





DSMS 2020



<u>The Doctoral School Multidisciplinary</u> <u>Symposium 2020 Conference Booklet</u> By the Doctoral Researcher's Group The University of Strathclyde 26th – 28th May 2020



SYMPOSIUM OVERVIEW

Day 1: Tuesday 26th May 2020

09:40	Zoom Sign in				
09:45	Welcome	Welcome: Lewis Hill and Prof. Eleanor Shaw			
10:00	Keynote	Speaker 1: Prof. Dame Ann "We can all make a difference"	Glover		
10:30	Victoria Walker	Matěj Hejda	Emanuela Romeo		
10:50	Suttinee Phuagkhaopong Cameron Webb Saiful Fazli Ramli				
11:10	10 mins Break				
11:20	Laura MacLean	Laura MacLean Rhona Muir Silvia Behrens			
11:40	Gillan Berrie Jonathan Fallman Ming Zhang				
12:00	10 mins Break				
12:10	Marisa Graser	Sheik Abdul Malik	Salisu Alhaji Uba		
12:30	Ryan Brown	Linda Lapp	Mohammad Khazaei		
12:50	Closing – End of Day 1				

Day 2: Wednesday 27th May 2020

All Day	Online Poster Presentations	Twitter Hashtag: #DSMSPoster2020

Day 3: Thursday 28th May 2020

09:30	Zoom Sign in		
09:40	Short Welcome		
09:45	Keynoto "5G a	e Speaker 2: Prof. Mischa De and the Internet of Skills in Actio	<mark>ohler</mark> n″
10:15	Gabriela Loredana Gherghina	Ansu Joseph A.	Wang Zhao
10:35	Mary Anderson	Saphia Matthew	Nicola Robertson
10:55	5 mins Break		
11:00	Ali Mohammad Jadali	Alessandra Orfeo	Sissi Lehto
11:20	George Holt	Neil Forbes	Rukhsar Hussain
11:40		5 mins Break	
11:45	Yaw Boakye-Ansah	Adel Gani	Arletta Gorecka
12:05	Leigh Paterson	Ilian Despard	Moses Olisah
12.25	5 mins Break		
12.30	Keynote Speaker 3: Prof. Heikki Nieminen "Biodesign process as a way to innovate need-driven medical technologies in multidisciplinary teams"		
13.00	Prize Giving Announcements		
13.15		Closing – End of Day 3	

Symposium	Enabling a more Prosperous	Driving Technology and	Empowering Connectivity
Theme Colour	and Sustainable Society	Creating Future	and Increasing Global
Кеу		Solutions	Awareness

Welcome Message

The DSMS 2020 Organising Committee, and the Doctoral Researchers' Group (DRG) as a whole, would like to take this opportunity to extend our warmest greetings to you all and welcome you to the Doctoral School Multidisciplinary Symposium for 2020!

While organising a conference is often a challenging venture, I don't think anyone from the committee envisioned us having to adapt and change the event quite so much as we have. In recent months, we have all seen the world around us radically diverged away from many of the things that we use to define 'normality', but we hope we have adapted well and that this new, online, style works, and delivers a great day for all involved.

We have endeavoured to gather some excellent keynote speakers for each of the symposium's main themes, which should not only be interesting for all, but also complement all the presentations from our fellow Strathclyders. I would also like to highlight the online poster session taking place on Twitter under the hashtag: #DSMSPoster2020.



Last year's DSMS Organising Committee. Originally, DSMS 2020 was also intended to take place in-person, but due to the ongoing COVID-19 pandemic, we, just like all of you, had to adapt to a new way of doing things!

In the spirit of a creating a truly multidisciplinary event, it was extremely encouraging to receive so many abstracts



Faculty breakdown of submitted abstracts matched well the faculty breakdown of doctoral students.*

from all over the university, and with the ratio of submitted abstracts matching well the ratio of doctoral students in each Faculty. This should ensure that there is ample opportunity for everyone to reach outside of their research 'bubble' and dabble briefly in perhaps a brand-new field.

