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15th Annual Scientific Meeting
Wednesday 14th June 2023

Mazumdar-Shaw Advanced Research Centre
University of Glasgow

Programme and Abstracts Booklet

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Welcome to the 15th SINAPSE Annual Scientific Meeting

Contents

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Venue

Location

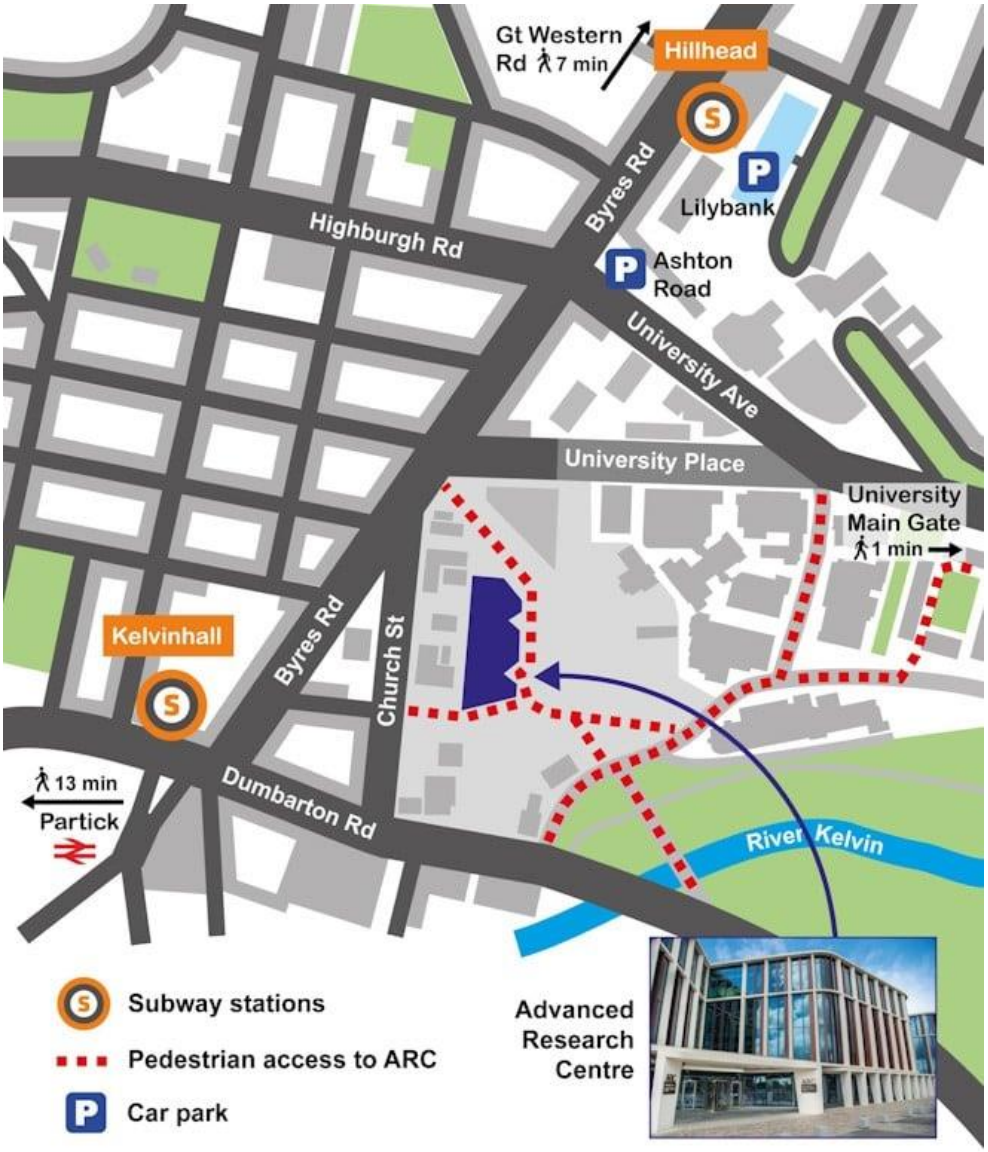
The Mazumdar-Shaw Advanced Research Centre is on the main campus of the University of Glasgow, in Glasgow's West End. The address is 11 Chapel Lane, G11 6EW.

Train

The nearest train station is Partick on the Argyle Line. Otherwise, you can take the Subway to either Hillhead, or Kelvin Hall from Queen Street or Glasgow Central.

Car Parking

There are no car parks in the area.



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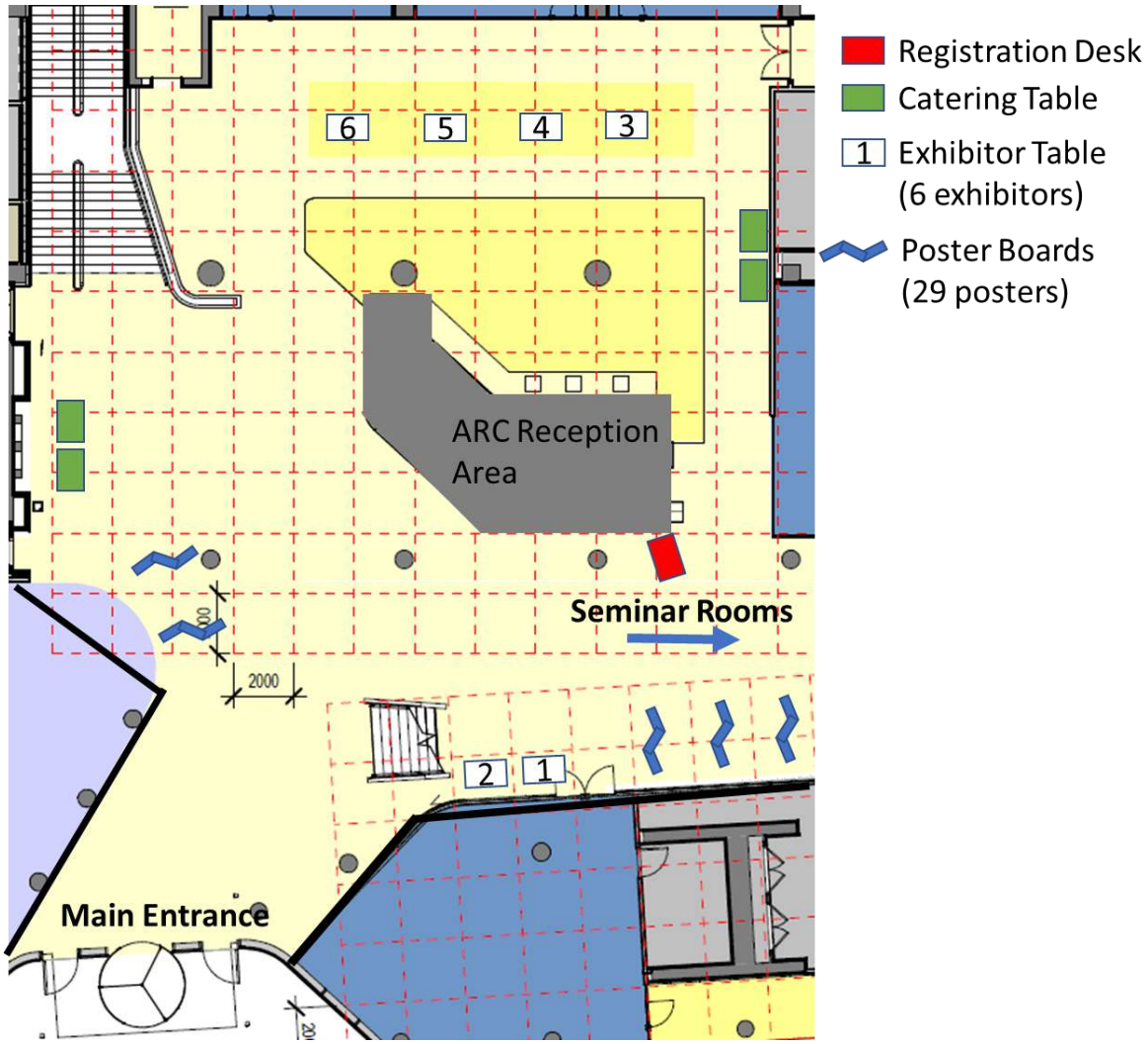
Exhibition, Posters, and Catering

All catering, posters, and the exhibition can be found in **the Atrium**



Exhibitors

E1 – Ballater Medical

E2 – NordicNeuroLab

E3 – GE Healthcare

E4 – MR CoilTech

E5 – NVIDIA

E6 – Tayside Innovation Medtech Ecosystem (TIME)

E7 – Siemens Healthineers

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Exhibitors

SIEMENS Healthineers

Nordic Neuro Lab

MR CoilTech

NVIDIA

Tayside Innovation Medtech Ecosystem
University of Dundee

Ballater Medical
DELIVERING ULTRASOUND SOLUTIONS

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Agenda

Wednesday 14th June 2023			
Advanced Research Centre, University of Glasgow			
0900	Registration		
Plenary Session 1 Chair: Dr Sydney Williams, University of Glasgow			
0930	Welcome – Dr Sydney Williams, University of Glasgow		
0935	Welcome – Dr Jennifer Macfarlane, SINAPSE Director, NHS Tayside		
0940	Keynote 1: *Neuroimaging in AD diagnosis* Dr Gaël Chételat, Normandie University, GIP Cyceron, Caen Chair: Dr William McGeown, University of Strathclyde		
1030	*The EuroLaD-EEG consortium: towards a global EEG platform for dementia* Dr Mario Parra Rodriguez		
1100	Tea Break and Posters (30 mins)		
Parallel Sessions – See Next Page for Details on Talks			
1200	Session 1 – Psychology, Psychiatry & Preclinical Imaging Seminar Room A	Session 2 – Clinical Applications Seminar Room B	Session 3 – Methods Development Seminar Room C
1300	Lunch and Posters (60 mins)		
Parallel Sessions – See Next Page for Details on Talks			
1400	Session 4 – Neuroimaging Seminar Room A	Session 5 – Image Analysis Seminar Room B	
1500	Tea Break and Posters (30 mins)		
Plenary Session 2 Chair: Dr Graeme Keith, University of Glasgow			
1530	ECR Rising Star - *Illuminating adverse cardiovascular remodelling through the development of translational molecular imaging approaches* Dr Mark Macaskill, University of Edinburgh		
1615	Keynote 2: *The future of CT on Mobile Stroke Units* Prof Iris Grunwald, University of Dundee		
1700	Closing Remarks and Prize Giving – Dr Jennifer Macfarlane, NHS Tayside		
1730	Close of Program		

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Parallel Sessions (1200-1300)

Session 1 – Psychology, Psychiatry & Preclinical Imaging Seminar Room A Chair: Dr Magdalena Ietswaart, University of Stirling, Assisted by Sara Scarfo			
	Withdrawn		O01
1200	*cis- and trans-4-[18F]Fluoro-L-proline are biomarkers of active collagen synthesis following myocardial infarction*	Victoria Reid, University of Edinburgh	O02
1212	*Measuring neurodegeneration in models of multiple sclerosis using PET/MR imaging*	Pantila Panichnantakul, University of Edinburgh	O03
1224	*Developmental changes in occipital alpha rhythms: Recording EEG during public engagement events*	Christopher Turner, University of Glasgow	O04
1236	*Neuroanatomical correlates of psychotic symptoms in a sample of mci and ad patients over time*	Sara Scarfo, University of Strathclyde	O05

Session 2 – Clinical Applications Seminar Room B Chair: Dr Ammad Mahmood, University of Glasgow, Assisted by Amnah Alamri			
1200	*Skin pressure exerted by pelvic circumferential compression devices (PCCDs) in healthy volunteers*	Satish Puranik, University of Dundee	O06
1212	*Comparative Analysis for the Distinction of Chromophobe Renal Cell Carcinoma from Renal Oncocytoma in Computed Tomography Imaging Using Machine Learning Radiomics Analysis*	Abeer Alhussaini, University of Dundee	O07
1224	*Using RNA aptamers to detect pathological protein misfolding in neurodegenerative diseases*	Jenna Gregory, University of Aberdeen	O08
1236	*Generalisability of Deep Learning Algorithms for Diagnostic Dermatology: An Investigation on Non-Dermoscopic Datasets from the Primary-Secondary Care Interface in the NHS*	Jacob Carse, University of Dundee	O09
1248	*Detection of rectal cancer by using Field-Cycling Imaging at magnetic field strength below 200 mT*	Amnah Alamri, University of Aberdeen	O10

Session 3 – Methods Development Seminar Room C Chair: Dr Jennifer Macfarlane, Assisted by Zhengshuyi Feng			
1200	*Evaluation of 0.22MHz and 0.65MHz focused ultrasound transducer performance through cranial bones*	Han Li, University of Dundee	O11
1212	*Real-time image-based motion correction for 7T task-based functional MRI*	Steven Winata, University of Glasgow	O12
1224	*Photoacoustic Image Reconstruction with Generative Adversarial Networks*	Philip Twaddle Edinburgh Napier University	O13
1236	*Optimal excitation angle of air-pulse system for optical coherence elastography*	Zhengshuyi Feng, University of Dundee	O14
1248	*Quantitative Ultrasound Measurement of Healthy Brain and Glioblastoma in the Frequency Range 16 - 35 MHz*	Hannah Thomson University of Glasgow	O15

Parallel Sessions (1400-1500)

Session 4 – Neuroimaging Seminar Room A **Chair: Dr Sin Yee Foo, Assisted by Jenny Waymont**			
1400	*Imaging Headaches: Retrospective Analysis of Incidental Pituitary Lesions Discussed in a Neuroendocrine MDT*	Robert Cronshaw, Royal Infirmary of Edinburgh	O16
1412	*Eight-channel transceiver and fifty-six channel receiver array for combined head-neck imaging at 7 tesla*	Divya Baskaran, University of Glasgow	O17
1424	*Detection of cerebral small vessel disease using field-cycling MRI*	Nicholas Senn, University of Aberdeen	O18
1436	*Quantifying Perivascular Spaces in UK Biobank: A work in progress*	Jennifer Waymont, University of Edinburgh	O19
1448	*Vessel Wall Imaging at 7-Tesla using 3D Turbo Spin-Echo*	Janhavi Ghosalkar, University of Glasgow	O20

Session 5 – Image Analysis Seminar Room B **Chair: Dr Gordon Waiter, Assisted by Steven Winata**			
1400	*Relationships Between Subcortical Iron and Blood Markers for Iron and Inflammatory Status in Cognitively Healthy Adults*	Holly Spence, University of Aberdeen	O21
1412	*Can we see carotid stent thrombosis? Comparison of metal artefacts and stent lumen visualisation between conventional computed tomography and photon-counting detector*	Leah White, University of Dundee	O22
1424	*DeepThickness: A Deep Learning Method for Brain MRI Cortical Thickness Estimation*	Michele Svanera, University of Glasgow	O23
1436	*Scottish Medical Imaging (SMI) – providing safe and secure access to research-ready, population scale health and imaging data*	Susan Krueger, University of Dundee	O24

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Poster Presentations – All Day

Poster Number	Title	Presenting Author
P01	*Investigating social content information in the Early Visual Cortex using 3T fMRI*	Serena Dimitri
P02	*Intact Mismatch Negativity Responses in Emerging Psychosis: Evidence from MEG*	Pradeep Dheerendra
P03	*Mobile EEG in real world environments using LCD glasses*	James Dowsett
P04	*40Hz auditory stimulation and naturalistic soundscapes for the treatment and management of AD*	Claire Rogers
P05	*Neuroscientific perspectives on surrealism: insights from fMRI brain imaging*	Yingying Huang
P06	*Investigating predictive cortical feedback processing for expected and surprising scene information*	Zirui Zhang
P07	*Structural variance of circle of Willis on Magnetic resonance angiography in brain tumour patients*	Deepa Manoj
P08	*CT texture characterization of perirenal fat in patients with upper urinary tract cancers*	Abdulrahman Al Mopti
P09	*Development of an Intraoral Handhold Swept-Source Optical Coherence Tomography based Angiography System for Oral Imaging*	Tianyu Zhang
P10	*Machine Learning-Based Radiomics Analysis for Predicting Pathological Grade of Upper Tract Urothelial Transitional Cell Carcinoma using CTU Scans*	Abdulsalam Alqahtani
P11	*MRS Reproducibility in a Phantom Brain*	Ella Fish
P12	*Reader bias in breast cancer screening: inexperienced second readers defer to experienced first readers' opinions*	Clarisse de Vries
P13	*How ultrasound envelope statistics could be used to detect deep tissue injury in lower limb prosthetic users*	Ben Hicks
P14	*Connectivity Neurofeedback in the young healthy brain*	M. Keime
P15	*Developing a deep learning method for optical coherence elastography to predict human skin biomechanical property*	Tianyu Zhang
P16	*PVA based phantom for prostate cancer detection using multiparametric ultrasound: a validation study*	Adel Jawli
P17	*Application of robotic arm in Automated Breast Ultrasound for automatic 3D imaging of breast phantom*	Wadhhah Aldehani
P18	*Magnetic Microbubbles for Contrast Enhanced Magnetomotive Ultrasound Imaging for colorectal cancer lymph node assessment*	Georgia Adam
P19	*Computational Methods for Augmenting the Echocardiographic Assessment of Low-Flow, Low-Gradient Aortic Valve Stenosis*	Marcell Illyes
P20	*Simulating the effect of a Single Element Focused Ultrasound Transducer various distances from skull*	Saeed Charbenny
P21	*Learned Multi-level Wavelet for Fast MRI Reconstruction*	Fatemah Aladwani

P22	*An Evaluation of Cardiovascular Disease Biomarkers on Routine Chest CT of Patients with Bronchiectasis*	Khalid Hakami
P23	*Assessing Robustness of Network-Based Correlation Analysis with Total-Body PET Data*	Abigail Hellman
P24	*A Deep-Learning Method for Single-Scan Optical Coherence Tomography Angiography Extraction*	Tianyu Zhang
P25	*Optical attenuation coefficient (OAC) based automatic segmentation of limbal epithelial thickness and age-related differences*	Tianyu Zhang
P26	*Enhancing nerve visualisation and optimising infusion site selection for local anaesthesia using OCT*	Zhengshuyi Feng
P27	*Cataloguing DICOM images*	Bianca Prodan
P28	*Natural Language Process of Radiology Reports*	Andrew Brooks
P29	*Medical Image Anonymisation*	Andrew Brooks

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Abstracts

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Keynote Talks

Keynote 1

Neuroimaging in AD diagnosis

Dr Gaël Chételat

Normandie University, GIP Cyceron, Caen

Abstract: There has been tremendous advance in the field of AD biomarkers towards improving early and differential diagnosis, including neuroimaging biomarkers.

This talk will be devoted to discussing the role of neuroimaging biomarkers in the framework of other AD biomarkers (e.g. fluid - cerebro-spinal and blood - biomarkers). We will also discuss the complementarity of the different neuroimaging biomarkers leading to decide which biomarker should be used in priority depending on the clinical situation. Finally, new neuroimaging tools; more recently developed and that still need validation but have potential for diagnosis and prognosis, will be discussed.

Biography: Director of Research at Inserm, Dr Chetelat is responsible for the "Pathological Mechanisms and lifestyle-based interventions in Brain Disorders" research team. Her work is devoted to the understanding of the mechanisms underlying ageing and dementia processes and the lifestyle factors that could prevent or delay age-associated disorders. She is mainly involved in clinical studies using multimodal neuroimaging techniques including MRI and PET. Her research team is also interested in promoting healthy ageing and wellbeing through non-pharmaceutical interventions. In particular, she is coordinating a Horizon 2020 European grant (www.silversantestudy.eu PHC22) investigating the impact of English learning and meditation training on mental health and well-being in ageing populations.

Introducing the EuroLaD-EEG Consortium

The EuroLaD-EEG consortium: towards a global EEG platform for dementia

Dr Mario Parra Rodriguez

University of Strathclyde

Abstract: The value of Electroencephalography (EEG) to unveil pathophysiological signatures in neurodegenerative diseases that cause dementia has been recently highlighted. To grant EEG tools the necessary validity, reliability, and scalability to support the diagnosis of dementia globally, efforts will need to integrate knowledge developed by EEG labs across diverse countries and develop protocols that can be swiftly implemented by such labs to harmonize research and clinical practices. The EuroLaD-EEG Consortium is a global EEG initiative that comprises 2000+ EEG recordings from healthy adults, patients with mild cognitive impairment, and familial and sporadic variants of neurodegenerative diseases (e.g., AD and FTD) from around the globe. In this talk I will share the aims and current status of the consortium as well as recent developments such as new harmonization pipelines and new multi-feature multimodal approaches that are shedding new light on dementia phenotypes.

Biography: Graduated as a Medical Doctor in 1993 and as a Clinical Neurophysiologist in 1997. He worked at the Cuban Neuroscience Centre and at different University Hospitals in Cuba and in Colombia. His clinical and research work has focused on neurophysiological aspects of dementia syndromes and other neurological disorders. His motivation for teaching and research led him to a major career change into academia. This started with a PhD in Human Cognitive Neuroscience from 2005-2009 and continued with three Postdoctoral Fellowships. His is currently a Reader in Psychology at the University of Strathclyde, School of Psychological Sciences and Health where he leads the Applied Cognition Lab. His lab connects to wide international network. He has contributed novel neurocognitive biomarkers for the preclinical detection of Alzheimer's disease which are implemented worldwide. He leads major international networks such as the Latin American and Caribbean Consortium on Dementia and the EuroLAD-EEG Consortium which aim to bridge gaps between the global north and south regarding effective methodologies to investigate age-related diseases and provide affordable and cultural valid tools and intervention. He is also interested in the development of new technologies that can assess and assist people affected by these diseases across their continuum.

