ Alzheimer's Research UK Annual Conference. Manchester, March 2016.
○ Alzheimer's Research UK Annual Conference PhD Day. Manchester, March 2016.
○ Large Scale Brain Networks in Health and Disease: A GW4 Dissemination Event. M-Shed, Bristol. 8th Jan 2016.

Public Engagement

○ Oral presentation at Alzheimer's Research UK South-West public open day, Exeter, June 2018
○ Stand at University of Exeter Public Engagement Day, Exeter, March 2018
○ Meet a Neuroscientist Event, Exeter, March 2018
○ Electrophysiology Stand at Brain Awareness Week Event to Schools, Exeter, March 2018
○ INSPIRE Lecture at Exeter Maths School, Exeter, December 2017
○ Stand at Alzheimer's Society Memory Walk, Exeter, September 2017
○ Oral presentation at Alzheimer's Society Legacy Fundraiser, Exeter, July 2017
○ Oral presentation at Exeter School, Exeter, March 2017
○ Stand at Alzheimer's Society Memory Walk, Plymouth, October 2016