This year's organising committee is once again made up of volunteers from the DRG, many of whom are pictured above in last year's DSMS committee, but with some brilliant new additions also. Atop this core team there was overwhelming support from the Strathclyde Doctoral School, directed by Professor Eleanor Shaw, and members from Strathclyde's RDP team, such as Dr Gabrielle Milson and Dr Stephanie Colvan. Huge recognition is also deserved for the army of abstract peer reviewers, in total, 120 of you(!) gave up your valuable time to

ensure a robust review process, and so, you too, all have our thanks.

With this all said, we hope you will all have a great few days with us learning about the amazing research done by our Doctoral Researchers' community at the University of Strathclyde, and I ask that you all join the Organising Committee in crossing your fingers and wishing us luck for no technological difficulties with Zoom! Apart from that, simply sit back and...

Enjoy!

Lewis Hill – Chair of the Doctoral Researchers' Group

Keynote Speakers



Professor Dame Anne Glover DBE FRS PRSE -

President, Royal Society of Edinburgh

Anne is a molecular biologist by trade and holds a number of nonexecutive director roles on several boards as well as being a Trustee of several charities. Among these roles is a number of prestigious positions including President of the Royal Society of Edinburgh (2018-2021), Special Advisor to the Principal and Vice-Chancellor of the University of Strathclyde and Chair of the Board of Trustees for the Carnegie Trust for the Universities of Scotland.

Anne gained her first-class Bachelor of Science honours degree at

the University of Edinburgh in Biochemistry, before completing her PhD in Molecular Microbiology at King's College, Cambridge. Anne was recognised in 2008 as a Woman of Outstanding Achievement by the UK Resource Centre for Women in Science, Engineering and Technology and awarded a CBE in 2009 for her services to environmental science and a DBE in 2015 for her services to science in the UK and Europe.

Anne was the first Chief Scientific Adviser to the President of the European Commission (2012-2015) and prior to that appointment was the first Chief Scientific Adviser for Scotland (2006-2011). Anne's research interests include the development of sensors for the detection of environmental pollutants, how our response to stress is linked to how we age and how knowledge can be used to transform lives in Africa.

Professor Glover will speak on how "We can all make a difference" in the first keynote session, under the theme of "*Enabling a more Prosperous and Sustainable Society*".

Professor Mischa Dohler – King's College London

Mischa Dohler is full Professor in Wireless Communications at King's College London, driving cross-disciplinary research and innovation in technology, sciences and arts. He is a Fellow of the IEEE, the Royal Academy of Engineering, the Royal Society of Arts (RSA), the Institution of Engineering and Technology (IET); and a Distinguished Member of Harvard Square Leaders Excellence. He is a serial entrepreneur with 5 companies; composer & pianist with 5 albums on Spotify/iTunes; and fluent in 6 languages. He acts as policy advisor on issues related to digital, skills and education. He has had ample coverage by national and international press and media.



He is a frequent keynote, panel and tutorial speaker, and has received numerous awards. He has pioneered several research fields, contributed to numerous wireless broadband, IoT/M2M and cyber security standards, holds a dozen patents, organized and chaired numerous conferences, was the Editor-in-Chief of two journals, has more than 200 highly-cited publications, and authored several books.

He was the Director of the Centre for Telecommunications Research at King's from 2014-2018. He is the Cofounder of the Smart Cities pioneering company Worldsensing, where he was the CTO from 2008-2014. He also worked as a Senior Researcher at Orange/France Telecom from 2005-2008.

Professor Dohler's talk will be on "5G and the Internet of Skills in Action", which addresses the symposium theme, "Empowering Connectivity and Increasing Global Awareness".



Professor Heikki J. Nieminen – Aalto University, Finland

Heikki Nieminen is an Assistant Professor and the Head of Medical Ultrasonics Laboratory (MEDUSA) in the Department of Neuroscience and Biomedical Engineering (NBE) at Aalto University, Finland. He is also the Project Manager and PI of the Stanford-originating Biodesign Finland Programme focusing on innovating medical technologies.

Dr Nieminen's research and innovation interests are in new diagnostic and interventional platforms employing nonlinear ultrasonics. He holds several patents in medical technologies and aims at translating research findings into clinic via commercialization. Dr Nieminen is a co-founder of

three medical technology companies, two in Finland and one in Canada.