ECR Rising Star

Illuminating adverse cardiovascular remodelling through the development of translational molecular imaging approaches

Dr Mark Macaskill

University of Edinburgh

Abstract: Adverse cardiovascular remodelling is a process that occurs across the cardiovascular system were structural and functional changes arise due to underlying pathologies such as myocardial infarction and atherosclerosis. The impact of adverse remodelling includes compromised cardiac function, increased risk of cardiovascular events and poorer patient outcomes. However, the molecular processes underpinning these adverse changes are not fully understood, driving the need for better molecular imaging approaches. This talk will cover the use of molecular imaging with PET in preclinical research to develop an approach targeting inflammation using the TSPO radiotracer [^{18}F]LW223. In addition, a novel approach for the investigation of cardiac healing using [^{18}F]NS14490 to target Alpha7 Nicotinic Acetylcholine Receptors will also be discussed, as well as the investigation of micro-calcification with [^{18}F]NaF. The ultimate aim of this research is to use molecular imaging to deepen our understanding of these pathological processes, discover novel prognostic tools and guide the development of therapeutic strategies to reduce adverse cardiovascular remodelling.

Biography: Dr Mark MacAskill is translational preclinical scientist who has recently been promoted to Research Fellow in Cardiovascular Imaging at the University of Edinburgh. His work involves the investigation of the mechanisms driving adverse cardiovascular remodelling through the development and application of molecular imaging approaches. Dr MacAskill gained his PhD in Vascular Biology and Pharmacology from the University of Strathclyde in 2014 before moving to the University of Edinburgh to specialise in translational and preclinical molecular imaging using Positron Emission Tomography (PET) with Dr Adriana Tavares and Prof. David Newby. A highlight of Dr MacAskill's research to date has been his work on the development of the novel TSPO PET radiotracer, [^{18}F]LW223, for the assessment of cardiovascular inflammation following myocardial infarction. This work, which was awarded the Journal of Nuclear Medicine Editors' Choice award in 2022, has advanced from the preclinical stages and will begin Phase I clinical trial later this year. Dr MacAskill currently serves as the Early Career Researcher Lead in Cardiometabolic Imaging within the Centre for Cardiovascular Science at the University of Edinburgh.

Keynote 2

The future of CT on Mobile Stroke Units

Prof Iris Grunwald

University of Dundee

Abstract: Mobile Stroke Units (MSU) are equipped with an onboard CT scanner, point-of-care laboratory, and telemedicine. They facilitate earlier intervention and treatment on-scene whilst transporting the patient to the most suitable centre, significantly decreasing the time taken to provide the patient appropriate care and improving patient outcomes. MSUs have already clearly demonstrated to be effective and cost-efficient.

In a modified MSU (Hybrid-MSU) with more diagnostic imaging tools (X-ray, US …) we could show that prehospital imaging and diagnosis avoided 86% of A&E admissions. Traditional CT scanners use energy-integrating detectors, which measure the total amount of X-ray energy absorbed. In contrast, photon counting detectors (PCD) can measure the energy of each individual photon. This talk discusses imaging potentials and limitations on Mobile Stroke Units and the potential for integrating PCD scanners.

Biography: Prof. Iris Grunwald is the Chair of Neuroradiology at University of Dundee and Consultant at NHS Tayside. She is Vice President of the World Federation for Interventional Stroke Treatment (WIST).

Iris is passionate about developing and implementing novel imaging methodologies, working closely with SINAPSE. She co-founded Brainomix Ltd. - where she developed the 1st ever AI solution for image interpretation in acute stroke, now the European market leader. She was in the team that developed the world's 1st Mobile Stroke Unit Ambulance (MSU). She recently won the InnovateUK Women in Innovation award. This year she brought the 1st mobile Photon Counting CT scanner (the only one in Europe) to Dundee, a scanner that can produce images with much higher resolution and less radiation.

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Parallel Sessions

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Abstract number: O02

cis- and trans-4-[18F]Fluoro-L-proline are biomarkers of active collagen synthesis following myocardial infarction.

Victoria J. M. Reid[1,2], Mark G. MacAskill[1,2], Kalyani Pandya[1], Alice Arcidiacono[1], Carlos J. Alcaide-Corral[1,2], Timaeus E. F. Morgan[1,2], Viktoria Balogh[1], Leanne M. Riley[3], Takeshi Fujisawa[1], Nicholas L. Mills[1,4], Ross J. Lennen[1,2], Maurits A. Jansen[1,2], Ferheen Baig[5], Gillian A. Gray[1], Andrew H. Baker[1,6], David E. Newby[1], Manuel Mayr[5], Andrew Sutherland[3], Adriana A. S. Tavares[1,2].

1. Centre for Cardiovascular Science, The University of Edinburgh, UK
2. Edinburgh Imaging, The University of Edinburgh, UK
3. School of Chemistry, University of Glasgow, UK
4. The Usher Institute, The University of Edinburgh, UK
5. School of Cardiovascular Medicine and Science, King's College London, UK
6. CARIM, School for Cardiovascular Diseases - Maastricht University, Netherlands

Introduction: Myocardial infarction (MI) is a common precursor of Heart Failure (HF) and remains one of the leading causes of death worldwide. Following an MI, active collagen biosynthesis is fundamental for maintenance of cardiac integrity and function, and is a key component of myocardial remodelling which can lead to HF. At present, there are no suitable probes for selective, non-invasive, in vivo assessment of active collagen biosynthesis. This study will assess the value of cis-4-[18F]-fluoro-L-proline and trans-4-[18F]-fluoro-L-proline Positron Emission Tomography (PET) radiotracers as biomarkers of active collagen biosynthesis in the myocardium following permanent coronary artery ligation (CAL) in rats.

Methods: Adult male Sprague-Dawley rats underwent permanent CAL to induce MI. At 1-, 2-, 4-, and 12-weeks post-MI, PET/CT imaging was performed with cis-4-[18F]-fluoro-L-proline and trans-4-[18F]-fluoro-L-proline. In a separate cohort, 3,4-dehydro-L-proline and L-azetidine-2-carboxylic acid were used to inhibit collagen biosynthesis and to impair collagen triple helix stability respectively. Biochemical assays and Picrosirius Red (PSR) staining were completed on heart sections ex vivo.

Results: cis- and trans-4-[18F]fluoro-L-proline were both upregulated in the anterior left ventricle (LAV) following MI. SUVr for trans-4-[18F]fluoro-L-proline increased at 2, 4 and 12 weeks post-MI ($p<0.05$), relative to naïve controls, while cis-4-[18F]fluoro-L-proline uptake peaked at 4weeks post-MI ($p<0.01$). Peak signal for both tracers in the posterior left ventricle (LPV) occurred at 12-weeks post-MI, indicative of detrimental remodelling. Acute administration of collagen inhibitors 3,4-dehydro-L-proline and L-azetidine-2-carboxylic acid reduced SUVr for both cis- and trans-4-[18F]fluoro-L-proline ($p<0.05$). Chronic administration resulted in less established fibrosis compared to untreated MI controls ($p<0.01$), but with minimal changes to SUVr for both cis- and trans-4-[18F]fluoro-L-proline.

Conclusion: cis- and trans-4-[18F]-fluoro-L-proline can be used to detect regional changes in active collagen biosynthesis within the myocardium following MI. These biomarkers could enable better understanding of MI pathophysiology and have value in the assessment of new anti-fibrotic therapies.

Acknowledgements: This work was funded by the British Heart Foundation (FS/19/34/34354).

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Abstract number: O03

Measuring neurodegeneration in models of multiple sclerosis using PET/MR imaging

Pantila (Kelly) Panichnantakul[1], Adam Waldman[1], Adriana Tavares[2], Anna Williams[3]

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2. Centre for Cardiovascular Sciences, University of Edinburgh
3. Centre for Regenerative Medicine, University of Edinburgh

Multiple sclerosis is an inflammatory neurodegenerative disease characterised by demyelinated lesions in the central nervous system leading to progressive and permanent disability. In particular, synaptic alterations have been correlated with disease progression and severity and may thus underlie the observed neurodegeneration and clinical symptoms. More recently, positron emission tomography (PET) imaging of the presynaptic vesicle protein SV2A has been described as a method of quantifying synaptic density, highlighting its potential as an effective biomarker of neurodegeneration. To test this, global and focal cortical demyelination will be induced with the administration of cuprizone or lysophosphatidylcholine (LPC), respectively, in wildtype mice. PET imaging will then be performed alongside microstructural magnetic resonance imaging (MRI) of neurite density and myelin integrity at various points of the de- and remyelination processes and results will be validated against immunofluorescence, autoradiography, and electron microscopy experiments. Overall, this study will allow us to objectively and non-invasively visualise the neurodegenerative process as it occurs in vivo throughout different stages of disease and expand our understanding of how these mechanisms are linked to changes in myelination.

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Abstract number: O04

Developmental changes in occipital alpha rhythms: Recording EEG during public engagement events.

Christopher Turner[1], Satu Baylan[1], Martina Bracco[1,2], Gabriela Cruz[1], Simon Hanzal[1], Marine Keime[1], Isaac Kuye[3], Deborah McNeill[4], Zika Ng[3], Mircea van der Plas[1], Manuela Ruzzoli[5,6], Gregor Thut[1], Jelena Trajkovic[1], Domenica Veniero[7], Sarah P Wale[1], Sarah Whear[1] & Gemma Learmonth[1]

1. School of Psychology & Neuroscience, University of Glasgow
2. Sorbonne Université, Institut du Cerveau - Paris Brain Institute, Paris
3. School of Molecular Biosciences, University of Glasgow
4. School of Biodiversity, One Health & Veterinary Medicine, University of Glasgow
5. Basque Center on Cognition Brain and Language (BCBL), Donostia/San Sebastian
6. Ikerbasque, Basque Foundation for Science, Bilbao
7. School of Psychology, University of Nottingham

Statistical power in cognitive neuroscience experiments is often very low. Low sample size can reduce the likelihood of detecting real effects (false negatives) and increase the risk of detecting non-existing effects by chance (false positives). Here we present a study investigating a relatively unexplored method of increasing the sample size for simple electroencephalography (EEG) studies, of recording EEGs in the community during public engagement and outreach events in Glasgow. We collected data from 346 participants (189 females, age range 6-76 years) over 6 days, totalling 29 hours, at local science festivals. Occipital alpha activity (6-15 Hz) was recorded for 30 seconds using a single-channel electrode placed on the occipital midline (location Oz) while participants rested with their eyes closed. Using this community-based approach, we identified age-related changes in individual alpha frequency (IAF) and alpha power within a cross-section of the population. IAF increased throughout childhood, reaching a peak frequency in people in their early 20s, and slowed again in middle and older age. Alpha power reduced linearly with advancing age, but after accounting for aperiodic signal there was no reduction in alpha power over the lifespan. We also present a set of recommendations for researchers who wish to collect behavioural and EEG data within public engagement and outreach environments.

Acknowledgements: Funded by The Wellcome Trust

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Abstract number: O05

Neuroanatomical correlates of psychotic symptoms in a sample of mci and ad patients over time

Sara Scarfo, Yashar Moshfeghi, William McGeown

University of Strathclyde

Psychosis (hallucinations and/or delusions), one of the most prevalent neuropsychiatric symptoms in Alzheimer's Disease (AD) and Mild Cognitive Impairment (MCI), is associated with severe aggravation of the clinical picture. The severity of adverse outcomes and high prevalence make psychosis an important research target, as clarifying its underlying mechanisms has potential to improve earlier detection and inform treatment strategies. The current study explored this from a neuroanatomical perspective, investigating the associations between psychotic symptoms in AD and MCI, and brain areas derived from our recently completed comprehensive systematic review (https://osf.io/tg8xp/).

Samples were obtained from the Alzheimer's Disease Neuroimaging Initiative (ADNI) database (adni.loni.usc.edu), using data from the Neuropsychiatric Inventory (NPI), from the baseline assessment visit, month 12 and month 24 visits. The samples included MCI and AD dementia patients (based on ADNI's inclusion criteria) with a total of 124 patients presenting psychotic symptoms, of which 21 presented both delusions and hallucinations, 69 only delusions and 34 only hallucinations. Psychotic symptoms were measured using the Neuropsychiatric Inventory (NPI); the neuroanatomical features were measures of cortical thickness of a range of regions of interest (ROIs), derived using Magnetic Resonance Imaging (MRI) scans, analysed with the FreeSurfer software.

A correlational analysis will be used to investigate the psychotic symptoms, both as a cluster and according to their more specific underlying phenomena (e.g., delusions hallucinations, misidentification and paranoia), across the three timepoints. Using SPSS (version 28), a series of multiple regressions was performed, to investigate the associations between the symptoms of interest, and the brain areas previously identified. Analyses are under way; however we to find a primary involvement of the frontal areas in association with delusions, with a fronto-temporal involvement particularly in relation to paranoia, and fronto-occipital areas in association with hallucination and misidentification phenomena.

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Abstract number: O06

Skin pressure exerted by pelvic circumferential compression devices (PCCDs) in healthy volunteers

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2. Department of Trauma & Orthopaedics, Ninewells Hospital,
3. Department of Trauma & Orthopaedics, Southmead Hospital

Background: Pelvic fractures can result in haemorrhage and instability. Several commercially available pelvic circumferential compression devices (PCCDs) control bleeding by reducing the pelvic volume. However, high areas of pressure over bony prominences can lead to pressure sores and skin breakdown. The aim of this study was to investigate the safety of 3 different PCCDs by analyzing the pressure each exerted.

Methods: Pressure exerted at six locations by three PCCDs (Pelvic Belt, SAM sling and T-pod) were analyzed on forty healthy volunteers. Pressure exerted by all PCCDs was measured using oscillometer cuffs placed underneath the pelvic binders, in the supine position.

Results: There are variations in the pressure at the six bony locations because of different characteristics of PCCDs. The pressure exerted by the Pelvic Belt and SAM sling was lower than tissue damaging pressure of 69.75 mmHg (9.3 KPa) at all six locations. Pressure exerted by the T-pod at the greater trochanters was higher than the damaging pressure (mean 80.14mmHg on the right and 80.73mmHg on the left). This indicates a higher risk of skin damage in these areas with the T-pod device. BMI was inversely correlated with skin pressures.

Conclusions/Findings: This study notes that the T-pod has a higher chance of developing pressure complications at skin belt interface than the other 2 devices. Particular care should therefore be taken when using this device to remove it as soon as possible to minimize the risk of pressure complications. Lower BMI is also associated with higher skin pressures.

Disclosures: No conflicts of interest to declare.

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Abstract number: O7

Comparative Analysis for the Distinction of Chromophobe Renal Cell Carcinoma from Renal Oncocytoma in Computed Tomography Imaging Using Machine Learning Radiomics Analysis

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Background: ChRCC and RO are two types of rarely occurring renal tumours that are difficult to distinguish from one another based on morphological features alone. They differ in prognosis, with ChRCC capable of progressing and metastasizing, but RO is benign. This means discrimination of the two tumours is of crucial importance.

Objectives: The purpose of this research was to develop and comprehensively evaluate predictive models that can discriminate between ChRCC and RO tumours using Computed Tomography (CT) scans and ML-Radiomics texture analysis methods. Methods: Data were obtained from 78 pathologically confirmed renal masses, scanned at two institutions. Data from the two institutions were combined to form a third set resulting in three data cohorts, i.e., cohort 1, 2 and combined. Contrast-enhanced scans were used and the axial cross-sectional slices of each tumour were extracted from the 3D data using a semi-automatic segmentation technique for both 2D and 3D scans. Radiomics features were extracted before and after applying filters and the dimensions of the radiomic features reduced using the least absolute shrinkage and selection operator (LASSO) method. Synthetic minority oversampling technique (SMOTE) was applied to avoid class imbalance. Five ML algorithms were used to train models for predictive classification and evaluated using 5-fold cross-validation.

Results: The number of selected features with good model performance was 20, 40 and 6 for cohorts 1, 2 and combined, respectively. The best model performance in cohorts 1, 2 and combined had an excellent Area Under the Curve (AUC) of 1.00 ± 0.000, 1.00 ± 0.000 and 0.87 ± 0.073, respectively.

Conclusion: ML-based radiomics signatures are potentially useful for distinguishing ChRCC and RO tumours, with a reliable level of performance for both 2D and 3D scanning.

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Abstract number: O8

Using RNA aptamers to detect pathological protein misfolding in neurodegenerative diseases

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The pathological accumulation of misfolded TDP-43 in the brain and spinal cord of people with motor neuron disease and frontotemporal spectrum disorders (ALS-FTSD) is the key pathological hallmark in the majority of cases. We recently showed that this pathology can be detected in peripheral tissues, including the gut, years prior to motor symptom onset. Not only does this provide a possible peripheral non-invasive target for biomarker development, but it also raises the possibility of an early, pre-symptomatic biomarker. If we can detect TDP-43 pathology in colonic biopsies and in large amounts in the gall bladder, then it could be possible to detect TDP-43 pathology in stools samples. However, current antibodies used for the detection of TDP-43 pathology lack either sensitivity (pTDP-43 antibody) or specificity (c-terminal TDP-43 antibody) making their implementation in clinical testing challenging. Therefore, we recently developed an RNA aptamer with the ability to sensitively and specifically detect TDP-43 in biofluids and tissue with unprecedented resolution. The RNA aptamer preferentially binds to pathological TDP-43 (improved specificity) and given its small size compared to antibody molecules, there is reduced steric hindrance and so it can bind to TDP-43 in larger numbers (improved sensitivity). Indeed, using this approach we have shown that the RNA aptamer can detect pathological TDP-43 at femtomolar concentrations in biofluids (an order of magnitude better than classical antibody approaches) and on the nanometre scale in tissue.

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Abstract number: O9

Generalisability of Deep Learning Algorithms for Diagnostic Dermatology: An Investigation on Non-Dermoscopic Datasets from the Primary-Secondary Care Interface in the NHS

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The utilisation of deep learning algorithms for diagnostic dermatology has been extensively investigated with prior studies demonstrating the efficacy of skin lesion classifiers, exhibiting performance on par with experienced dermatologists on specific datasets. Clinical skin lesion images are typically acquired without the use of dermoscopes and are more variable, presenting a challenge for deep learning algorithms. It is imperative to examine the generalisability of these algorithms across populations and acquisition settings. This study aims to assess the performance of deep learning in generalising to non-dermoscopic datasets captured from the primary-secondary care interface in the NHS. The challenge of achieving high performance on non-standardised real-world local data, without the usage of a large diagnostically-labelled local dataset is investigated. We curated two diagnostic image datasets, comprising macroscopic images referred to secondary care from primary care practitioners in NHS Tayside and NHS Forth Valley. In addition, we used two public domain datasets for training, namely the dermoscopic ISIC-2019 dataset and non-dermoscopic SD-260 dataset. Classifiers were trained on each dataset and evaluated on all datasets. Further to this the classifiers were then fine-tuned on the NHS datasets and evaluated again on all datasets. Balanced accuracies and ROC curves were employed to evaluate performance. Our findings indicate that training on the SD-260 dataset resulted in the best generalisation performance. Pre-training on the SD-260 dataset, followed by fine-tuning on the target domain data, is an approach for enhancing performance. Pre-training on ISIC-2019 did not provide any benefit compared to training on the NHS dataset by itself. While pre-training on public macroscopic data followed by tuning on local data shows promising results, further improvements are required for deployment in a real clinical pathway. Our study suggests that larger datasets local to the target dataset may yield further enhancements in classification performance.

Acknowledgements: Dr Sanaa Butt and Dr Gordon Allott assisted with diagnostic labelling of the Tayside image dataset. This work is funded by the National Institute for Health and Care Research (Artificial Intelligence, Deep learning for effective triaging of skin disease in the NHS, AI AWARD01901) and NHS Transformation Directorate. The views expressed in this publication are those of the authors and not necessarily those of the National Institute for Health and Care Research, NHS Transformation Directorate or the Department of Health and Social Care. J. Carse was also supported by the UK Engineering and Physical Sciences Research Council (EPSRC Training Grant EP/N509632/1).

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Abstract number: O10

Detection of rectal cancer by using Field-Cycling Imaging at magnetic field strength below 200 mT

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Background: Field-Cycling imaging (FCI) is a novel tool that measures changes of R1 relaxation rate (1/T1) with the magnetic field strength (1,2). This feature can be exploited to observe the field-dependent changes of R1, represented as the R1 dispersion profile. It provides insights into underlying structural and molecular dynamics information that a standard MRI system cannot access. The aim of this pilot study is to test the feasibility of the FCI whole-body scanner to characterize rectal cancer.

Methods: Five patients diagnosed with locally advanced rectal cancer were scanned by using FCI scanner, Field-cycling pre-polarized and non-polarized pulse sequences were used with four evolution fields ranging from 0.2 T to 0.2 mT, TE of 21 ms, 20 kHz bandwidth, in-plane resolution of 4.3 mm, and slice thickness of 10 mm. The duration of the FCI scan is approximately 45 minutes.

The curve fitting approach used an absolute-valued monoexponential decay model to estimate R1 values from the absolute magnitude data.

Results: The FCI scan was done for patients with rectal tumours and correlated to the clinical MRI images to delineate the ROIs. The in-vivo R1 dispersion profiles extracted from the tumour and the healthy ROIs showed clear contrast with different dispersion shapes (Figure 1).

Conclusion: This preliminary study provided the first insights into using the FCI technique as it can provide a potential biomarker for the characterization of rectal cancer. Although the primary source of the signals is not well defined yet, previous studies have reported that (R1 = 1/T1) is related to changes in molecular dynamics within tumour tissues, and the water exchange rate across the plasma membrane is a distinctive feature that distinguishes healthy from tumour cells (3).

Acknowledgements: We thank King Abdulaziz University for supporting A.A and funding this study, and we are grateful to the University of Aberdeen for all the research support.

References:

1. Steele RM, Korb JP, Ferrante G, Bubici S. New applications and perspectives of fast field cycling NMR relaxometry. Magnetic Resonance in Chemistry. 2016;54(6):502–9.
2. Broche LM, Ross PJ, Davies GR, MacLeod MJ, Lurie DJ. A whole-body Fast Field-Cycling scanner for clinical molecular imaging studies. Scientific Reports. 2019 Jul 18;9(1):10402.
3. Ruggiero MR, Baroni S, Aime S, Crich SG. Relaxometric investigations addressing the determination of intracellular water lifetime: a novel tumour biomarker of general applicability. Molecular Physics. 2019 Apr 18;117(7–8):968–74.

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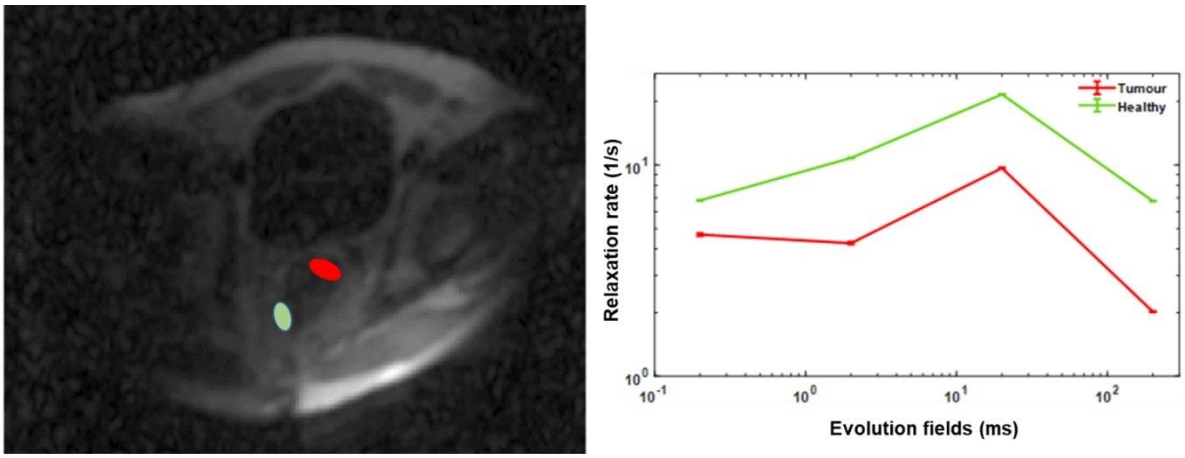

Figure 1 (Left) FCI transverse processed image of the rectum of patient diagnosed with Locally Advanced Rectal Cancer at 0.2 mT. (Right) The R1 dispersion profiles from tumour and healthy regions (highlighted in red and green colour, respectively).

Abstract number: O11

Evaluation of 0.22MHz and 0.65MHz focused ultrasound transducer performance through cranial bones

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This study aims to evaluate transcranial low intensity focused ultrasound delivered by single-element focused ultrasound transducers of frequencies 0.22 MHz and 0.65 MHz, and to visualize the acoustic field at the focal point.

72 regions from 10 historical skulls covering frontal, parietal, and temporal bones were selected for testing. CT scans were performed to acquire density information. 0.22 and 0.65 MHz focused ultrasound transducers delivered pulses through all regions. Regions were positioned at normal incidence to the surface of the transducer and at the distance of the integers of half-wavelength. A needle hydrophone was positioned behind the skull. Matlab software (developed in-house) was used for both scanning control and data acquisition. Speed of sound at each region was measured, and 2D field maps with time history were constructed.

Each region tested was found to be between 3.8-11.2±1.3 mm thick. The mass density (converted from radiodensity) is between 1360-1860±250 kg/m^3, which was linearly correlated to the sound velocity (R^2=0.9), which is between 2160-3150±140 m/s. Across the majority of the regions, compared to the free field value, maximum signal amplitudes and focal intensities drop by13-54% and 17-80% respectively for the 0.22 MHz transducer; and by 53-74% and 77-94% respectively for the 0.65MHz transducer. attenuation of the skulls was expressed as a function of the thickness and the internal impedance coefficient (R^2=0.83 and 0.69). Insignificant focal point and phase aberrations were observed at normal incidence regions. Greater shifts were observed through regions of irregular curvature and thickness. Standing waves at in-phase distance resulted in a 30 % pressure increase at the focal point compared to out-of-phase. Although the acoustic reflection coefficient at water-skull interface is typically at least 30%, we achieved a minimum pressure loss compared to free field of 13% for the 0.22 MHz transducer.

Acknowledgements: This work has been carried out in Ninewells hospital. The author thanks Tyler Halliwell from the Centre for Anatomy and Human Identification(CAHID) at the University of Dundee for providing us the skull specimens.

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SINAPSE
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Abstract number: O12

Real-time image-based motion correction for 7T task-based functional MRI

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Introduction: Compared to standard MRI clinical field strengths, 7T has a higher resolution potential but is also more susceptible to motion artefacts. This is pronounced in the longer, high-resolution acquisitions used for functional MRI (fMRI), which are typically corrected with retrospective motion correction [1]. The restricted environment in 7T scanners makes markerless, non-hardware techniques a compelling option. This abstract presents an implementation of the markerless, real-time Multislice Prospective Acquisition Correction (MS-PACE) technique for 7T task-based fMRI.

MS-PACE estimates motion by continuously registering a subset of equidistant 2D-EPI slices to a reference volume. This allows for sub-repetition-time motion correction. This method has previously been implemented at 3T [2].

Methods: The study was performed in a MAGNETOM Terra 7T scanner (Siemens Healthineers, Erlangen, Germany) using an in-house-developed GRE-EPI sequence on 10 healthy subjects (age 31±9). The fMRI protocol consisted of 3 scan groups: 2 resting scans; 2 left-hand tapping; 2 right-hand tapping. Motion correction was applied to 1 scan/group. The scan parameters were otherwise identical: voxel size 2×2×2mm3, matrix 96×96, GRAPPA factor 3, 60 slices, 110 volumes, TR 4s, TE 18ms, total acquisition time 7m32s. The tapping stimulus was transmitted by PsychoPy [3]. Fig.1 shows how the motion correction pipeline operates. Estimated motion parameters were subsequently used to update the scanner. The rigid-body motion parameters were calculated in the Image Calculation Environment (Siemens Healthineers, Erlangen, Germany) using ITK open-source image registration libraries.

Results: Fig.2 compares the mean voxel displacement from each scan group across all subjects. It demonstrates the consistent ability of the technique to correct for motion in subjects with various levels of movements.

Conclusion: This study evaluated an implementation of a real-time motion correction technique for 7T task-based fMRI and showed that it can consistently reduce the effects of long-term motion in a motion-propensity diverse cohort of subjects.

Acknowledgements: The authors are grateful for the scientific support of Kristian Stefanov (University of Glasgow), Belinda Ding (Siemens Healthineers UK) and Radhouene Neji (Siemens Healthineers UK).

References:

1. Maknojia S et al. Front Neurosci. 2019;13:1-13.
2. Hoinkiss DC et al. Neuroimage. 2019;200:159-73.
3. Peirce J et al. Behav Res. 2019;51:195–203.

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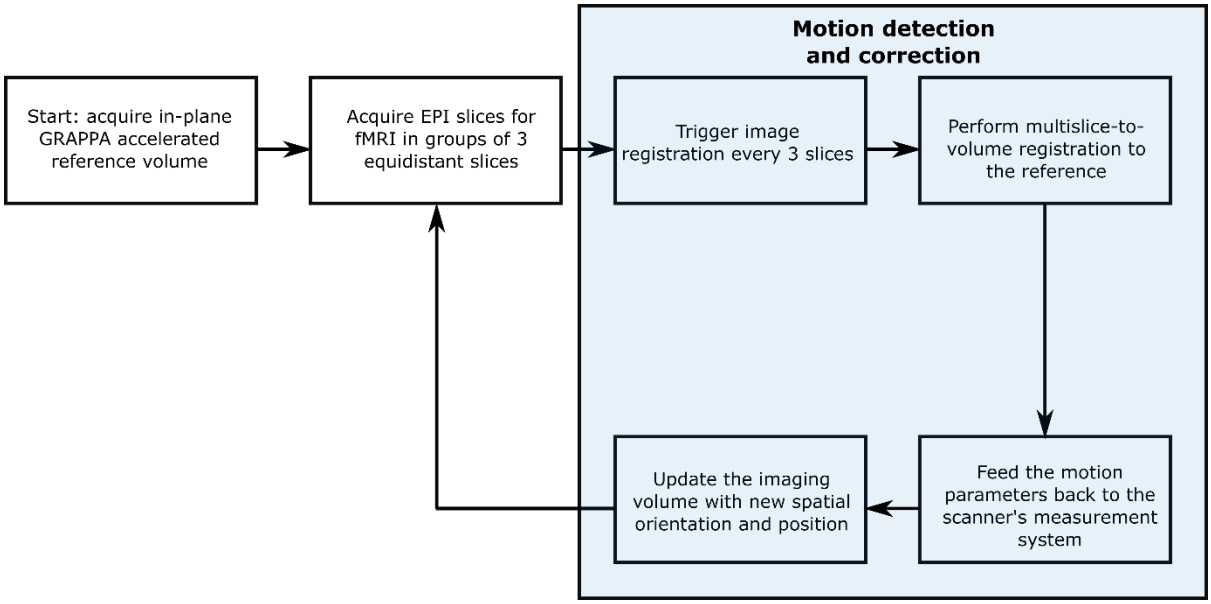

Figure 1. The MS-PACE motion correction pipeline.

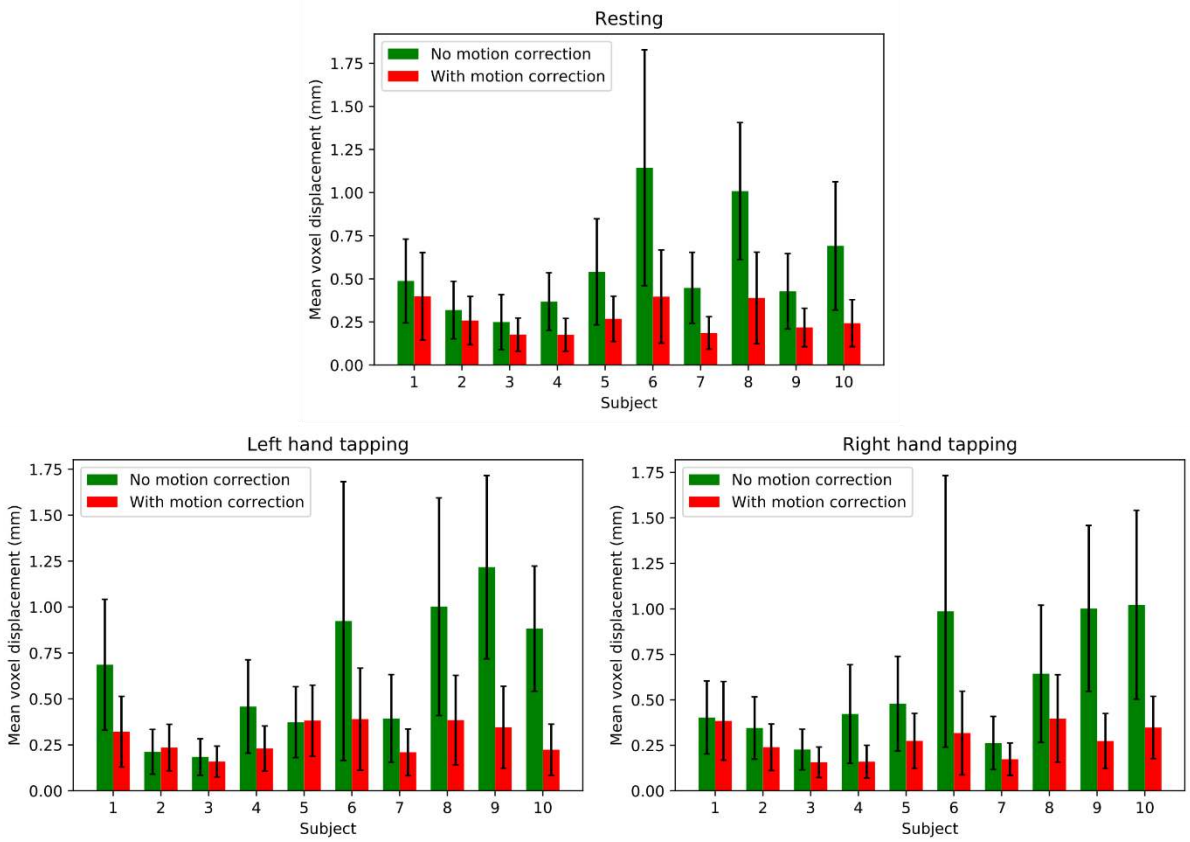

Figure 2. Mean voxel displacement with (red) and without (green) real-time motion correction from each functional scan group: resting scans (top); left hand tapping (bottom left); right hand tapping (bottom right). The error bars represent the standard deviation of each dataset.

Abstract number: O13

Photoacoustic Image Reconstruction with Generative Adversarial Networks

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Photoacoustic imaging is a powerful imaging modality that combines the advantages of optical and ultrasound imaging. However, it is prone to limited-view artifacts that occur when not all parts of the object are illuminated by the light source. This can result in incomplete or distorted images that affect the accuracy of diagnosis and treatment. In this project, we explore the use of the cycle generative adversarial network (GAN) architecture to remove limited-view artifacts from photoacoustic images via image translation, including CycleGAN, Pixle2pixel, and Contrastive Unpaired Translation. The basic idea behind GANs is to learn a mapping between two domains, such as the limited-view and complete-view domains in photoacoustic imaging, using a pair of generator and discriminator networks. The generator network learns to translate images from the limited-view domain to the complete-view domain, while the discriminator network tries to distinguish between the generated complete-view images and the real complete-view images. A loss function is used to ensure that the translation is bijective, meaning that images translated from the limited-view domain to the complete-view domain and then back to the limited-view domain should be similar to the original limited-view images. We show the best results of three GANs networks is pixle2pixle with SSIM 0.86, FSIM 0.98, and MAE 0.04 compared to the ground truth images. While the findings indicate that unsupervised training is ineffective for the task, a supervised approach has demonstrated potential.

However, to ensure clinical certainty in the model's performance, evaluation could be conducted by having trained humans manually label the inference results as correct or incorrect. This would ensure a clinician-approved output of a future model. Furthermore, future research could involve a multi-modal approach, in which input data about the tissue being reconstructed, the scale of the image, or possibly the time-series data is provided.

Acknowledgements: We would like to thank Janek Grohl at University of Cambridge's support to run this experiment.

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Abstract number: O14

Optimal excitation angle of air-pulse system for optical coherence elastography

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Air-pulse optical coherence elastography (OCE) is a totally non-contact imaging modality that provides biomechanical properties of tissues by analysing characteristics of wave behaviours. A previous study (Wang et al., 2013) has shown that the excitation angle of air-pulse can influence air-pulse pressure. However, the impact of the excitation angle on wave characteristics in sample has yet to be explored. This study aims to investigate the optimal excitation angle in air-pulse OCE.

Air-pulse OCE consists of a phase-sensitive optical coherence tomography (PhS-OCT) system and an air-pulse excitation system with a needle port of an internal diameter of 0.4 mm generated air pulses with a bandwidth of 1250 Hz. The PhS-OCT system has a central wavelength (1310±110nm) and a high-speed line camera with sampling frequency of 20730 Hz. The excitation angles of incidence relative to the normal surface would be set within the operable range, so 35°, 45°, 60° and 70° were examined. The optimum excitation angle to stimulate the surface acoustic wave (SAW)on the silicone surface was determined by comparing the peak-to-peak amplitudes of SAW generated at the focal area on the sample surface and comparing the bandwidth of SAW under the -20dB width of spectrum in MATLAB, respectively.

The excitation angle of 45° was found to produce the largest peak-to-peak amplitude of the SAW, which was 1.91, followed by 35°and 60° with 1.69 and 1.14 separately. A minimum was 70° with amplitude of 0.88. The widest bandwidth of SAW was generated from excitation angle of 45°, with 1544.59 Hz. Followed by 35°and 60° with a bandwidth of 1333.23 Hz and 1048.70 Hz respectively. A minimum bandwidth of 70° was 634.09 Hz. Therefore, 45° is the optimal stimulation angle of the air-pulse OCE system to simulate SAW on sample. The outcomes can potentially provide an essential reference for future tissue research.

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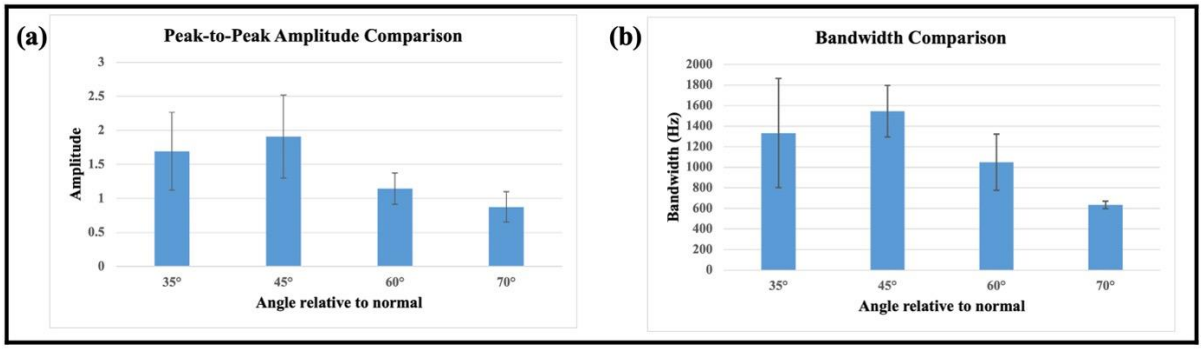

Figure 1

Abstract number: O15

Quantitative Ultrasound Measurement of Healthy Brain and Glioblastoma in the Frequency Range 16 - 35 MHz

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Acoustic characterisation of tissue, via attenuation and speed of sound (SoS), may be important for cancer detection. However, attenuation measurement of the brain has not previously been achieved above 10 MHz, despite potential use for intraoperative residual brain tumour detection. Quantitative ultrasound (QUS) analysis, involving estimation of statistical parameters from backscattered signals, also has potential use, with spectral and statistical modelling of backscattered power spectra explored in cancer detection in various soft tissues but not previously the brain. The present study aims to correct these omissions.

Ten frozen healthy cortical white matter samples (Edinburgh Brain Bank Ref TR76/20) and ten glioblastoma multiforme (GBM) samples (Brain UK Ref 20/013) were obtained. Each sample under investigation was placed on a planar reflector in PBS solution. Data was collected with linear array transducers (L5-11 MHz, L16-35, Verasonics Inc., WA, USA) connected to an ultrasound research system (Vantage 128, Verasonics Inc., WA, USA) and processed with MATLAB (v2019b, The Mathworks, Cambridge, UK). QUS parameters were calculated via the frequency dependence of the backscattered power spectrum (effective scatterer diameter, effective acoustic concentration) and system independent model parameters (α, κ) from the homodyned-K distribution were estimated.

The average SoS of healthy tissue was found to be 1551.8 ± 18.7 ms-1 with GBM slightly higher at 1560.4 ± 23.3 ms-1. The higher GBM SoS suggests slightly higher stiffness. The values of attenuation at 25 MHz were 29.9 ± 1.6 dB cm-1 and 34.8 ± 4.3 dB cm-1 for healthy tissue and GBM respectively, indicating a 5.1 dB difference on average. Combining low and high-frequency results allowed attenuation to be mapped from 5 - 35 MHz, the first study in human tissue since the 1970s. There was a significant difference ($P < 0.05$) in the acoustic concentration parameter in healthy and GBM samples. HK parameters were insensitive in this instance.

Acknowledgements: We are grateful to UK EPSRC and Stryker for the funding of this work.

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Abstract number: O16

Imaging Headaches: Retrospective Analysis of Incidental Pituitary Lesions Discussed in a Neuroendocrine MDT

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Incidental pituitary lesions are a common imaging finding (1). The optimal strategy for the long term follow up of these lesions is uncertain, especially with respect to imaging, with guidelines relying on low quality evidence (2).

We performed a retrospective, longitudinal analysis of incidental pituitary lesions discussed in a neuroendocrine MDT. Specifically, imaging was reviewed to determine the frequency and duration of follow up, the change in lesion size over the course of follow up and to determine whether predictors of lesion growth could be extracted.

69 patients were identified as meeting the inclusion criteria, of whom 58 underwent follow up imaging that was available for review. The average age was 57, with 50% female. The average initial lesion height was 14 mm and 5 (9%) individuals subsequently underwent surgical intervention.

Lesion growth, as defined as height increase of > 1 mm, was observed in 16 (28%) individuals. Of these, 15 cases had lesions initially larger than 10 mm, although this relationship did not meet the threshold for statistical significance ($X2 = 0.96$, $p = 0.33$).

Lesion growth on final follow up study was moderately strongly correlated with growth on initial follow up study, ($r = 0.65$ and $p > 0.005$). This relationship held true on a categorical analysis of growth/no-growth on initial follow up and final follow up ($X2 = 13.6$, $p < 0.005$).

Overall we found that long term lesion growth is moderately associated with growth on initial follow up imaging. No significant association between initial lesion size and growth was found.

References:

1. Ezzat S et al. The prevalence of pituitary adenomas. Cancer. 2004;101(3):613–9.
2. Freda PU et al. Pituitary Incidentaloma: An Endocrine Society Clinical Practice Guideline. J Clin Endocrinol Metab. 2011 Apr;96(4):894–904.