Dr Nieminen is our third keynote speaker and his presentation entitled "**Biodesign process as a way to innovate need-driven medical technologies in multidisciplinary teams**" falls under the theme of "Driving Technology and Creating Future Solutions".

Session Chairs

Session	Chair(s)		
Keynote 1	Kelly Brown		
Day 1 Parallel Sessions	Roberto Ravenna	Maisie Keogh	Esraa Karam
Online Poster Session	Kelly H	Brown, Sissi Lehto & Esra	a Karam
Keynote 2	Lewis Hill		
Day 3 Parallel Sessions	Stephen Ugwuanyi	Alan Keenan	David Bomark
Keynote 3		Sissi Lehto	

Full list of PGR Presentations

Poster Presentations

Day 2: Wednesday 27th May 2020

Taking place on Twitter under the hashtag: **#DSMSPoster2020**

Name	Poster Presentation Title
Kiri Thornalley	Physicochemical Characterisation of PLGA Nanoparticle Protein Corona using Orthogonal Techniques
Abdullahi Daya	Application of Artificial Neural Network and Expert Systems for Enhanced Reliability in Predictive Ship Machinery Health Condition Monitoring
Silpa Singharajwarapan	BIM-based Building Code Compliance Checking System
Gemma Egan	Protein Release and Characterisation from Silk Fibroin Hydrogels formed by Electro-gelation and Sonication
Maria Egizia De Pascale	To what extent is science a creative discipline, and how far is that reflected in the teaching vs the learning of science in Scotland?
Matt Mitchell	Developing an Optical Accordion Lattice with Variable Lattice Spacing for Quantum Simulation
Zuzana Pinkosova	Cortical Activity of Relevance
Saleh Almogrbe	Urbanisation in Post-Conflict Contexts: Urban Development and Reconstruction in Post-Conflict Cities. Benghazi Libya 2010-2020, As a Case Study.
Kirsty Goudie	Advanced Manufacturing for Vascular Graft Sealant Technology
Thomas Rashford	A Novel Approach to Integrate Ant Colony Clustering into Data Visualization Accounting Dashboards to Improve the Appraisal Efficiency and Accuracy of Executive Decision Making.

Oral Presentations

Day 1: Tuesday 26th May 2020

Namo	חו	Oral Presentation Title	Start Time
Victoria Walker	#P1	The Experience of Well-Being in Low Paid Service Work: A Multiple Case Study	10.30
Matěi Heida	#T1	Neuromorphic Systems Based on Photonics	10.00
Emanuela Romeo	#C1	A Hidden Treasure: Exploring Partisan Communication	
Suttinee Phuagkhaopong	#P2	Histological Evaluation of Engineered Self-Assembling Silk Fibroin Hydrogel Biodegradation in a MCAO Stroke Rat Models	10:50
Cameron Webb	#T2	Use of a Novel Microfluidic Technology to Accelerate Lipid Nanomedicine Development: From the Lab Bench to GMP	
Saiful Fazli Ramli	#C2	Effective Heritage Building Maintenance Strategies Using H-Bim	
Laura MacLean	#P3	Residents Subjective Assessment of Their Quality of Urban Life in Lilongwe, Malawi.	11:20
Rhona Muir	#T3	Protein Glycation Detected by Changes in its Intrinsic Fluorescence	
Silvia Behrens	#C3	Young People's Political Activism: Themes and Structures of Youth Political Participation in England and Scotland	
Gillan Berrie	#P4	Manufacture of Fully Synthetic Liposomes Using Microfluidics	11:40
Jonathan Fallman	#T4	Real-time Simulations of a Future Low-Carbon University Campus Microgrid	
Ming Zhang	#C4	Predictive Control of Heaving Compensation System Based on Machine Learning Prediction Algorithm	
Marisa Graser	#P5	Aetiology and Risk Factors of Deep Tissue Injury Explained	12:10
Sheik Abdul Malik	#T5	A Comprehensive Investigation on the Electrical Resistivity Variance of Thin Ply Hybrid Composites and its Correlation to Internal Micro Fibre Damage & Fragmentation – A Headway in Developing Next Generation SHM Sensor	
Salisu Alhaji Uba	#C5	Understanding Blockchain Technology: a Survey of Supply Chain Network in Nigeria	
Ryan Brown	#P6	Sphingosine Kinase-1 and Cancer	12:30
Linda Lapp	#T6	Evaluation of Random Forest and Ensemble Methods at Predicting Complications Following Cardiac Surgery	
Mohammad Khazaei	#C6	Appliance Usage Detection from Smart Meter Data Using Supervised and Unsupervised Non-Intrusive Load Monitoring	