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		Grouped by adenoma		
		Overall	No	Yes
n		58	15	43
Age, mean (SD)		57.0 (18.0)	47.7 (16.6)	60.3 (17.5)
gender, n (%)	f	29 (50.0)	9 (60.0)	20 (46.5)
	m	29 (50.0)	6 (40.0)	23 (53.5)
Initial lesion height (mm), mean (SD)		13.9 (5.4)	11.2 (3.1)	14.8 (5.7)
Intervention?, n (%)	No	52 (91.2)	15 (100.0)	37 (88.1)
	Yes	5 (8.8)		5 (11.9)

Table 1. Summary of population

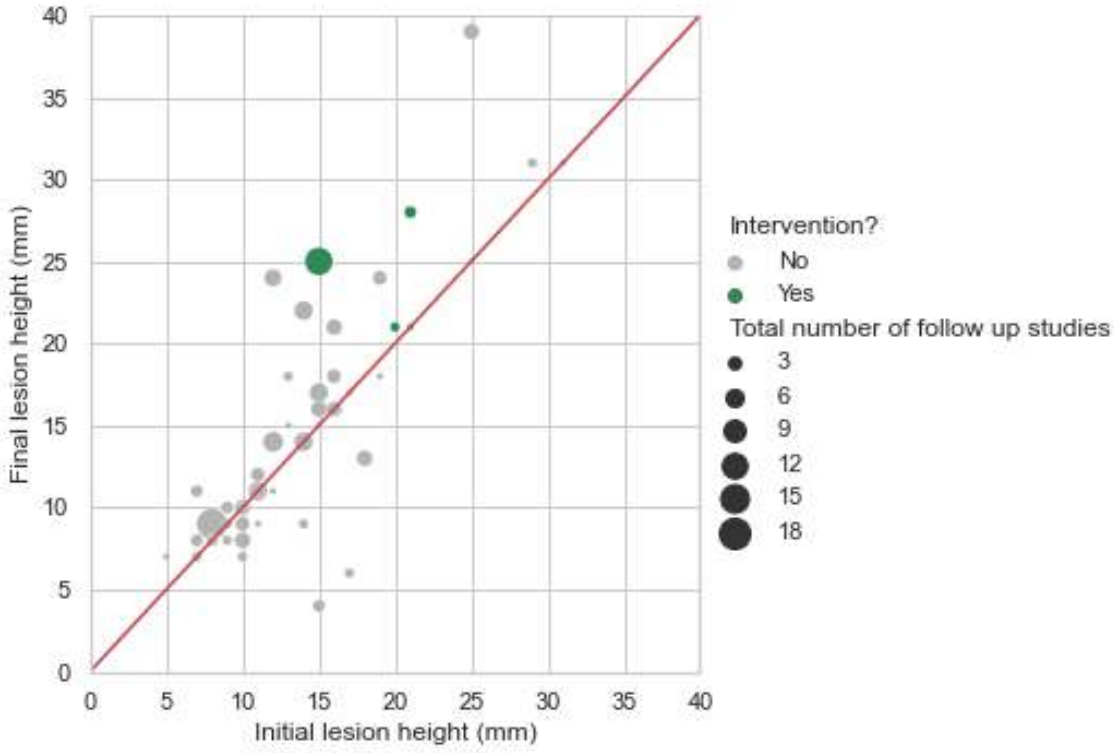

Figure 1. Summary of lesion behaviour/follow up imaging

Abstract number: O17

Eight-channel transceiver and fifty-six channel receiver array for combined head-neck imaging at 7 tesla

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3. MR CoilTech, Ltd, Glasgow, Scotland

Earlier diagnosis of pathological characteristics in the brain and spinal cord can be greatly enhanced with ultra-high field MRI (≥7T) due to its improved spatial resolution and signal-to-noise ratio. Currently available brain and cervical spinal cord radiofrequency (RF) coils at 7T are either equipped with 16-transmit channels, which is not industry standard, or can only individually image the different regions of the neurovascular anatomy separately. For simultaneous head-and-neck imaging, a dedicated RF coil with the ability to excite a larger field-of-view (FOV) than existing 7T brain coils is required. This work presents a novel dual-row 8-channel transceiver and 56-channel receiver array and demonstrates its extended longitudinal coverage for neurovascular imaging.

The transceiver array consists of eight conventional loops arranged around a 290 mm diameter fiberglass cylinder with six elements in the top row and the remaining two elements in the lower row. Each loop consisted of evenly distributed fixed capacitors and a variable capacitor, which are connected with 2 mm diameter silver plated copper wire. Two cut-outs of 70 × 65 mm2 are included in front of the eyes for patient comfort. All adjacent elements within the row are decoupled with transformers, and the elements between the two rows are partially overlapped. The 3D CAD model and constructed coil assembly are shown in Figure 1. A 3D electromagnetic and circuit co-simulation was carried out in CST Studio Suite 2021 (Dassault Systems, France). MR measurements of the coil were performed on a Magnetom Terra 7T whole body scanner (Siemens Healthcare GmbH, Germany). The measured B_1^+ field in the tissue mimicking head and shoulder phantom and healthy volunteer images (Figure 2) demonstrate the feasibility of capturing both the brain and C-spine region within one acquisition at 7T using the proposed neurovascular coil.

Acknowledgements: This project has received funding from SINAPSE, Christine Rodgers endowment fund, Neuroscience Foundation and UKRI strength in places.

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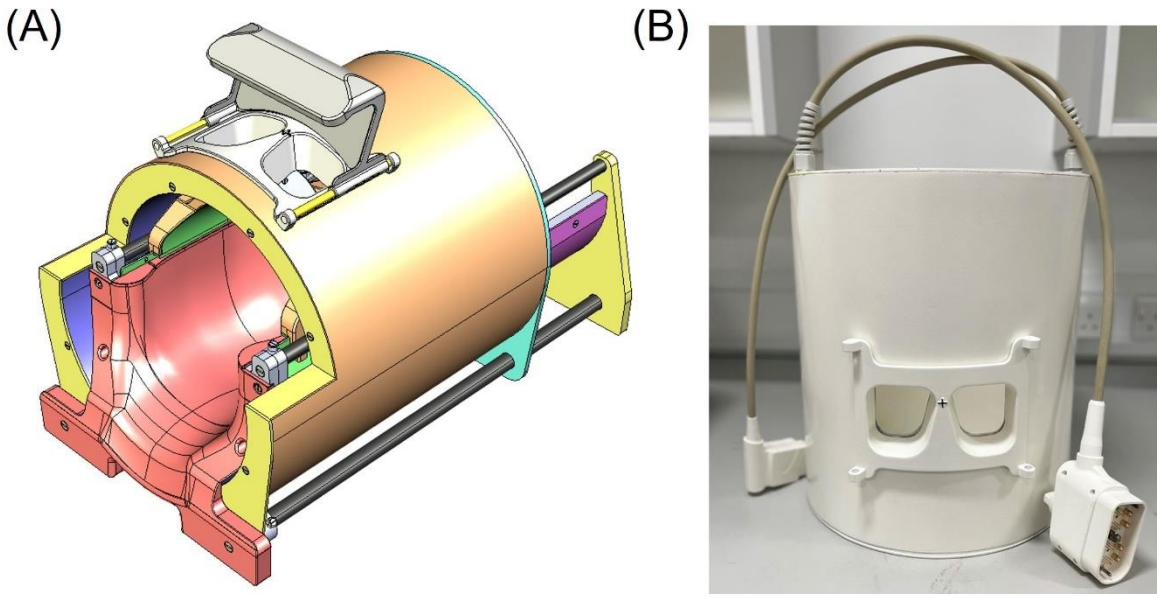

Figure 1. (A) 3D CAD model of the complete coil assembly and (B) Front view of the constructed coil with transmit and receive plugs.

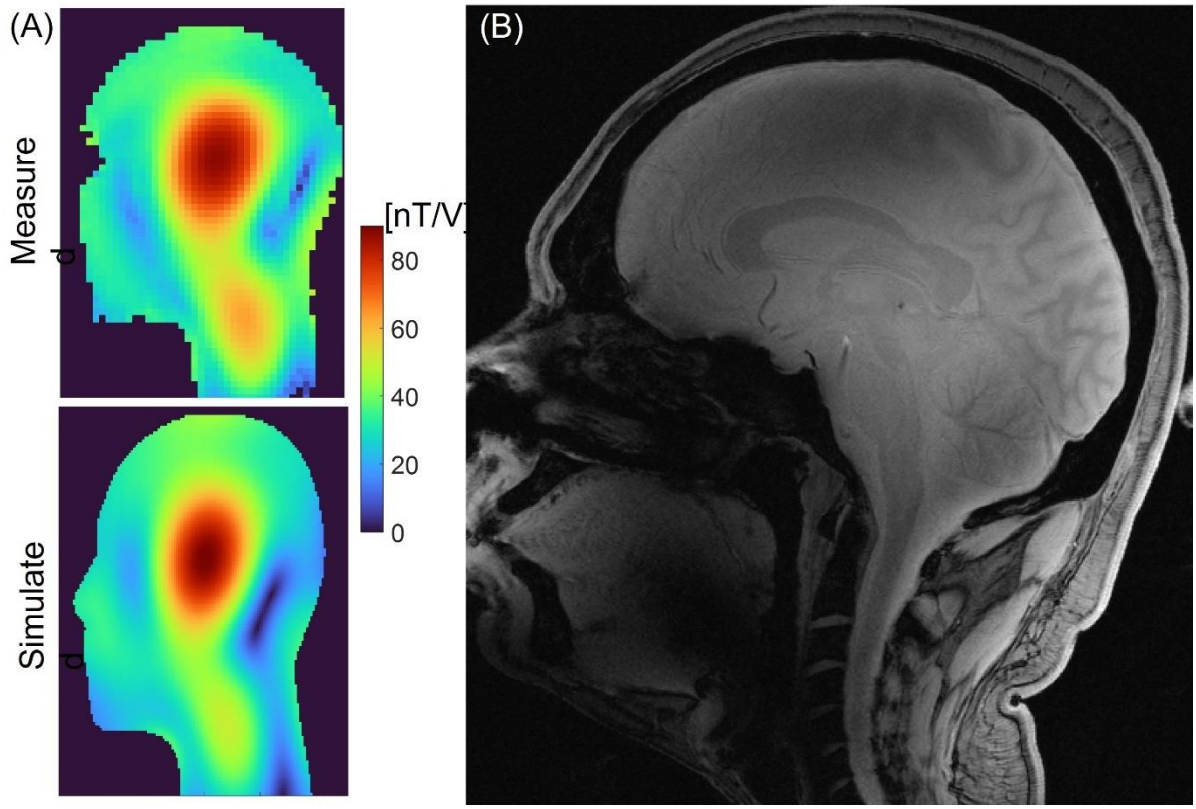

Figure 2. (A) Measured and simulated B1+ maps in head and shoulder phantom in sagittal plane with the constructed 8-channel transceiver array in CP configuration. (B) Combined head-and neck-image obtained from the FLASH sequence with the constructed transceiver array (TE: 2.3 ms, TR: 418 ms, resolution: 0.46*0.46*3.37 mm3, FOV: 225*240 mm2

Abstract number: O18

Detection of cerebral small vessel disease using field-cycling MRI

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Cerebral small vessel disease (SVD) is prevalent in patients with stroke and contributes to cognitive decline. Field-cycling imaging (FCI) is an emerging whole-body magnetic resonance imaging (MRI) technology unique to the University of Aberdeen, that acquires images over multiple magnetic field strengths to provide endogenous contrast R1 maps at magnetic fields below 0.2T. We show here the preliminary FCI image contrast obtained between SVD and white matter.

The study was approved by the North of Scotland Research Ethics Committee (21/NS/0128). The initial six patients recruited with clinically determined moderate or severe SVD were included in this preliminary investigation. A total of 9 data sets were included from patients who attended an initial 3T MRI (Philips 3T dStream) and FCI scan (N=6) and repeated scans after 30 days (N=3). 20 FCI images were obtained across evolution fields of 0.2, 2, 20, and 200mT.

FCI images were denoised using a pretrained denoising convolutional neural network contained within MATLAB (MathWorks, USA). R1 maps were generated at each evolution field and rescaled to a normalised grey scale dynamic range of 0–255. Tissue label maps were created from 3T MRI data using an automated approach to produce regions of white matter (WM), and regions of SVD white matter hyperintensity (WMH). Tissue labels were co-registered to images obtained from FCI and used to interrogate differences between R1 values (Fig.1).

A significant difference was observed between R1 values (cohort median, IQR) extracted from WM and WMH regions at 0.2mT (149.9, 147.1–159.9 Vs. 124.7, 114.7–128.6, P=0.008) and 2mT (144.2, 139.1–149.9 Vs. 118.2, 110.2–124.5, P=0.008).

The preliminary results obtained from this study demonstrate for the first time the feasibility of FCI to detect SVD. FCI has the potential to provide a clinically feasible imaging solution for assessment of SVD severity and disease progression.

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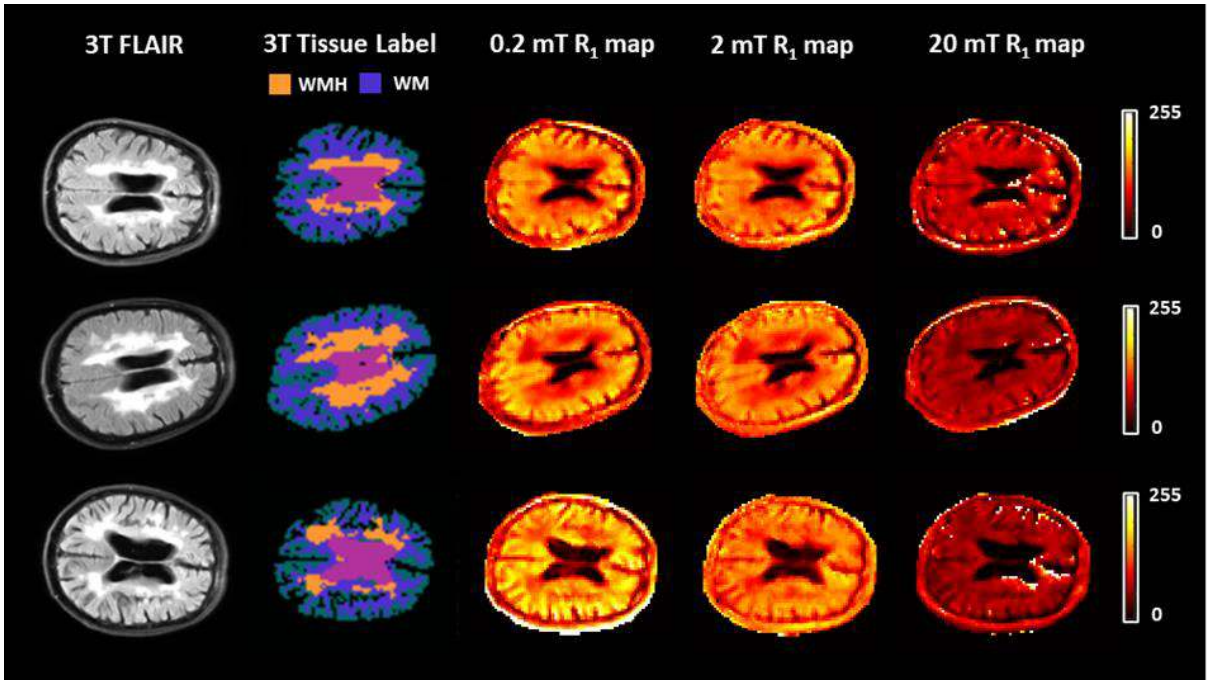

Figure 1. **R_1 maps obtained from first 2 participants.** Each row corresponds to a single participant data set of co-registered images. The first column shows the 3T MRI FLAIR image. Hyper-intense signal corresponds to regions of white matter hyperintensities (WMH) associated with small vessel disease. The second column shows the tissue label map generated from 3T MRI data. Subsequent columns of R_1 maps were generated at each field and rescaled to a grey scale dynamic range of 0 – 255.

Abstract number: O19

Quantifying Perivascular Spaces in UK Biobank: A work in progress

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Perivascular spaces (PVS) are the fluid-filled cavities surrounding the small blood vessels of the brain. While their exact function is not fully established, they are believed to play a vital role in the clearing of interstitial fluid (e.g., waste products within the brain). With age and exposure to vascular risk factors, PVS often appear enlarged. Enlarged PVS are considered to be a marker of cerebral small vessel disease, coinciding with increased burden of white matter hyperintensities, lacunes, and microbleeds. Enlarged PVS have independently been associated with poorer performance on cognitive testing, and may be associated with increased risk of stroke and of vascular dementia.

The UK Biobank cohort is a very large population study, providing imaging, genetic, and environmental data. To date, approximately 50,000 participants have provided baseline imaging data, with UK Biobank aiming to recruit up to 100,000 volunteers for baseline imaging and repeat imaging in 60,000 volunteers in the coming years.

Over the past year, we have been processing UK Biobank brain imaging of over 40,000 participants, in order to segment and quantify PVS for future analysis of clinical and lifestyle factors associated with increased PVS burden. Here, we will present our pipeline for segmenting PVS, from selecting the appropriate images through to the challenge of quality control in a big data project. Alongside presenting the broad methodology, we will reflect on challenges and achievements encountered along the way, and identify next steps in our analysis. In presenting this work in progress, we hope to share learning of processing images in very large datasets with experienced audience members and members about to embark on big imaging data projects alike.

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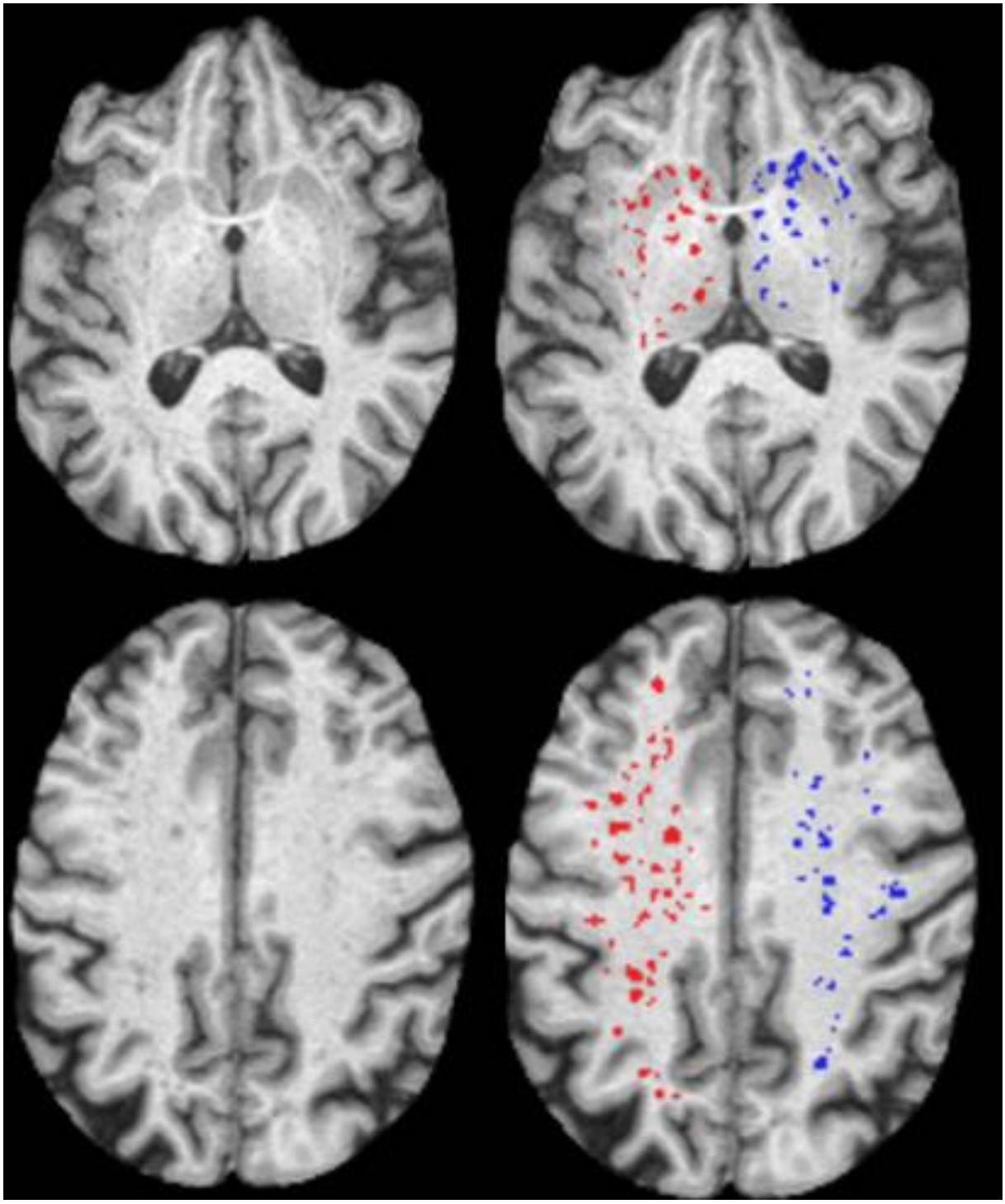

Figure 1. T1 axial image of basal ganglia (top left) with overlaid PVS segmentation (top right). T1 axial image of centrum semiovale (bottom left) with overlaid PVS segmentation (bottom right).

Abstract number: O20

Vessel Wall Imaging at 7-Tesla using 3D Turbo Spin-Echo

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Background: Intracranial vessel wall imaging (VWI) is widely used clinically for evaluating neurovascular diseases (1). Unruptured aneurysms demonstrate vessel wall enhancement, strongly indicating stability, and VWI establishes additional management methods (2,3). VWI has demonstrated an association between intracranial wall lesions and cognitive function (4), vascular risk factors (5), and as a marker of extracranial atherosclerotic disease (6). With increasing magnetic field strengths, the signal-to-noise ratio (SNR) increases supra-linearly (7). This increased SNR at 7T (compared to 3T), provides increased spatial resolution required to image small intracranial vessel walls in the order of 0.2-0.3mm thick (8). Variable flip angle turbo spin-echo (SPACE) is a 3D turbo spin-echo (TSE) variation that increases k-space sampling efficiency with a longer echo-train duration with variable-flip-angle refocusing pulses that adjusts for T2 decay and shorter echo spacings (9). This study investigates two MRI sequences with a SPACE readout module optimized for VWI at 7T.

Materials/methods: Four healthy volunteers were scanned on a MAGNETOM 7T Terra MRI scanner (Siemens, Erlangen, Germany) and a custom-built head coil (10) using delay alternating with nutation for tailored excitation (DANTE) prepared 3D SPACE (DS) (11) and magnetisation-prepared inversion recovery (MPIR) SPACE (MS). Images were obtained at 0.6 - 0.9 mm3 isotropic resolution and 0.6mm slice thickness. Images were reviewed by a consultant neuroradiologist (SYF).

Results/Discussion: Although SPACE effectively suppresses fast-moving blood spins, its effect on slow-moving CSF spins is limited. DANTE achieves the latter, as it's sensitive and can efficiently suppress slow velocities (~mm/s) (11). The DS sequence has slightly better SNR than the MS sequence, resulting in a higher resolution of the vessel walls. CSF suppression is greater in the MS sequence (12). Although the CSF is suppressed at the MCA cisterns on the DS sequence, some optimisation is still necessary as suppression is incomplete and restricted up to the level of Sylvian fissures. Finally, the DS sequence is susceptible to signal loss at the level of the sphenoid sinus at the air-bone contact. The acquisition field-of-view and sample direction may have an impact, which will be investigated in the following optimisation phases.

References:

1. Lindenholz A, van der Kolk AG, Zwanenburg JJM, Hendrikse J. The Use and Pitfalls of Intracranial Vessel Wall Imaging: How We Do It. Radiology. Jan 2018;286(1):12-28. doi:10.1148/radiol.2017162096
2. Molenberg R, Aalbers MW, Appelman APA, Uyttenboogaart M, van Dijk JMC. Intracranial aneurysm wall enhancement as an indicator of instability: a systematic review and meta-analysis. European Journal of Neurology. Nov 2021;28(11):3837-3848. doi:10.1111/ene.15046

3. Texakalidis P, Hilditch CA, Lehman V, Lanzino G, Pereira VM, Brinjikji W. Vessel Wall Imaging of Intracranial Aneurysms: Systematic Review and Meta-analysis. World Neurosurgery. Sep 2018;117:453-+. doi:10.1016/j.wneu.2018.06.008
4. Zwartbol MHT, van der Kolk AG, Ghaznawi R, et al. Intracranial atherosclerosis on 7T MRI and cognitive functioning The SMART-MR study. Neurology. Sep 2020;95(10):E1351-E1361. doi:10.1212/wnl.0000000000010199
5. Zwartbol MHT, van der Kolk AG, Ghaznawi R, et al. Intracranial Vessel Wall Lesions on 7T MRI (Magnetic Resonance Imaging): Occurrence and Vascular Risk Factors: The SMART-MR Study. Stroke. Jan 2019;50(1):88-94. doi:10.1161/strokeaha.118.022509
6. Zwartbol MHT, Geerlings MI, Ghaznawi R, et al. Intracranial Atherosclerotic Burden on 7T MRI Is Associated with Markers of Extracranial Atherosclerosis: The SMART-MR Study. American Journal of Neuroradiology. Dec 2019;40(12):2016-2022. doi:10.3174/ajnr.A6308
7. Guerin B, Villena JF, Polimeridis AG, et al. The Ultimate Signal-to-Noise Ratio in Realistic Body Models. Magnetic Resonance in Medicine. Nov 2017;78(5):1969-1980. doi:10.1002/mrm.26564
8. Mandell DM, Mossa-Basha M, Qiao Y, et al. Intracranial Vessel Wall MRI: Principles and Expert Consensus Recommendations of the American Society of Neuroradiology. American Journal of Neuroradiology. Feb 2017;38(2):218-229. doi:10.3174/ajnr.A4893
9. Xie YB, Yang Q, Xie GX, Pang JN, Fan ZY, Li DB. Improved Black-Blood Imaging Using DANTE-SPACE for Simultaneous Carotid and Intracranial Vessel Wall Evaluation. Magnetic Resonance in Medicine. Jun 2016;75(6):2286-2294. doi:10.1002/mrm.25785
10. Williams SN, Allwood-Spiers S, McElhinney P, et al. A Nested Eight-Channel Transmit Array With Open-Face Concept for Human Brain Imaging at 7 Tesla. Frontiers in Physics. Jul 2021;9701330. doi:10.3389/fphy.2021.701330
11. Viessmann O, Li LQ, Benjamin P, Jezzard P. T2-Weighted intracranial vessel wall imaging at 7 Tesla using a DANTE-prepared variable flip angle turbo spin echo readout (DANTE-SPACE). Magnetic Resonance in Medicine. Feb 2017;77(2):655-663. doi:10.1002/mrm.26152
12. Sannananja B, Zhu C, Colip CG, et al. Image-Quality Assessment of 3D Intracranial Vessel Wall MRI Using DANTE or DANTE-CAIPI for Blood Suppression and Imaging Acceleration. American Journal of Neuroradiology. Jun 2022;43(6):837-843. doi:10.3174/ajnr.A7531

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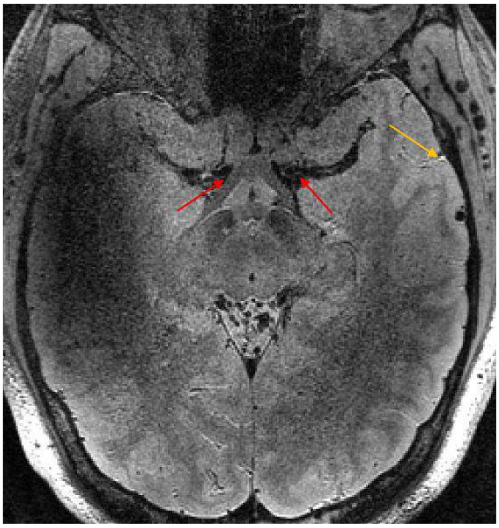


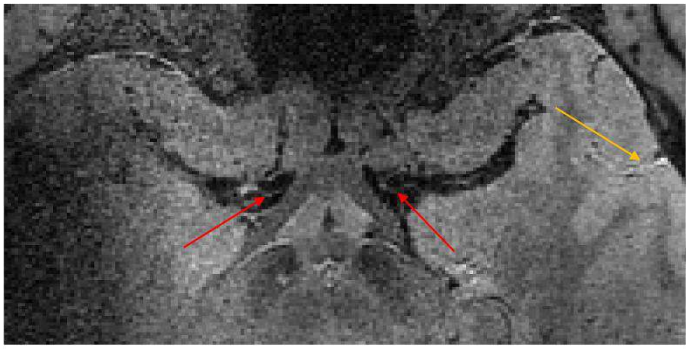
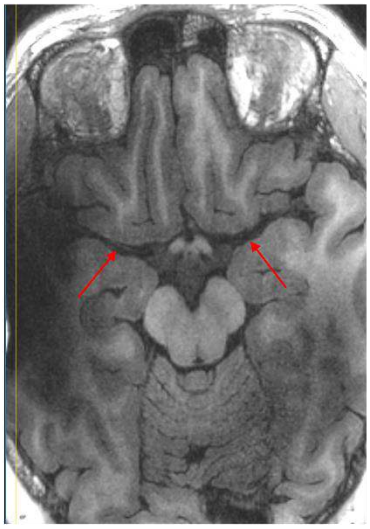


Fig 1-a: SPACE protocol with a DANTE preparation module with TE = 36 ms, TR = 3950 ms, turbo factor = 128. The yellow arrow shows areas of incomplete CSF suppression and the red arrows show the vessel walls of the middle cerebral arteries. The signal loss in the left temporal lobe is the result of the increased B_1 inhomogeneity at 7T but does not affect the anatomical region of interest in this case.



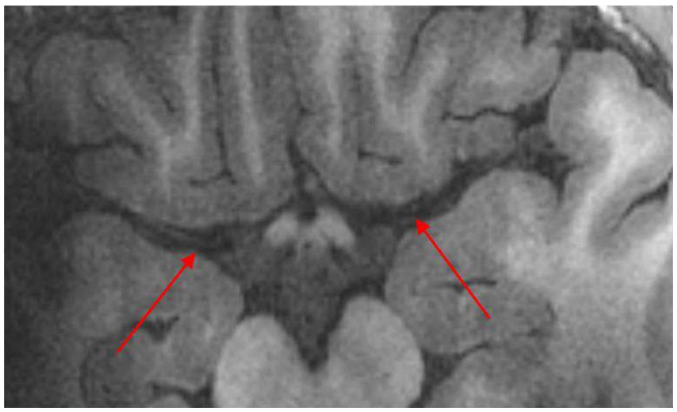
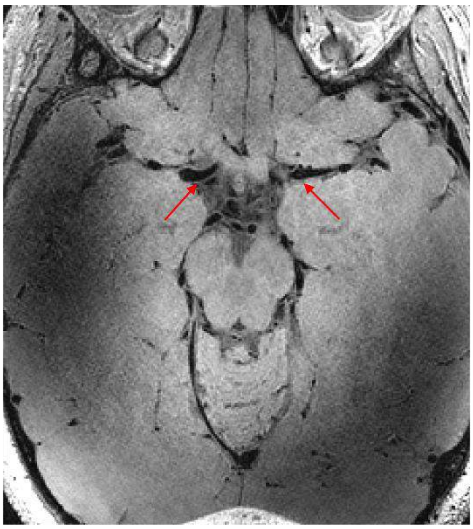


Fig 1-b: SPACE protocol with an MPIR preparation module with TE = 36 ms, TR = 3950 ms, and turbo factor = 95. The red arrows showing the vessel walls of the middle cerebral arteries.



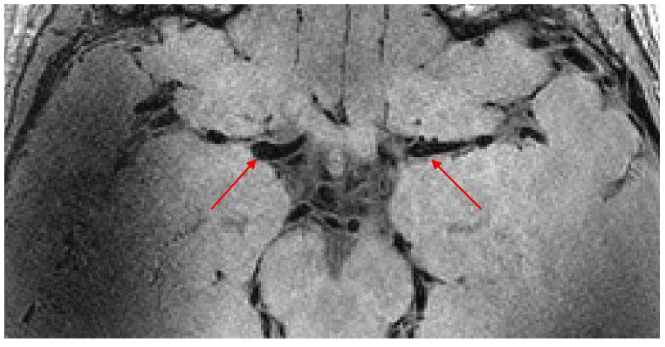


Fig 1-c: Revised SPACE protocol with TE = 12 ms, TR = 1200 ms, and highlighted vessel walls of the middle cerebral arteries with red arrows.

Abstract number: O21

Relationships Between Subcortical Iron and Blood Markers for Iron and Inflammatory Status in Cognitively Healthy Adults.

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Increased brain iron is observed in several neurodegenerative diseases, with several studies demonstrating relationships between increased subcortical iron and decline in cognitive function. However, the causes of brain iron increases remain unclear. This study investigates relationships between subcortical iron and blood markers for systemic iron and inflammatory status to improve our understanding of brain iron regulation.

Brain MRI scans and blood plasma samples were collected from 328 cognitively healthy participants (59.8 ± 7.9 years; 152 male, 176 female). Quantitative susceptibility mapping was used to quantify regional brain iron. To assess systemic iron, haematocrit, ferritin and soluble transferrin receptor (sTfR) were measured and total body iron index (TBI) was calculated. To assess systemic inflammation, C-reactive protein (CRP), Neutrophil/Lymphocyte ratio (NLR), macrophage colony stimulating factor 1 (MCSF), interleukin 6 (IL6) and interleukin 1β (IL1β) were measured.

Females exhibited associations between TBI and iron levels in the left and right caudate and right pallidum. Females also exhibited associations between haematocrit and iron levels in the right pallidum and left putamen. However, no associations were observed between brain and blood iron levels in males. In males, positive associations were observed between CRP levels and iron in the right thalamus and between IL6 levels and iron in the right amygdala and right pallidum. Males also exhibited a negative association between IL6 levels and iron in the left caudate. Positive associations between iron in the left thalamus and NLR were observed in both sexes.

We demonstrate links between systemic iron levels and brain iron in females but not males, whereas more associations were observed between systemic inflammation and brain iron in males. Our results suggest differing iron regulation mechanisms between sexes which could have implications on neurodegenerative disease mechanisms. Further research is necessary to determine the true nature of these relationships.

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Abstract number: O22

Can we see carotid stent thrombosis? Comparison of metal artefacts and stent lumen visualisation between conventional computed tomography and photon-counting detector

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Introduction: Acute stent thrombosis is a life-threatening post-procedural complication[1] occurring in 0.5-17% of patients treated with carotid stenting[2,3]. Therefore, prompt diagnosis is essential to reduce ischemic damage[1]. However, visualisation of the stent lumen can be challenging with traditional computed tomography (CT) imaging due to the metal artefacts[4]. The photon-counting detector (PCD) CT scanner is an incoming revolution in medical imaging. It converts X-rays directly into electrical signals[5], thus improving spatial resolution, as well as reducing artefacts and radiation doses[6]. The NeuroLogica Omnitom Elite PCD scanner is the first mobile PCD-CT device enabling imaging outside the radiology department. We aim to determine if the PCD-CT scanner can enable assessment of stent patency in the carotid artery.

Methods: Images of nitinol stents in the University of Dundee's unique perfused human cadaveric model in the right internal carotid artery were acquired with (1) GE Revolution Evo 64-slice CT (Figure 1) and (2) OmniTom Elite PCD Scanner in the high-resolution setting (Figure 2). No artefact removal during post-processing was performed. We visually compared metal artefacts and the visibility of the inner stent lumen.

Results and Discussion: Our results showed that mobile PCD-CT produces images of a superior quality to conventional CT: the inner lumen was delineable, stent struts could be visualised, and there were minimal metal artefacts. The use of mobile PCD technology in the acute clinical setting could greatly improve patient care by enabling efficient and accurate diagnosis of acute carotid stent thrombosis at the bedside.

Acknowledgements: All cadaveric research is conducted in compliance with relevant anatomical legislation, with donors having given their consent in accordance with the Anatomy Act Scotland (1984) and the Human Tissue (Scotland) Act (2006).

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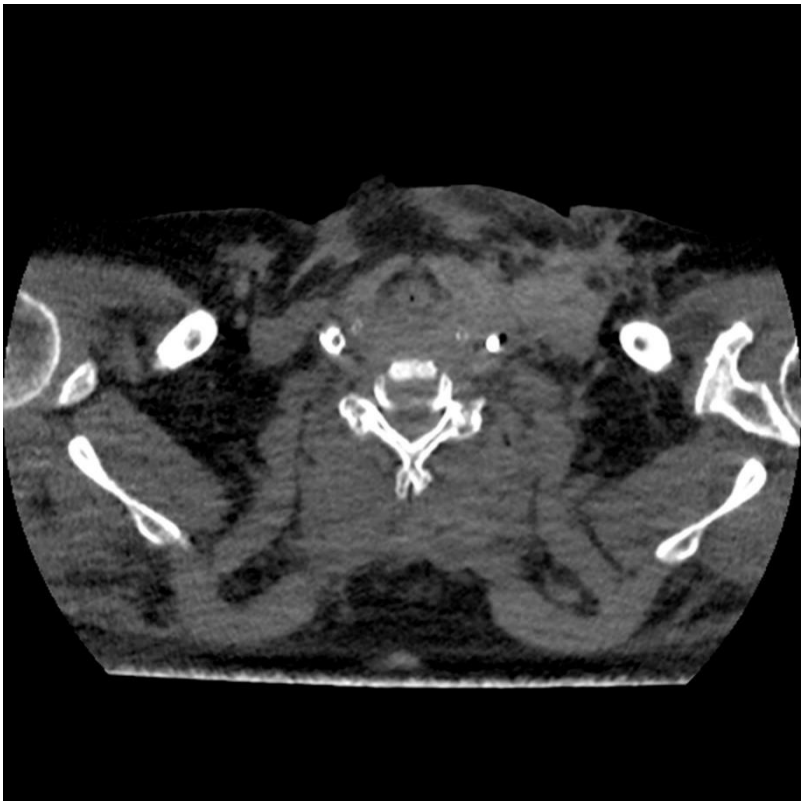

Figure 1. A conventional CT image of a nitinol stent in the right internal carotid artery.

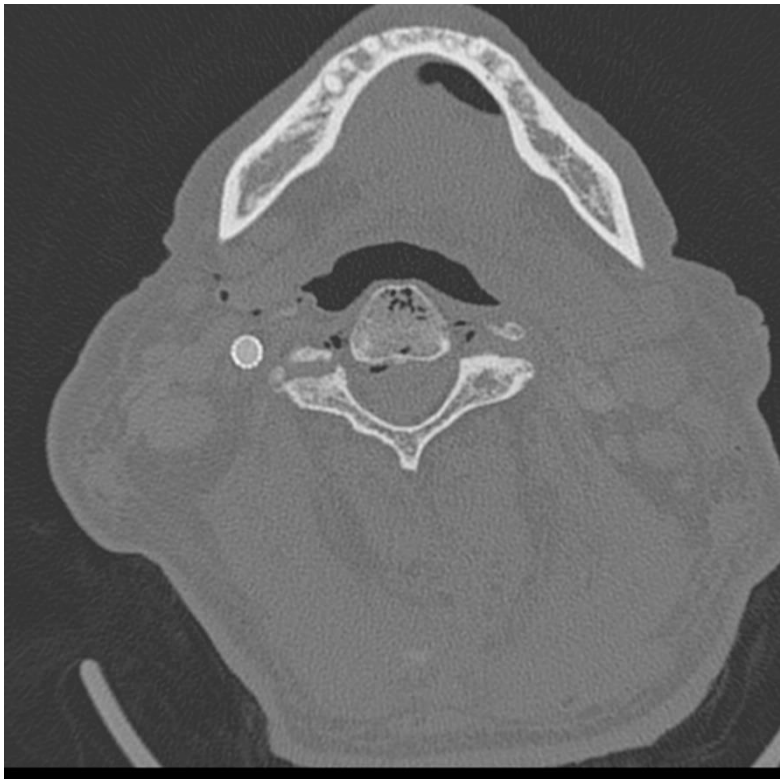

Figure 2. A PCD image of a nitinol stent in the right internal carotid artery.

Abstract number: O23

DeepThickness: A Deep Learning Method for Brain MRI Cortical Thickness Estimation

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Studying brain anatomical deviations from normal progression along the lifespan is essential for understanding inter-individual variability and its relation to the onset and progression of several clinical conditions. Among available quantitative measurements, mean cortical thickness across the brain has been associated with normal ageing and neurodegenerative conditions like mild cognitive impairment, Alzheimer's disease, frontotemporal dementia, Parkinson's disease, amyotrophic lateral sclerosis, and vascular cognitive impairment. Automatic techniques, such as FreeSurfer and CAT12 Toolbox, offer out-of-the-box cortical thickness estimates, but with an excessively long computational time (up to 10 hours per volume). Moreover, comparison studies have found systematic differences between these approaches, with discrepancies particularly pronounced in clinical data, questioning the reliability of these CT estimations.

We here propose DeepThickness, the first Deep Learning-based approach for estimating cortical thickness from structural MRI in just a few seconds. The proposed framework exploits our recent achievements in deep learning segmentation methods for extracting grey and white matter segmentation masks and the associated probability maps from an MRI T1w volume. The network architecture resembles a 3D U-Net, with 4 levels of convolutional layers, and two output branches predicting the pial surface and the cortical thickness. Training, validation, and testing volumes are obtained from the AOMIC dataset, counting 1311, 100, and 500 volumes, respectively. The experimental part shows very good qualitative results, highlighting how our method performs similarly to FreeSurfer in mesh generation and cortical thickness estimation. Numerically, our method computes cortical thickness estimation distributions very close to FreeSurfer.

The extraction of cortical thickness distributions in just a few seconds unlocks the ability to quickly draw population trajectories for thousands of healthy subjects' data, creating an atlas with different distributions for different brain areas.

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Abstract number: O24

Scottish Medical Imaging (SMI) – providing safe and secure access to research-ready, population scale health and imaging data

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Routinely collected text-based health care records and associated imaging data are extremely useful for healthcare research. However, using such data is challenging because it is large and unwieldy, and requires specialist tools and skills to work with. Trusted Research Environments (TREs) such as Scottish Medical Imaging (SMI) provide the capabilities and controls needed to unlock the value of such data whilst ensuring patient confidentiality.

Generally, the primary reason for medical image capture is not research; the data is not organised, it's not clean, and the purpose for taking an image is not clear, this means a lot of effort goes into making them research-ready. We share our solutions to some of the major research challenges faced in establishing SMI, through the PICTURES collaboration:

1. Cataloguing – the metadata that describes each image, series or study is often inconsistent, incomplete or incorrect, making it very difficult to reliably index and catalogue image data for cohort building.
2. Natural Language Processing – useful image descriptors can be found in associated Radiology Reports, specifically free-text notes describing expert observations and diagnosis.
3. Pixel anonymisation – many scanning devices or secondary processing steps result in Personally Identifiable Information (PII) being burnt-in to the images themselves, requiring tools and methods for identifying and removing PII from pixel data at-scale.

This poster will cover the work of the PICTURES programme to enhance Trusted Research Environments to support AI development on large scale data, whilst protecting patient confidentiality. The SMI Service will be presented, which can support researchers and industry partners to train new models on routinely collected imaging data linked to healthcare records from the whole Scottish Population.