Day 3: Thursday 28th May 2020

Nome	ID	Out Durantation Title	Start
Name	ID	Oral Presentation Life	Time
Gabriela Loredana Gherghina	#P7	Explaining Gender Pay Gap in the UK: The Effects of Organisational Determinants	10:15
Ansu Joseph A.	#T7	A Risk Predictive Tool for Clostridioides Difficile	
Wang Zhao	#C7	Building Epidemiological Models Using Fragmented Information: A Case Study of Wuhan Coronavirus in 2020	
Mary Anderson	#P8	Microbial Induced Calcite Precipitation as a Viable Ground Improvement Technique	10:35
Saphia Matthew	#T8	A Systematic Approach to Silk Nanoparticle Manufacture in Semi-Batch Format	
Nicola Robertson	#C8	Pedagogical Reduction and The Power of The Image: Propaganda and The Post-Truth Era	
Ali Mohammad Jadali	#P9	The Techno-economic Assessment of End Life Scenarios in Offshore Wind Turbine	11:00
Alessandra Orfeo	#T9	Development and Modelling of Innovative Devices for the Seismic Protection of Buildings	
Sissi Lehto	#C9	Assessing the Impact of Marketing Automation on Customer Engagement in a Business-to-business Setting	
George Holt	#P10	Investigation of Transient Plasma Photonic Crystals	11:20
Neil Forbes	#T10	Protein Delivery to the G.I Tract: Microfluidics as a Scale-independent Production Platform for Protein Loaded Nanoparticles	
Rukhsar Hussain	#C10	Representation of Hijras in the Postcolonial Indian Fiction	
Yaw Boakye-Ansah	#P11	Sensitivity of Travelling Wave Solutions to Richards' Equation to Soil Material Property Functions	11:45
Adel Gani	#T11	Experimental Study of Cutting Two Separate Thin Steel Sheets Simultaneously Using Plasma Machining, Parameters Optimisation and Response Prediction	
Arletta Gorecka	#C11	Privacy: A Means to Protect Competition or Advance Consumer Welfare or Innovation?	
Leigh Paterson	#P12	Electrical Machines: is Technology Growth Leading to an Unsustainable Future?	12:05
Ilian Despard	#T12	Dual Species Bosonic Quantum Gas Microscopy	
Moses Olisah	#C12	Investigation of Collaborative Supply Chain Drivers: A Case Study Nigerian Oil and Gas Industry	

Full List of PGR Presentation Abstracts

Enabling a more Prosperous and Sustainable Society

The Experience of Well-Being in Low Paid Service Work: A Multiple Case Study	8
Histological Evaluation of Engineered Self-Assembling Silk Fibroin Hydrogel Biodegradation in a MCAO Stroke Rat Models	. 10
Residents Subjective Assessment of Their Quality of Urban Life in Lilongwe, Malawi.	.11
Manufacture of Fully Synthetic Liposomes Using Microfluidics	. 12
Aetiology and Risk Factors of Deep Tissue Injury Explained	.13
Sphingosine Kinase-1 and Cancer	. 15
Explaining Gender Pay Gap in the UK: The Effects of Organisational Determinants	.17
Microbial Induced Calcite Precipitation as a Viable Ground Improvement Technique	.18
The Techno-economic Assessment of End Life Scenarios in Offshore Wind Turbine	.19
Investigation of Transient Plasma Photonic Crystals	.21
Sensitivity of Travelling Wave Solutions to Richards' Equation to Soil Material Property Functions .	. 22
Electrical Machines: is Technology Growth Leading to an Unsustainable Future?	.24