Acknowledgements: This work was supported by the Medical Research Council (MRC) grant No. MR/M501633/1 and the Wellcome Trust grant No. WT086113 through the Scottish Health Informatics Programme (SHIP). This project has also been supported by MRC and EPSRC (grant No. MR/S010351/1) and by the Scottish Government through the "Imaging AI" grant award.

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SINAPSE

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Posters

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ASM 2023

Poster number: P01

Investigating social content information in the Early Visual Cortex using 3T fMRI

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Contextual feedback information about natural scenes is fed back to early visual cortex, however we do not yet fully understand the information content of contextual feedback. This project will investigate contextual feedback signals in early visual cortex related to social information. Social interaction is built upon several different sources of information; we predict others' beliefs, we take into account emotions, we read body language and facial expressions and we build an unconscious idea of others. These features involve different brain areas; the Temporal Parietal Junction and Superior Temporal sulcus are linked to theory of mind (TOM) representations and action prediction, and the fusiform area is linked to facial expression and face recognition. The novelty of the proposed study is in investigating areas involved in processing social information send feedback signals to visual cortex about social content. This will be of key importance to understand if the prior knowledge of social features in others projects this information to visual cortex even before we see the other person. The aim of this project is to investigate if having prior beliefs of a person that you are about to meet, creates expectations in visual cortex.

Acknowledgements: This project has received funding UKRI Centre for Doctoral Training in Socially Intelligent Artificial Agents, Grant Number EP/S02266X/1 to Serena Dimitri.

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SINAPSE
ASM 2023

Poster number: P02

Intact Mismatch Negativity Responses in Emerging Psychosis: Evidence from MEG

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Background: To examine whether Mismatch Negativity (MMN) Responses are impaired in participants at clinical high-risk for psychosis (CHR-P) and first episode psychosis (FEP) patients and predict clinical outcomes.

Methods: Magnetoencephalography data were collected during a duration-deviant MMN-paradigm for a group of 116 CHR-P participants, 33 FEP patients, (15 antipsychotic-naïve), a psychosis-risk-negative group (CHR-N: n=38) and 49 healthy controls (HC). Analysis of group differences of source-reconstructed event-related fields (ERFs) as well as time-frequency and inter-trial-phase-coherence (ITPC) focused on bilateral Heschl's gyri (HES), superior temporal gyri (STG).

Results: Significant MMN responses were found across all participants in bilateral HES and STG. However, MMN-amplitude, as well as time-frequency and ITPC-responses, were intact in CHR-P and FEP-patients relative to HC. There were also no MMN differences in CHR-Ps with persistent APS vs. those who remitted. Similarly, there were no MMN differences in CHR-Ps who transitioned vs those who did not. Finally, processing speed cognitive domain was correlated to MMNm amplitude in right Heschl's Gyrus in CHR-Ps but otherwise there were no correlations between demographic, cognitive and clinical variables with MMN-data in auditory cortices.

Conclusions: Our data indicate that MMN responses are intact in early-stage psychosis and do not predict clinical outcomes in CHR-P participants.

Acknowledgements: The study was supported by the Medical Research Council (MR/L011689/1).

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Abstract number: P03

Mobile EEG in real world environments using LCD glasses

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Movement is fundamental to the everyday functioning of the brain, but imaging the human brain during movement is typically neglected due to the limitations of the primary methods of cognitive neuroscience. The overall goal of this research is to develop a method for studying the brain during natural exploration of real world environments and during social interaction.

Mobile EEG is a promising solution, but analysis is difficult due to artefacts in the data caused by movement. We have recently developed a method for recording EEG during motion and in real world environments using modified LCD glasses to provide high frequency visual flicker. Visual flicker produces the so called “steady state visually evoked potential” (SSVEP) in the EEG which has a high signal to noise ratio, this allows a clean signal to be recovered despite movement artefacts. Participants do not need to be seated looking at a screen as the actual visual scene is the visual input. This method allows real world neuroscience in naturalistic settings with a minimalistic setup; small numbers of electrodes and small mobile EEG headsets can be used.

Here we present data from a selection of experiments where we demonstrate this method with participants walking and standing in real world environments and making eye movements during naturalistic social interaction combined with eye-tracking. Different visual scenes can be accurately distinguished with SSVEPs from a short amount of data (approx. 5 seconds), demonstrating that this method has greater decoding accuracy than traditional resting EEG or ERP approaches. Decoding accuracy is frequency specific with certain flicker frequencies, for example the alpha band, resulting in greater information about the visual scene. This is potentially due to an interaction with the preferred frequency of endogenous neural oscillations.

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Abstract number: P04

40Hz auditory stimulation and naturalistic soundscapes for the treatment and management of AD

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Background: People with Alzheimer's Disease (AD) have reduced cognitive functioning that is accompanied by a decrease in brain gamma oscillations. Recent research has demonstrated that 40Hz sound stimulation can induce neural gamma oscillations and when applied to animal models of AD, is associated with a decrease in neuropathology. Naturalistic soundscapes (immersive sounds, for example, reflecting the noises of a forest) have also shown therapeutic effects on people with AD in care homes. An opportunity exists to integrate 40Hz auditory stimulation and natural soundscapes for the treatment and management of AD. Furthermore, few studies to date, have investigated the impact volume may have on effectiveness.

Aim: To assess the feasibility of integrating natural soundscapes and 40Hz sound stimulation (at different volumes) on eliciting gamma oscillations. In this early-stage study, the sound stimuli combinations will be tested on healthy control participants to investigate their effects.

Design: Participants will be aged 18-30 years with no neurological or psychiatric diagnoses. Gamma oscillations will be measured using EEG and participants will complete 9 conditions. These include baseline control, 40Hz auditory stimulation on its own at two different volume levels, beach and forest soundscapes on their own, and the combinations of the soundscapes along with the 40Hz stimulation sounds. Participants will reflect on their experiences of the stimuli using Likert scales to assess nostalgia, positive emotions, and relaxation, and a short semi-structured interview will be used to assess comfort, emotions, and thoughts

Results: Data collection will be underway at the time of the conference and an update will be provided. ANOVA and inductive thematic analysis will be applied to analyze results.

Conclusions: Research in this area should optimize future sound stimulation intervention research for AD, by providing a cost effective, non-invasive approach.

Keywords: EEG, 40Hz, Soundscapes, Gamma Oscillations, Alzheimer’s Disease.

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Abstract number: P05

Neuroscientific perspectives on surrealism: insights from fMRI brain imaging

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Surrealism, which is often claimed to have psychological significance, has not been extensively studied from a neuroscientific perspective. Our study aims to contribute to the dialogue between art and neuroscience by investigating the potential neural mechanisms underlying the perception of surrealistic art, specifically in relation to surprise, error prediction, and neural representation.

We used fMRI to examine the brain response to images of surrealistic objects and paintings, in comparison to images of naturalistic objects and paintings. To control for confounding factors, such as valence, arousal, familiarity, and luminance, a pilot study was used to select a set of images consisting of 64 surreal objects, 64 surreal paintings, 64 natural objects, and 64 natural paintings. A total of 27 participants attended the fMRI experiment.

We performed an Analysis of Variance (ANOVA) model based on a general linear model to analyse the fMRI data. We then conducted a F-test to validate the interaction effect and main factor effects. Using cluster thresholding ($p<0.05$) with a cluster determining threshold of $p<0.001$ results revealed a significant interaction effect in multiple brain regions, including the frontal cortex, parietal lobe, visual cortex. This suggests that surrealistic images may engage unique neural mechanisms compared to naturalistic images, possibly related to the surprising and unexpected elements often present in surrealist art. Additionally, the main effect of condition (surreal vs natural) and category (object vs painting) factors were also found to be significant in various brain regions, including the frontal cortex, parietal lobe, visual cortex.

These findings provide preliminary evidence for the neuroscientific relevance of surrealism and suggest that further research in this area could contribute to our understanding of surprise, error prediction, and representation in the brain.

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Abstract number: P06

Investigating predictive cortical feedback processing for expected and surprising scene information

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Visual predictions formed from prior experience and contextual cues are crucial for humans to understand our visual environments. Under such predictive processing accounts of the brain, sensory (feedforward) signal is 'explained away', when possible, by compatible top-down (feedback) signal so that only information that is useful to update our internal models reaches the next stage of processing. The visual occlusion paradigm (Smith and Muckli, 2010) provides evidence that context is used to generate predictions about scene properties in the early visual cortex. Here we investigated the modulating effect of consistent and inconsistent contextual information on the processing of feedforward information. In our experiment involving 24 participants, we found that adding inconsistent contextual information before the target image presentation can evoke significantly higher responses in the early visual cortex compared with only presenting consistent contextual information before target image, although this effect was not significant when showing contextual information after the target image. Meanwhile, only adding consistent information before the target showed similar BOLD signals with only showing target image, which means visual prediction reduced the brain activity in V1. The results also indicated that showing contextual information before and after the target has obviously time difference of BOLD signal changes, presenting context before evoked brain activity earlier than showing it 'after'.

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SINAPSE
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Abstract number: P07

Structural variance of circle of Willis on Magnetic resonance angiography in brain tumour patients

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Presented by **Deepa Manoj**

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Background: The major arterial network supporting a reorganization of blood flow in the brain is the Circle of Willis (CoW). Diseases affecting cerebral hemodynamics and circulation are strongly linked with CoW variation. However the question is still unknown that causes change in normal formation of CoW. A handful of studies have focused on the variability of the cerebral arterial circle as a whole. This study aims to recognize the frequency and variation pattern in the arteries forming circle of Willis in patients with brain tumour.

Methods: It is a retrospective study on variability in the structure of circle of Willis. The patients included in this research are 66 (n=66) aged between 5 to 70 years. All patients were diagnosed with brain tumour underwent time of flight (TOF) magnetic resonance angiography (MRA) of circle of Willis with 3T Philips Achieva scanner. An evaluation of integrity of the whole circle of Willis was performed and the diameter of major arteries are analysed. IBM SPSS version 23 is utilized to analyse the data. A t test was performed to compare the mean values between two groups.

Results: The frequencies and pattern of the different variances throughout the entire circle of Willis and across individual segments were diverse in two genders. There is hypoplasia (diameter < 1mm) of A1 and A2 segment of right anterior cerebral artery in females. Hypoplasia of left posterior communicating artery and complete absence of right posterior communicating artery is detected in males. Absence of posterior communicating artery is observed in 20 patients (13.2%).Statistically significant differences were found in artery diameters between the male and female.

Conclusion: The discovery of variation in circle of Willis and brain tumour together is infrequent. These cases are crucial for the neurosurgeons as they need to handle them cautiously to plan for a proper treatment.

Keywords: Brain tumour, patients, circle of Willis, arterial calibre, MRA

Acknowledgements: Authors like to extend gratitude to Department of Radiology and Department of Neuroscience in School of Medicine of Universiti Sains Malaysia

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SINAPSE
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Abstract number: P08

CT texture characterization of perirenal fat in patients with upper urinary tract cancers

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Perirenal fat (PRF), the adipose tissue surrounding the kidneys and nearby organs, has gained attention for its possible role in the upper urinary tract (UUT) cancer progression and outcomes. Malignancies are known to secrete proteins, e.g., cytokines, that alter the cellular structure surrounding the tumour and make it favourable for tumour progression and aggressiveness. These cellular changes influence various aspects of cancer development, such as angiogenesis, invasion, and metastasis. Radiomics, an innovative technique that extracts quantitative data from medical images, can offer valuable insights into tissue properties and cellular structures, potentially clarifying the relationship between PRF and UUT cancers.

This research aimed to thoroughly evaluate perirenal and peritumoral fat using radiomics analysis to understand their roles in UUT cancer type, grade, stage, and behaviour. Objectives included exploring the feasibility of using radiomics analysis of perirenal fat in CT images to predict UUT cancer characteristics; identifying potential radiomics biomarkers for cancer behaviour and prognosis; examining associations between perirenal fat radiomics features, and clinical variables; and developing and validating predictive models based on radiomics features using machine learning methods.

The study design involved patients with histologically confirmed UUT cancer, CT scans, and relevant information. Perirenal fat was segmented into three regions of interest (ROIs) to investigate its role in cancer behaviour and prognosis. The analysis plan comprised a comprehensive radiomics approach to extract, analyse, and evaluate imaging features. Feature selection techniques identified the most relevant characteristics of AI and machine learning algorithms. Classifier models, such as Random Forest, SVM, and CNN, were used to construct predictive models for UUT tumour behaviour. Model performance was evaluated using statistical methods. This research holds significant potential for enhancing our understanding of the role of perirenal fat in UUT cancers and may ultimately contribute to improved diagnostic and prognostic tools in clinical practice.

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Abstract number: P09

Development of an Intraoral Handhold Swept-Source Optical Coherence Tomography based Angiography System for Oral Imaging

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Oral cancer is a significant global health issue, with oral squamous cell carcinomas (OSCC) being the most common type of oral cancer. Early detection of oral cancer is vital to prevent it from spreading and to improve patient outcomes. However, the current gold standard for detecting oral lesions, which involves a clinical examination followed by histopathological analysis of biopsy samples, is invasive and uncomfortable for patients. Optical Coherence Tomography (OCT) is a non-invasive imaging technique that is commonly used in ophthalmology and dermatology, and its angiography function (OCTA) can detect the microvascular network within tissue in vivo. Recent research has demonstrated that angiogenesis can be used as a diagnostic tool for OSCC. Therefore, by identifying the presence of angiogenesis, OCTA has the potential to detect OSCC and oral potentially malignant disorders (OPMDs) at an earlier stage, allowing for more effective diagnosis and treatment, and improving patient outcomes. Therefore, we developed an intraoral Swept-Source OCT (SSOCT) imaging system, which is handhold, portable, non-invasive, and high-resolution, with the angiography function. The system utilizes a swept-source laser with a centre wavelength of 1300 nm, and a two-lens system to achieve a small, thin and rounded scanning sub-probe. The scanning range is around 10 mm on both axes, with a penetration depth of around 2 mm, and lateral and axial resolutions of 19.68 µm and 8.14 µm, respectively. The scanning tip is made of disposable 3D-printing material, which can be replaced after each scan. Overall, this intraoral SSOCT system's handhold, portability, and high-resolution, intraoral imaging capabilities make it a promising technology for oral imaging applications. The system has the potential to replace invasive biopsy procedures and detect oral cancers at an earlier stage, leading to improved patient outcomes.

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Abstract number: P10

Machine Learning-Based Radiomics Analysis for Predicting Pathological Grade of Upper Tract Urothelial Transitional Cell Carcinoma using CTU Scans

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Cancer diagnosis and treatment have greatly benefited from recent advances in medical imaging techniques. Computed tomographic texture analysis (CTTA) is a powerful tool for the analysis of cancerous tissues that can provide valuable information for precision medicine. Texture-based features extracted from radiological images have been shown to be highly informative in differentiating cancerous from healthy tissues. In this study, we focused on the potential of radiomics-based CTTA and machine learning for predicting the pathological grade of upper tract urothelial transitional cell carcinoma (TCC). TCC is a type of bladder cancer that accounts for approximately 5-10% of all bladder cancers. The ability to accurately predict the pathological grade of TCC is important for determining the most appropriate treatment strategy for individual patients. Our study involved the analysis of a collection of CTU scans using FIJI and 3D Slicer software to extract numerical readouts for radiomics-based analysis and plotting of crucial parameters. The histopathology of tissue served as the reference standard. Our results indicate that CTTA-based radiomics analysis can accurately differentiate between high and low grades of TCC, with important implications for automation, high-throughput screening, and therapeutics. Furthermore, our machine learning approach using radiomics features outperformed conventional clinical and radiological features. This suggests that radiomics-based CTTA has significant potential for translational precision medicine in TCCs, highlighting the importance of advanced imaging tools and machine learning techniques in cancer diagnosis and treatment. In conclusion, our study sheds light on the value of radiomics-based CTTA in enhancing the accuracy of cancer diagnosis and paving the way for personalized treatment. These findings have significant implications for the future of cancer care, highlighting the importance of continued research into advanced imaging techniques and machine learning algorithms.

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Abstract number: P11

MRS Reproducibility in a Phantom Brain

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The project aimed to determine the reproducibility of MRS (Magnetic Resonance Spectroscopy) in accurately measuring the known N-acetylaspartate (NAA) and Myo-Inositol (mIns) metabolite concentrations in a phantom (SPECTRE phantom, manufactured by Gold Standard Phantoms) between 3T PrismaFIT MRI scanner (Siemens Healthineers, Erlangen, Germany scan sessions. We determine whether increasing the number of signal averages and the voxel position has any effect on the results. Furthermore we determine the differences in mIns/NAA ratios found by analysis softwares TARQUIN (https://tarquin.sourceforge.net/) and Syngo.via (Siemens Healthineers), with the comparison to the known ratio. Under the ideal conditions we have determined the variation in the metabolite measurements between scans.

It is hoped that MRS can produce reproducible results in a phantom so it can be used in human studies to determine if they have abnormal metabolite concentrations. Specifically whether their NAA and mIns concentration levels give an indication of a cognitive disease such as Alzheimer's disease.

The variation found between scans can be used to determine whether treatments for cognitive impairment are making a difference on metabolite concentration levels detected in a patient's brain or if the change in the levels is due to the variation between scans.

The results concluded that MRS is reproducible between scan sessions using a phantom. Increasing signal averages improved the accuracy of the results. The voxel position at the centre of the phantom gave more accurate results than those performed at the boundary. Syngo.via gave us ratio values closer to the known ratio than TARQUIN. This work paves the way for healthy volunteer MRS studies.

Acknowledgements: Dr Michael McDonald, University of Dundee as well as NHS Tayside Medical Physics Department for supplying the phantom.

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SINAPSE
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Abstract number: P12

Reader bias in breast cancer screening: inexperienced second readers defer to experienced first readers' opinions

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Introduction: For routine breast cancer screening, each set of mammograms is read by two readers, with the second able to view the first reader's opinion. If the two readers disagree, a third reader (arbiter) decides whether to recall the woman for further investigation. This study aims to determine factors influencing reader agreement in breast cancer screening and investigate the relationship between agreement level and patient outcomes.

Methods: Reader pair agreement for 83,265 consecutive sets of mammograms from the Scottish Breast Screening service (2015-2020) was evaluated using Cohen's kappa statistic. Variation in reader agreement was examined by whether the reader acted as the first or second reader, reader experience, recall rate, cancer detection rate, and arbitration recall rate.

Results: Data from 11 readers (81 reader pairs) was evaluated. Reader agreement varied widely from 0.21 to 0.96 (1 representing perfect agreement). Readers' opinions varied by whether they acted as the first or second reader. Furthermore, reader 2 was more likely to agree with reader 1 if reader 1 was more experienced than they were, but less likely to agree if they themselves were more experienced than reader 1 ($p < 0.001$). The agreement was not significantly associated with cancer detection rate, overall recall rate or arbitration recall rates ($p > 0.05$). Lower agreement between readers was associated with a greater proportion of arbitrated cases ($p < 0.001$).

Conclusions: In mammography screening, the second reader's opinion appears to be heavily influenced by the first reader's opinion; the degree of influence is dependent on the readers' relative experience levels. While these results suggest that inexperienced second readers do not read independently, no adverse impact on service outcomes was observed. Experienced readers therefore play an important role in maintaining service outcomes within acceptable standards.

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Abstract number: P13

How ultrasound envelope statistics could be used to detect deep tissue injury in lower limb prosthetic users

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Background: Deep tissue injury (DTI) due to steep pressure gradients, can develop undetected in lower limb prosthetic users during normal use, resulting in prosthetic abandonment. Progression leads to tissue degradation loss of tissue structure until the area affected extends to the skin surface. Effective, early detection could allow preventative action. Ultrasound envelope statistics (ES) can be applied to clinically available ultrasound data to describe tissue microstructure based on detection of sub-resolution scatterers. This simulation study investigates ES as a tool for monitoring tissue health and early detection of DTI

Methods: The open-source acoustic wave software K-Wave was used to simulate DTI inclusions in healthy tissue. Hemispherical inclusions of increasing size (0.5 - 6mm radius, 0.5mm increments) and random scattering distribution were used to represent DTI. Healthy tissue was based on the pattern of a healthy musculoskeletal B-Mode of the calf. Inclusion depth was fixed (6mm) and ultrasound data was simulated from a 16-Element 5MHz transducer, with a simulation resolution of 7.7x10-5m, sampling rate of 200MHz. The raw signal was processed to produce a Probability Density Function (PDF) of the signal amplitudes and simulations repeated with varied 'healthy' tissue background structure (N=6).

Results: The 0mm radius DTI was taken as healthy tissue and its PDF conformed to the expected Nakagami distribution, verifying the model. PDFs of the DTI inclusions were increasingly more normally distributed than the healthy PDFs as the size of DTI inclusion grew. Plotting the squared sum difference between the two PDFs (A) as a function of radius returns a linearly increasing trend (B: Plotted on a standard box plot). These data suggest that ES is sensitive to small changes in tissue structure associated with the early stages of DTI and therefore may present a viable method of tissue health monitoring in lower limb prosthetic users.

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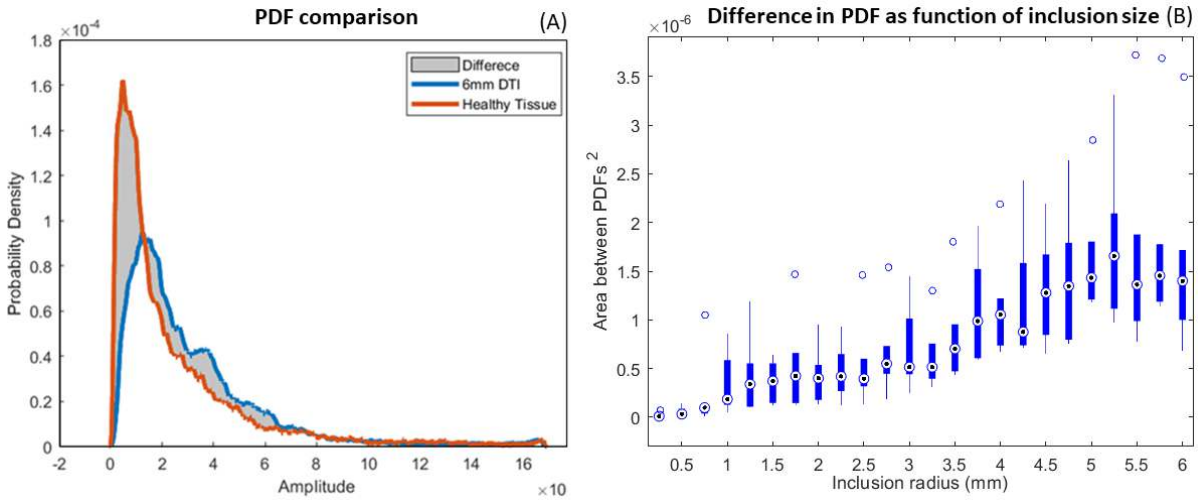
PDF comparison
(A)
Differece
6mm DTI
Healthy Tissue
Probability Density
Amplitude
Difference in PDF as function of inclusion size (B)
Area between PDFs 2
Inclusion radius (mm)

Figure 1.

Abstract number: P14

Connectivity Neurofeedback in the young healthy brain

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Connectivity between the primary motor cortex (M1) and the premotor cortex (Pmd) has been implicated in the planning of actions. Specifically, increased M1-Pmd connectivity during action selection (AS) has been linked to superior task performance (Stewart et al., 2014). However, causal relationships have not been directly tested. The present study investigated the modulation of this connectivity using covert fMRI-neurofeedback (NF) in a group of young, healthy adults. NF is a technique that allows participants to visualise a graphical representation of their brain activity and to modulate it. Our aim was to determine whether successful and directional modulation of M1-Pmd connectivity would result in specific and directional changes in AS performance.

A double-blinded within-subject design was employed, with 20 participants completing two counterbalanced sessions. In one session, participants attempted to increase their M1-Pmd connectivity by increasing the size of a bar representing it, while in the other, they attempted to decrease it. Participants were unaware of the study aims and what the bar represented. NF training sessions lasted 24 minutes, split into 3 fMRI runs. To promote reinforcement learning, a monetary reward was associated with successful NF performance. We predicted that participants would successfully modulate their connectivity in both conditions, with increased connectivity leading to better performance in AS and decreased connectivity leading to worse performance.

At a group level, participants were unable modulate their M1-Pmd connectivity in either condition, tested by a repeated-measures ANOVA (condition x time) that revealed no significant interaction effect ($p=0.68$). Furthermore, there was no significant difference in AS performance following NF training in either condition (paired t-test on post-performance, $p=0.29$). We speculate that these null findings may be attributed to an insufficient amount of training. Interestingly, we found that participants who were more sensitive to reward exhibited superior NF performance in the decrease condition ($r=-0.76$, $p<0.01$).

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Abstract number: P15

Developing a deep learning method for optical coherence elastography to predict human skin biomechanical property

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Presented by **Tianyu Zhang**

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Skin diseases, which affect nearly 900 million people worldwide, are among the most common human illnesses. Optical coherence elastography (OCE) is a non-invasive and high-resolution imaging technique for assessing tissue elasticity, an important indicator of skin health. Wave-based OCE estimates tissue elasticity by analysing wave propagation velocity derived from captured sequences of phase information. However, conventional OCE analysis requires significant expertise and time-consuming image processing. This study aims to address these limitations by employing artificial intelligence (AI) technology to quickly and accurately predict human skin elasticity.

Eleven healthy adults were enrolled in the study, with three skin sites (palm, forearm, and back of hand) examined under the University of Dundee's ethical approval. An OCE system consists of a piezoelectric actuator for wave generation and a lab-built spectral domain optical coherence tomography for capturing phase information. A sampling rate of 92 kHz was applied, and the system's axial and transverse resolutions are 6.89 µm and 23.5 µm in air, respectively. 2D images of original phase data, formed with a transverse distance of 9.3 mm and a time of 5.5 ms, along the depth axis (around 150 pixels, 0.7 mm), were input into convolutional neural networks (CNN). Ground truth for the CNN training involved calculating phase difference between consecutive time points and processing them with conventional regression methods to obtain shear wave velocity, referring to the expected outcome for trained model validation. With the trained CNN, the convolution operation will have the capability to extract the features of phase information and output wave velocity, thereby predicting skin elasticity.

This study is the first to apply deep learning to OCE data for human skin elasticity prediction. The proposed method can accurately predict skin elasticity in microseconds without imaging processing. The method has significant potential for benefiting patients by enabling early diagnosis and monitoring of skin conditions.

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SINAPSE
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Abstract number: P16

PVA based phantom for prostate cancer detection using multiparametric ultrasound: a validation study

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Background: Tissue mimicking phantom is important in medical imaging quality before clinical usage. Fabrication of tissue mimicking materials (TMM) phantom that include flow and elastography biomarkers for the detection and characterisation of prostate cancer is still lacking. PVA has proven as a good choice to simulate a prostate gland and PCa inclusion. It provides a wide range of mechanical properties that is changed based on the physical cross-linking formed by number of freeze-thaw cycles. IEC agar is most recommended to simulate a surrounding tissue. The main aim of this study was to validate a PCa with a mpUS TMM phantom.

Methodology: Speed of sound, attenuation coefficient and elasticity were measured in four samples of PVA within 1 to 10 FTC, and one sample of IEC agar phantom. Two group of PVA samples were fabricated A and B. in group A, contain two phantoms made from low Mw of PVA, where in group B, a high Mw of PVA used to create two phantoms. All samples contained 10% of PVA added with SiC. Glycerol was added to one sample in each group. A prostate phantom with inclusion were fabricated. The prostate phantom used as wall less flow phantom.

Results: The average SOS of group A and group B for sample without and with glycerol was 1524.50 ±2.12 m/s, 1554.90±2.33 m/s and 1534.50±1.84, m/s 1562.20±2.39 m/s respectively. The mean attenuation coefficient for group A and B was 0.93 dB/cm/MHz and 1.23 dB/cm/MHz respectively. Mechanical compression testing showed that the range in group A and B were 5.04 to 53.20 kPa and 22.61 to 107.49 kPa respectively. The US b-mood image showed homogeneity prostate. The fabricated phantom was validated with prostate commercial phantom. Due to short time, elastography and doppler US image result will be added later in the result.

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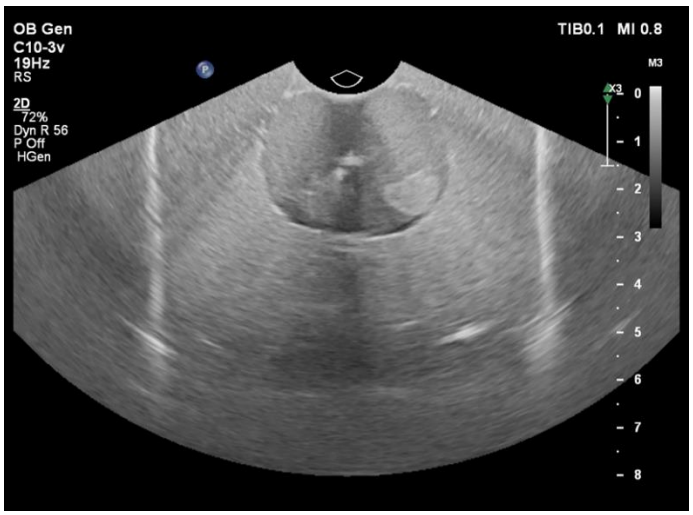

Abstract number: P17

Application of robotic arm in Automated Breast Ultrasound for automatic 3D imaging of breast phantom

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Background, Motivation and Objective: Automated breast ultrasound (ABUS) is an emerging ultrasound technique developed to support mammograms with high accuracy and effectiveness, providing a three-dimensional representation of breast tissue. Multiplanar reformation is an advantage of this technique, as is the ability to review the images retrospectively once the examination has been conducted. ABUS is also more reproducible and less operator dependent than handheld ultrasound. ABUS is currently being investigated as a complementary tool for mammography screening in women with dense breast tissue as screening demand increases. Thus, we aim to investigate the feasibility of robotic arm for 3D ABUS imaging and image reconstruction of breast phantom.

Method: To begin with we had fabricated the ingredients in the International Electrotechnical Commission (IEC) TMM for breast phantom with embedded target to conduct the scans. The materials were casted on previously 3D printed breast mould. Also, we designed a holder in SolidWorks and used 3D printing to construct a holder that connects the ultrasound transducer to the Dobot arm. a Dobot robotic arm was controlled by self-programming algorithm in Python (Dobotstudio) to scan the phantom, independently (Fig.1). During this process, the cycle, point coordinates, delay, and speed were set in order to ensure that the arm followed a predetermined path accurately and steadily. As for the 3D reconstruction method a minimum 100 images acquired by robotic-arm controlled ABUS scans. The DICOM 2D B-mode images are then transferred to self-programming algorithm in Python for 3D reconstruction.

Conclusion and future work: In conclusion, the study demonstrated that using a robotic arm and fabricated breast phantom is a promising and practical approach that can enhance the accuracy and efficiency of breast imaging procedures. However, further research will be necessary to determine its effectiveness and feasibility in clinical settings.

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Figure 1.

Abstract number: P18

Magnetic Microbubbles for Contrast Enhanced Magnetomotive Ultrasound Imaging for colorectal cancer lymph node assessment

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Background, Motivation and Objective: Contrast-Enhanced Magneto Motive Ultrasound (CE-MMUS) is a novel ultrasound-based imaging modality combining two different contrast agents, Superparamagnetic Iron Oxide Particles (SPIONS) and Microbubbles (MBs) for tissue stiffness assessment. These Magnetic MBs can delineate lymph nodes through standard perfusion approaches aiming to yield larger tissue displacements for more sensitive stiffness interrogation to determine metastatic involvement. In this study, we present a thorough characterisation of each agent to establish sizing, polydispersity and most importantly SPION loading on the MBs. After particle characterisation, a novel MB-SPIONS loaded tissue mimicking material [1] was fabricated exhibiting an improved tissue displacement over SPIONS alone.

Experimental Methods: Target ready MicroMarker (TR-MM, Fujifilm Visualsonics) pre-formulated to include streptavidin binding sites on the lipid shell, was reconstituted to yield 2 x 109 bubbles/vial. SPIONs were biotinylated (SPIONS-B) [2] and combined with the MBs to form SPION-MBs complexes. Detailed characterisation and verification of targeting was performed using Nanoparticle Tracking Analysis (NTA). Mean SPIONs-B loading per TR-MM microbubbles was calculated through titration and 1H NMR (Agilent/Varian VNMR-S 500MHz). Polyacrylamide (PAAm) hydrogel samples incorporating SPIONs or SPION-MBs were subject to an externally applied alternating magnetic field (0.14T, 4 & 20 Hz, sinusoid) and imaged with ultrasound (Vevo 3100). RF signals were post processed in Matlab to recover mean displacement.

Results/Discussion: NTA measurements provided particle sizing, 66.9 ± 1.5nm for the SPIONS-B and 1100.0 ± 180.0nm for the TR-MM, but also confirmed successful conjugation of SPIONs-B to TR-MM.1H NMR measurements of SPIONs-B to increasing TR-MM ratio was used to determine maximum loading of SPIONs that could be achieved per microbubble. T2 relaxation time of the proton peak was used for each dilution ratio as shown in (A). Data showed a gradual narrowing of the proton peak (increasing T2) to the point saturation occurs at a ratio of 1:3. PAAm hydrogel was fabricated and (B) shows preliminary data of displacement values. It can be noted that SPIONs-B + TR-MM display a trend towards higher displacement especially for the 20Hz case, though further investigation is required for optimisation and progression to preclinical work.

Acknowledgements: Cancer Research UK A23333

References:

1. Vera et al. Polymer Engineering & Science - 10.1002/pen.25895, 2022
2. E Beguin et al. Appl Mater Interfaces 11: 1829-1840, 201

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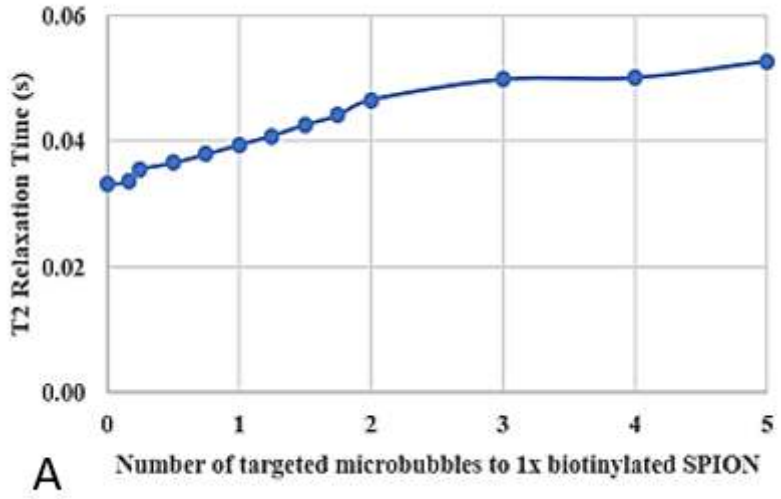

Figure 1.A

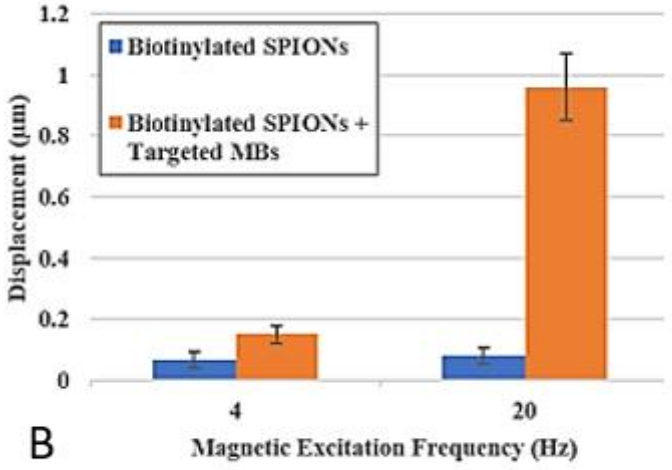

Figure 1.B

SINAPSE
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Abstract number: P19

Computational Methods for Augmenting the Echocardiographic Assessment of Low-Flow,

Low-Gradient Aortic Valve Stenosis

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Aortic stenosis (AS) is a common valvular heart disease characterized by narrowing of the aortic valve, resulting in reduced blood flow from the heart to the rest of the body, which can lead to left ventricular (LV) hypertrophy and heart failure. Echocardiography is the primary imaging modality used for the diagnosis of AS, however, the current clinical grading algorithm presents with discordant prognostic markers in a sub-group of patients with low-flow and low-gradient (LFLG) haemodynamic characteristics. Stress echocardiography is performed to affirm the diagnosis, nevertheless this may remain inconclusive, while imposing discomfort and potential health risks to the patients.

In this project, we investigate the efficiency of disease stratification by stress echocardiography from B-mode image series. We used a retrospective cohort of 6 patients with LFLGAS who underwent dobutamine stress echocardiography at the Golden Jubilee National Hospital alongside two large, open-source data sets consisting of ultrasound recordings.

First we adopt a deep learning model that employs convolutional neural networks to extract features from the images. Utilizing a form of transfer learning, the architecture is pre-trained on the LV segmentation masks from the first data set and then fine-tuned on the images from the second to examine the features specific to AS.

We also perform image registration to track the motion of the LV myocardial wall. Analysing the thickness, displacement and strain enables the examination of ventricular remodelling and dysfunction, often present in patients with AS, hence this approach can aid the classification of LFLGAS severity.

Our initial work demonstrates the use of deep learning models in conjunction with image registration techniques to derive prognostic markers of AS from ultrasound recordings to alleviate the need for stress echocardiography. Future work entails the evaluation of our current methodology in a larger set of patients via standard performance metrics, while embarking on developing models that uncover distinct patient phenotypes by combining all the derived features.

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Abstract number: P20

Simulating the effect of a Single Element Focused Ultrasound Transducer various distances from skull

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Background, Motivation and Objective: The placement of the transducer relative to the skull can result in different outcomes. Investigating the various distance of a single element focused transducer from the skull with the aid of simulation can give an understanding on the different outcomes that are associated with focused ultrasound exposure.

Statement of Contribution/Methods: The simulation is based on an experimental focused transducer and skull. The transducer was connected to an amplifier. The input signal was 70mV, amplified to 1W output with 666KHz. Hydrophone was placed at the focal point of 75mm. The pressure was recorded before and after skull. The placement of the skull was 4mm away from the transducer. Skull simulation data was extracted from a CT scan. The scan was imported onto a 3D slicer with a minimum threshold of 300. The design of the skull with the addition of a transducer was made with Solidworks. The final design was imported onto Onscale, where the simulation was conducted.

Results/Discussion: The resulting pressure and intensity, of the focal point remained within similar range as the skull was moved away from transducer. The effect of adding a skull was a pressure loss ranging from 84 to 88%. Heterogenous skull caused less effect on focal point compared to homogenous. Heterogenous ranged between 3 to 5 mm, while homogenous skull in the range of 10 mm difference from original. In addition, the further the skull, the closer the focal point to the origin. Simulation aided in realizing the effect of cancellous (trabecular) bone area, which in the experimental case, is filled with water. The skull pressure remained in similar range close to transducer while increased as the skull is reaching the focal point.

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SINAPSE
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Abstract number: P21

Learned Multi-level Wavelet for Fast MRI Reconstruction

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Background: Magnetic Resonance Imaging (MRI) is a widely applied medical imaging technology for various clinical applications. However, one major drawback is the long scan time, which results in significant artifacts due to patient's voluntary and non-voluntary movement. This work aimed to expedite the scan time by reconstructing diagnostic MRI images from an undersampled k-space.

Methods: To solve this ill-posedness, wavelet sparse transform was introduced to provide a successful model for optimizing and regularizing the inverse problem. It offers a complete representation of the image and accurate analysis at different spatial orientations. To that end, the implicit sparsity in MRI images is employed to undersampled k-space. In this study, we exploited MLTL, which is an iterative multi-level wavelet algorithm, to reduce MRI acquisition time and improve reconstruction. MRI brain experiment was carried out using multi-channels coil model to evaluate the parallel imaging acquisition. To evaluate the MLTL algorithm with this multi-channel coil model, different undersampling implementations were used. The acceleration factors were set to 5 and 10. The performance of the proposed algorithm is demonstrated and compared with that of the traditional reconstruction method (IFFT) and another competitive algorithm (FISTA).

Results: The final numerical simulation showed an outperformance of the proposed MLTL algorithm in terms of the accuracy of the reconstructed image and acceleration of the reconstruction time. MLTL reconstructed high-resolution images from the undersampled measurements. It maintained the details and recovered the structures of the image more accurately. Meanwhile, IFFT showed very noisy images and FISTA provided blurry images, both of which cannot be used clinically. The MSE and PSNR were calculated for the three methods, and the MLTL-reconstructed images showed less error and the best image resolution.

Conclusions: MLTL can be successfully applied to undersampled k-space reconstruction, which has the potential to accelerate clinical acquisition

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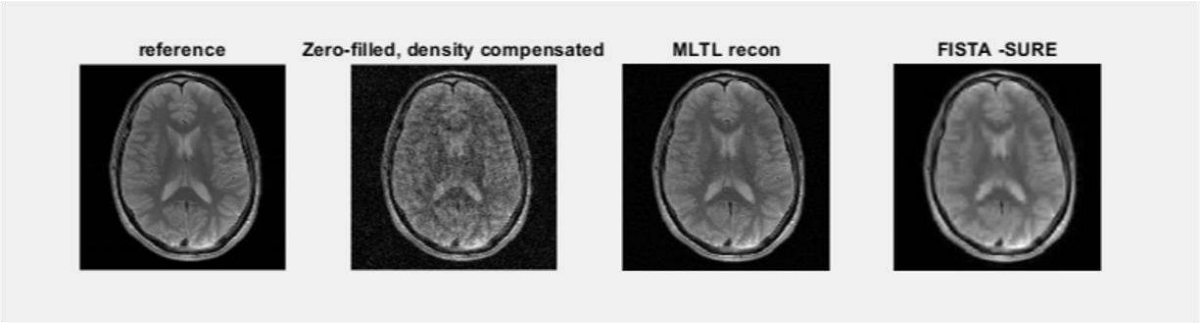

Figure 1.

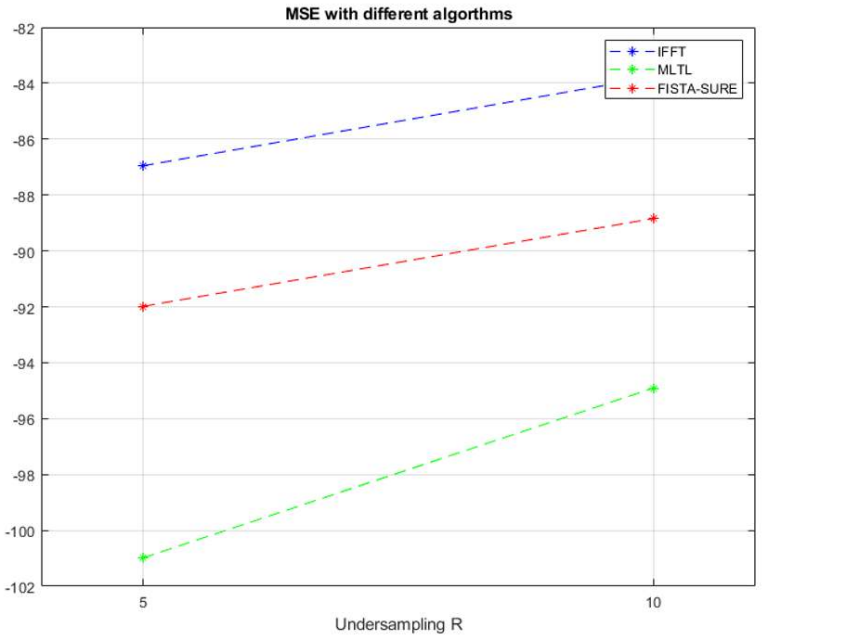

Figure 2.