Driving Technology and Creating Future Solutions

Neuromorphic Systems Based on Photonics
Use of a Novel Microfluidic Technology to Accelerate Lipid Nanomedicine Development: From the Lab Bench to GMP
Protein Glycation Detected by Changes in its Intrinsic Fluorescence
Real-time Simulations of a Future Low-Carbon University Campus Microgrid
A Comprehensive Investigation on the Electrical Resistivity Variance of Thin Ply Hybrid Composites and its Correlation to Internal Micro Fibre Damage & Fragmentation – A Headway in Developing Next Generation SHM Sensor
Evaluation of Random Forest and Ensemble Methods at Predicting Complications Following Cardiac Surgery
A Risk Predictive Tool for Clostridioides Difficile
A Systematic Approach to Silk Nanoparticle Manufacture in Semi-Batch Format
Development and Modelling of Innovative Devices for the Seismic Protection of Buildings
Protein Delivery to The G.I Tract: Microfluidics as a Scale-independent Production Platform for Protein Loaded Nanoparticles
Experimental Study of Cutting Two Separate Thin Steel Sheets Simultaneously Using Plasma Machining, Parameters Optimisation and Response Prediction42
Dual Species Bosonic Quantum Gas Microscopy43

Empowering Connectivity and Increasing Global Awareness

A Hidden Treasure: Exploring Partisan Communication44
Effective Heritage Building Maintenance Strategies Using H-Bim46
Young People's Political Activism: Themes and Structures of Youth Political Participation in England and Scotland
Predictive Control of Heaving Compensation System Based on Machine Learning Prediction Algorithm
Understanding Blockchain Technology: a Survey of Supply Chain Network in Nigeria51
Appliance Usage Detection from Smart Meter Data Using Supervised and Unsupervised Non- Intrusive Load Monitoring
Building Epidemiological Models Using Fragmented Information: A Case Study of Wuhan Coronavirus in 2020
Pedagogical Reduction and The Power of The Image: Propaganda and The Post-Truth Era57
Assessing the Impact of Marketing Automation on Customer Engagement in a Business-to-business Setting
Representation of Hijras in the Postcolonial Indian Fiction60
Privacy: A Means to Protect Competition or Advance Consumer Welfare or Innovation?61
Investigation of Collaborative Supply Chain Drivers: A Case Study Nigerian Oil and Gas Industry62

Online Poster Session

Physicochemical Characterisation of PLGA Nanoparticle Protein Corona using Orthogonal Techniques 63
Application of Artificial Neural Network and Expert Systems for Enhanced Reliability in Predictive Ship Machinery Health Condition Monitoring64
BIM-based Building Code Compliance Checking System65
Protein Release and Characterisation from Silk Fibroin Hydrogels formed by Electro-gelation and Sonication
To what extent is science a creative discipline, and how far is that reflected in the teaching vs the learning of science in Scotland?
Developing an Optical Accordion Lattice with Variable Lattice Spacing for Quantum Simulation71
Cortical Activity of Relevance72
Urbanisation in Post-Conflict Contexts: Urban Development and Reconstruction in Post-Conflict Cities. Benghazi Libya 2010-2020, As a Case Study74
Advanced Manufacturing for Vascular Graft Sealant Technology75
A Novel Approach to Integrate Ant Colony Clustering into Data Visualization Accounting Dashboards to Improve the Appraisal Efficiency and Accuracy of Executive Decision Making

The Experience of Well-Being in Low Paid Service Work: A Multiple Case Study

Victoria Walker

Purpose – Approximately 23% of workers are currently paid less than the real living wage (D'Arcy, 2018). Low paid jobs are often poor quality and precarious in nature, offering limited opportunity for progression. Many workers find themselves trapped in the 'low pay, no pay' cycle, with recent evidence suggesting that a quarter of low wage workers remain in low paid jobs for over ten years (D'Arcy and Finch, 2017). Various research has demonstrated the association between low pay and poor physical and mental health, as well as the high risk of poverty among low paid workers (Goulden, 2010; Cottini, 2012; Maitre, Nolan and Whelan, 2012; Shildrick *et al.*, 2012). The experience of low wage work therefore has significant consequences that reach far beyond the workplace, calling into question the effect that low wage work has on the well-being of workers.