Abstract number: P22

An Evaluation of Cardiovascular Disease Biomarkers on Routine Chest CT of Patients with Bronchiectasis

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Background: One of the factors that contribute to the burden and fatality in bronchiectasis patients is the increased prevalence of cardiovascular disease (CVD) comorbidities, such as coronary artery disease (CAD) and pulmonary hypertension (PH). The clinical importance of these cardiovascular findings has yet to be fully assessed previously in bronchiectasis patients.

Coronary artery calcification (CAC) is indicative of the burden of atherosclerosis and poses a substantial risk of mortality in patients with suspected CAD. On routine thoracic CT examinations, CAC can be detected without the use of electrocardiogram gating, and it can serve as a sign of CAD. Furthermore, chest CT scans can also be used to quantify CVD findings, such as pulmonary artery (PA) enlargements.

Aims: The aim of this study is to evaluate the association between bronchiectasis disease and cardiovascular disease by measuring coronary artery calcification (CAC) and pulmonary artery (PA) enlargements using chest CT scans.

Methods: Data from the Bronchiectasis Research Involving Databases, Genomics and Endotyping (BRIDGE) observational cohort study will be retrospectively evaluated. HRCT scans will be scored radiologically following The BRICS (Bronchiectasis Radiologically Indexed CT Score) method. Coronary artery calcification (CAC) will be evaluated using the semi-quantitative Weston method. Furthermore, pulmonary artery (PA) enlargements will be evaluated by measuring the MPA diameter divided by the diameter of the ascending aorta; then, the MPA/Ao ratio will be calculated.

Statistical analysis will be performed to examine the association between bronchiectasis disease and cardiovascular findings, adjusting for potential confounders such as age, sex, smoking status, and comorbidities. An appropriate statistical test will be used, such as Pearson/spearman correlation coefficient, chi-square, t-test, or regression models, to assess the significance of the results.

Conclusion: The analysis from this study will provide a better understanding of potential imaging-related biomarkers that relate to the severity/progression of lung disease and CVD comorbidity.

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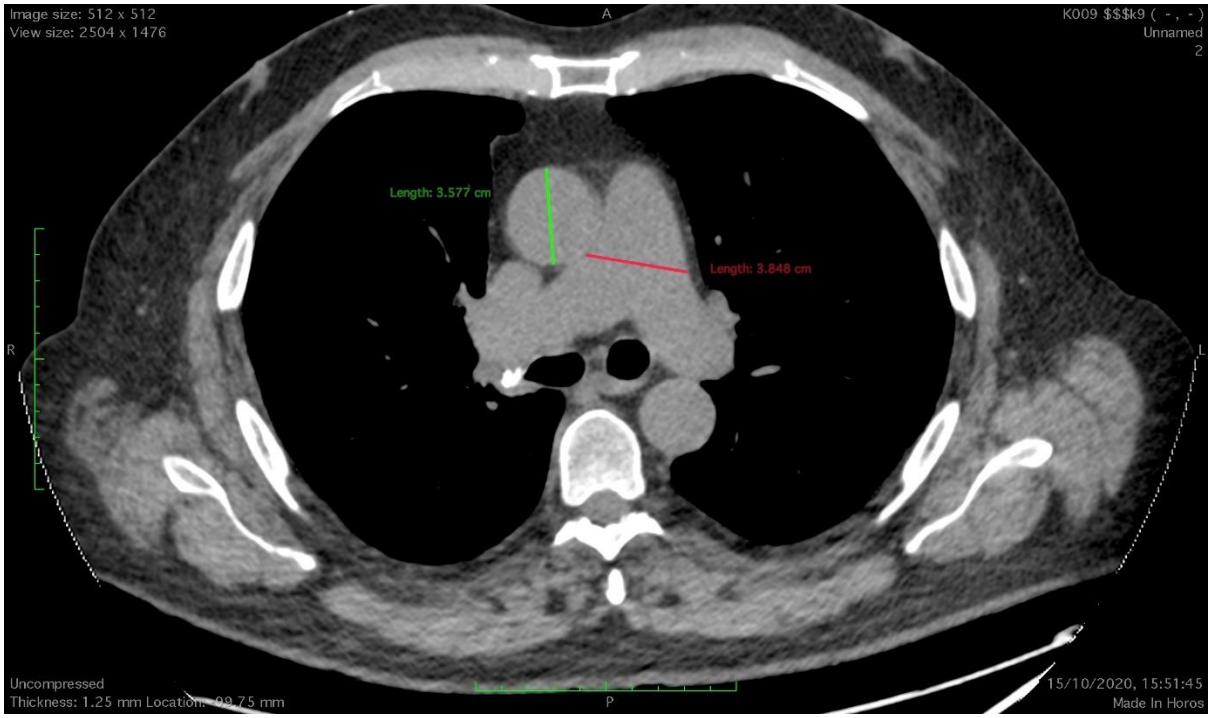

Figure 1.

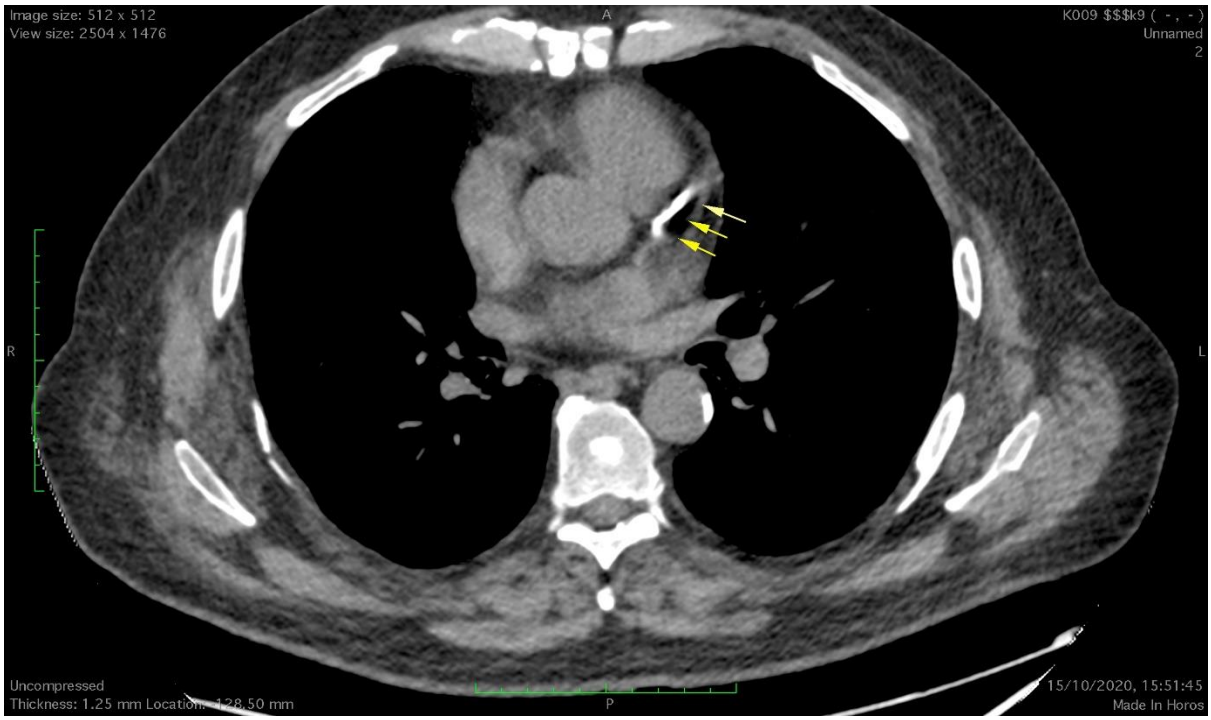

Figure 2.

Abstract number: P23

Assessing Robustness of Network-Based Correlation Analysis with Total-Body PET Data

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Positron emission tomography (PET) is a nuclear medicine approach to imaging and quantifying metabolic and physiological processes in vivo. While traditional PET scanners image only one area of the body at a time, total-body PET scanners have an increased geometric coverage allowing for a scan of the whole body to be taken at once. Total-body PET provides a unique ability to study systems medicine and analyze how different organs in the body work together.

Network analysis is a form of correlation analysis that is particularly useful in studying systems biology with total-body PET, as it provides a way to quantify differences and similarities in the PET data from different organs and different patients. From this, a representative network, or graph, is created which displays the relationships between data from different organs.

To perform future PET studies with network analysis, it is important first to find out if networks are robust. Robustness denotes the structural integrity of a network following changes in the data at either a local or global scale. If networks are consistent and robust between subjects, then the displayed connections may be biologically significant for the study population.

Robustness of network analysis with total-body PET was tested on dynamic imaging using the radioactive tracer [18F]Fluorodeoxyglucose in healthy mice as a way to assess glucose metabolism in bones. Networks were created with the data from six mice individually, all the data combined, and then all the data averaged across each bone. The networks were found to be robust between the individual mice and the average, in that there were distinct features that carried across each network. High connectivity was consistently seen between long bones (femur, tibia), whereas the spine had minimal connectivity to other bones in the network. The network robustness of combining will be subjected to further testing.

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Abstract number: P24

A Deep-Learning Method for Single-Scan Optical Coherence Tomography Angiography Extraction

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Optical coherence tomography angiography (OCTA) is a non-invasively imaging modality that extends the functionality of OCT by extracting the signal of moving red blood cells from the surrounding static biological tissues. OCTA has emerged as a valuable tool for analyzing skin microvasculature, allowing for more accurate diagnosis and treatment monitoring. Most existing OCTA extraction (e.g., speckle variance (SV)) algorithms implement a larger number of the repeat (NR) OCT scans at the same position to produce high-quality angiography images. However, a higher NR requires a longer data acquisition time, resulting in more unpredictable motion artifacts. In this study, we aim to leverage the power of neural networks to extract vascular signals from a single-repeated OCT signal, thereby generating high-quality OCTA images.

In this study, we proposed an angiography extraction pipeline based on a single-repeat OCT scan utilizing a trained U-Net, the pipeline can facilitate the data acquisition speed and reduce the motion artifacts in OCTA imaging. Regarding data collection, a swept-source OCT system with a 200kHz sweeping rate was used to acquire skin data from 14 healthy volunteers (The data acquisition was approved by an institutional review board).

A twelve-repeated scanning protocol with a 5.16 mm2 field of view and ~8.6 µm spatial sample rate was used to acquire data. The high-quality OCTA images generated by twelve-repeated OCT scans served as ground truth, while the input was structural images from the first single-repeated OCT scan. Supervised training was used to reduce the mean square error between the network output and ground truth.

In contrast to the reference OCTA image obtained via the SV algorithm on four NR OCT scans, the vascular image extracted by U-Net exhibits higher contrast and more vascular texture details, resulting in a higher PSNR of 17.28. Conversely, the denoising convolution neural network (DnCNN) outcomes perform inadequately compared to the reference OCTA image and U-Net. We believe that the encoder-decoder architecture network can perform better in angiography extraction. The results show that the U-Net can facilitate the data acquisition speed by extracting OCTA images from a one-repeated OCT scan, enabling a fast OCTA scan and accurate diagnosis to be achieved for patients.

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SINAPSE
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Abstract number: P25

Optical attenuation coefficient (OAC) based automatic segmentation of limbal epithelial thickness and age-related differences

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Presented by **Tianyu Zhang**

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Background, Motivation and Objective: The limbus niche, a distinctive area located at the junction of the cornea and the conjunctiva in the eye, provides a habitat for limbal epithelial stem cells. However, the anatomical changes in limbal niches due to limbal diseases or aging remain not well-studied. Optical attenuation coefficient (OAC) is a vital optical property reflecting tissue physiology. In this study, we quantitatively measured OAC from optical coherence tomography (OCT) signals in donor limbal tissues, aiming to investigate automatic segmentation of limbal epithelial layer based on OAC and examine differences across age groups.

Methods: 11 cadaveric corneoscleral tissues from donors aged from 4 to 96 were obtained from NHS tissue bank. Ex-vivo imaging of the superior limbus was performed using a lab-built spectral-domain OCT with a broadband laser (1310±110 nm) and a line-scan camera (91,912Hz sampling frequency) and a 10× objective lens. The limbal region with a size of ~2×5.27×1.05 (z×x×y, mm) was extracted from OCT volumetric stack for each tissue. An optimized depth-resolved estimation method was employed to estimate OAC (Liu et al., 2019). The epithelial and stromal surfaces were detected by the first non-zero pixel and the below first half-maximum gradient along the z-axis, respectively. The distance between the two surfaces resulted in a limbal epithelial thickness map. The en face OAC projected map was generated by averaging the OAC value between the two surfaces. Student's T-tests were carried out to compare thickness and OAC in limbal niche area for two age groups: A (≤65 years) and B (> 65 years).

Results/Discussion: The average thickness for group A was 73.9 ± 12.7 µm, thinner than the 66.0 ± 16.8 µm observed in group B. The OAC for group A at 0.7982 ± 0.1027 mm-1 was significantly higher than the 0.3938 ± 0.0911 mm-1 for group B ($P<0.001$).

Our study demonstrates that OAC can facilitate automatic segmentation of the limbal epithelial layer and reveal age-related changes. The OAC could serve as an indicator for screening abnormal limbal conditions in clinical practice.

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Abstract number: P26

Enhancing nerve visualisation and optimising infusion site selection for local anaesthesia using OCT

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Presented by **Zhengshuyi Feng**

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Background, Motivation and Objective: Using ultrasound guidance for inserting needles and injecting local anaesthetics during regional anaesthesia is common practice. However, visualising the entire needle length and accurately determining its position and tip remains challenging. Optical Coherence Tomography (OCT) is an imaging technique capable of providing high-resolution images, and it is increasingly used to structure tissues. This study aims to investigate the feasibility of OCT in identifying and visualising nerve layers that cannot be seen under ultrasound to determine the optimal location for local anaesthetic infusion during nerve block.

Methods: The study used nerves dissected from an ex-vivo lamb leg. A spectral-domain OCT (SD-OCT) system consisting of a broadband laser source (1100 ±110 nm) and a high-speed spectrometer of 91,912 Hz was utilised to visualise the nerves. The SD-OCT system had a lateral resolution of about 16 µm and an axial resolution of roughly 5.8 µm in the air. A scanning protocol of 512 consecutive cross-sectional images with a lateral spacing of 6 µm was employed to obtain the 3D structure matrix of the nerve within 2.85 seconds. The effective imaging plane size was approximately 2.4 mm x 3mm x 3 mm.

Results: The result of the study showed that OCT imaging was able to provide detailed information on the different layers of the nerve. The fascicles with maximum intensity, which are bundled nerve fibres, were visible in projection views when the nerve was scanned perpendicular to its length, as seen in Fig. a.

Furthermore, the epineurium, the outermost nerve layer, and the perineurium were clearly visible in both sagittal and axial views, as shown in Fig. b and c. Overall, the results suggest that OCT imaging can provide useful information on the structure of nerves, including the different layers and fascicles.

The OCT imaging can also help identify the optimal location for local anaesthetic infusion by visualising nerve layers and needle placement. This can lead to more effective regional anaesthesia with fewer complications. OCT can be a useful tool for nerve visualisation when ultrasound is limited. Additional research is needed to define the optimal usage of OCT in clinical practice.

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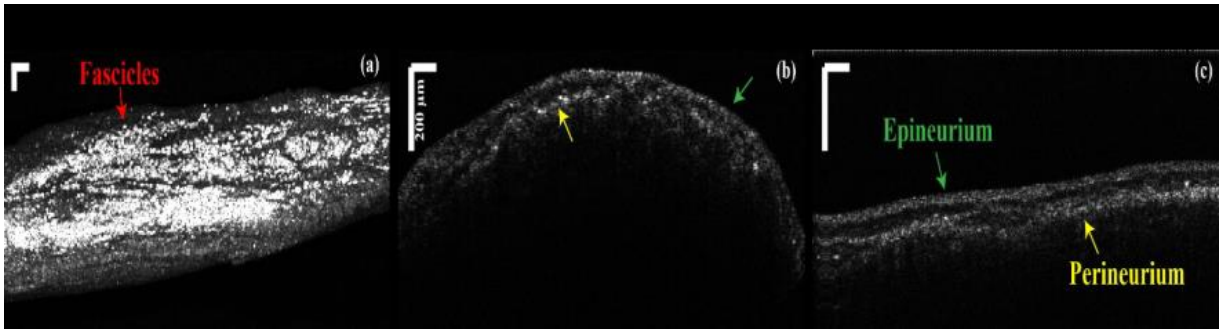

Abstract number: P27

Cataloguing DICOM images

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A major difficulty of working with big medical data is the classification of images by procedure, condition, treatment, and body part. Accurate image classification would enable researchers to specify criteria for the efficient extraction of relevant medical images for study and analysis.

Most solutions look at pixel data for classification due to its high reliability in comparison with attached metadata. In comparison, a text-based solution would be faster, more scalable, and more computationally efficient. To decide whether there is value in metadata classification, a radiologist examined a collection of common DICOM tags and measured their reliability for body part classification by comparing them with their respective pixel data.

They found the most reliable tag for body part descriptions was “StudyDescription”. We cleaned the "StudyDescription" text, extracting a list of unique values, to make the data more manageable. Analysing these unique studies, we created a dictionary defining medical terms with one or more common body part labels such as “head”, “neck”, “chest”, “abdomen”, “pelvis”, “upper limb”, “lower limb”, “spine”, and “whole body”.

Our current dictionary contains 223 terms. Applying this to 38,742 unique studies across 11 modalities, resulted in a labelling coverage of 92.98%. Manual verification of the labelling across the studies resulted in a 91.74% accuracy. Mislabelling issues such as false positives, harsh abbreviations, incorrect spellings, double meanings, negations, and body part ranges, were identified in 3.79% of the unique studies.

This short study highlights the potential advantages of using metadata for classification when a reliable set of tags is available. Further study of combinations of tags and validation against pixel data will help determine whether this solution can be used reliably and expanded to include other classification types. This study does not aim to replace pixel data classification; pixel and metadata solutions can validate and complement each other.

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Abstract number: P28

Natural Language Process of Radiology Reports

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The Scottish Medical Imaging (SMI) archive holds a copy of Scotland's radiology images for use by researchers. It includes radiology reports in text format for CT, MRI, Ultrasound, and other modalities. The PICTURES project has been funded to do research and development of tools and techniques for making the archive more easily accessible and usable.

The natural language processing (NLP) work package has been doing research into methods for removing all Personally Identifiable Information (PII) from the free-text reports. The aim is to detect and remove names, dates, and other PII which may appear anywhere in the text. The process must be robust enough to give confidence that reports can be delivered to researchers without the risk of re-identifying patients.

A second aim is to catalogue the text to make it easier to find reports about specific medical conditions, treatments or drugs. This labels the text using concepts defined in the UMLS metathesaurus, a comprehensive medical ontology, and it has the ability to spot different phrases with the same meaning. The medical reports are all associated with radiology images so this approach to building cohorts can be used to search the archive for relevant images as well as reports.

This poster describes the work to build an acceptable NLP solution for detecting PII, the validation process, the design of a process for extracting medical concepts from reports and a database for cataloguing them, and a web service with cohort building tool plugin for querying the catalogue.

Acknowledgements: This work was supported by the Medical Research Council (MRC) grant No. MR/M501633/1 and the Wellcome Trust grant No. WT086113 through the Scottish Health Informatics Programme (SHIP). This project has also been supported by MRC and EPSRC (grant No. MR/S010351/1) and by the Scottish Government through the "Imaging AI" grant award.

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Abstract number: P29

Medical Image Anonymisation

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The Scottish Medical Imaging (SMI) archive holds a copy of Scotland's radiology images for use by researchers. It includes radiology reports in text format for CT, MRI, Ultrasound, and other modalities. The PICTURES project has been funded to do research and development of tools and techniques for making the archive more easily accessible and usable.

The image anonymisation work package has been doing research into methods for removing all Personally Identifiable Information (PII) which has been 'burned in' to the image pixels. In contrast to most anonymisation tools, which only remove PII from the image metadata, the aim is to detect and remove names, dates, and other PII which appears written into the image pixels.

The images in the archive arrive in their raw form, in DICOM format but with no post-processing to clean them up. The first task was to determine the scale of the problem: which images might contain text, where the text is written, and what the text contains. In an archive containing billions of images, this is a Big Data task, so it was started by looking at the metadata, to try and find patterns between machines (by Manufacturer and Model), by Image Type tags, or by metadata such as the BurnedInAnnotation tag. The sheer variety of text in images rendered this impractical so an OCR method was tried instead.

This poster describes the work to find an acceptable OCR solution for detecting text, the tools which were created to assist in the validation process, and the end result being a pipeline for delivering anonymised images to researchers. All of the code has been made open source.

Acknowledgements: This work was supported by the Medical Research Council (MRC) grant No. MR/M501633/1 and the Wellcome Trust grant No. WT086113 through the Scottish Health Informatics Programme (SHIP). This project has also been supported by MRC and EPSRC (grant No. MR/S010351/1) and by the Scottish Government through the "Imaging AI" grant award.

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