Methodology/approach – Findings are drawn from qualitative case studies of four UK organisations based within two of the largest low paying sectors: hospitality and social care. 71 semi-structured interviews were carried out with employees at various levels of the organisation to gain a variety of perspectives, including frontline workers, line management, and senior management. Interviews explored the underlying philosophies of management, how HR practices are used within low wage, and how these HR practices affect the experience of low wage work.

Findings – A gap exists between what HR intends for well-being and what line managers deliver in terms of well-being for low paid workers. A driving force behind this is that managers are incentivised to deliver certain levels of performance but are not incentivised in the means by which they deliver that performance. It is in that 'means' that the processes of well-being or stress are at work. For low paid employees, social support from line managers appears to be the critical resource in terms of well-being, as line managers are the source and gatekeepers of the resources and demands that most affect individual well-being.

Research limitations/implications – The nature of qualitative case study research has the immediate limitation that the empirical results cannot be generalised, as only a small number of cases have been investigated.

Practical implications – For employers of low wage workers, the practical implications of this research are extensive. The evidence suggests that the ways in which line managers manage potentially have potentially significant consequences for the health and well-being of workers. In particular, a move away from reactive management and HR process towards preventative approaches is needed, if the benefits of this research are to be operationalised.

Originality/value – Quantitative research in this area has been extensive, while qualitative work exploring the underlying mechanisms is limited. While empirical generalisations cannot be made, theoretical generalisations can be made. Therefore, this research makes a contribution to the theory of well-being. A better understanding of well-being is arguably essential in enabling a more prosperous and sustainable society.

Key words - Well-being; low pay; HRM; line managers; qualitative

Paper type – Research Paper

References

Cottini, E. (2012) 'Health at work and low pay: a European perspective', *The Manchester School,* 80(1), pp. 75-98.

D'Arcy, C. (2018) Low Pay Britain 2018, London: Resolution Foundation.

D'Arcy, C. and Finch, D. (2017) *Calculating a Living Wage for London and the rest of the UK*, London: Resolution Foundation.

Goulden, C. (2010) *Cycles of poverty, unemployment and low pay*, York: Joseph Rowntree Foundation.

Maitre, B., Nolan, B. and Whelan, C. T. (2012) 'Low Pay, In-Work Poverty And Economic Vulnerability: A Comparative Analysis Using Eu-Silc', *The Manchester School*, 80(1), pp. 99-116.

Shildrick, T., MacDonald, R., Webster, C. and Garthwaite, K. (2012) *Poverty and insecurity : life in 'low-pay, no-pay' Britain.* Bristol: Policy Press.

Histological Evaluation of Engineered Self-Assembling Silk Fibroin Hydrogel Biodegradation in a MCAO Stroke Rat Models

Suttinee Phuagkhaopong¹, Natalia Gorenkova¹, Hilary V.O. Carswell¹, and F. Philipp Seib^{1,2}

¹Strathclyde Institute of Pharmacy and Biomedical Sciences, University of Strathclyde, Glasgow, United Kingdom

²Max Bergmann Center of Biomaterials, Leibniz Institute of Polymer Research, Dresden, Germany

The brain has a limited tissue regeneration capacity following trauma. Therefore, tissue loss after a stroke is not spontaneously regenerated. We hypothesized that silk hydrogels could serve as a reliable support matrix to ultimately develop regeneration therapies for stroke. We recently reported that silk hydrogels can fill the stroke cavity with excellent space conformity without inducing surrounding tissue injury up to 2 months post-stroke. However, the biodegradation profile of self-assembling silk fibroin hydrogels in the stroked brain over time is unknown. We therefore evaluate the biodegradation of self-assembling silk fibroin hydrogels in a middle cerebral artery occlusion rat stroke model. At 6 months, the silk fibroin graft showed good space conformity with visible signs of hydrogel degradation. Silk remnants were found in all animals (n=4). A wider area of reactive astrocytes, but not astrocytic scar, was found at the lesion-tissue interface. In addition, there was no microglia/macrophage (CD11b⁺) response toward the silk hydrogels observed around the lesion or within the lesion core. Thus the implanted silk hydrogels did not induce an overt host-immune response and show elements of biodegradation over 6 months, pre-requisites of a reliable support matrix. Overall, this study provides insight into the degradation and chronic tissue response towards selfassembling silk fibroin hydrogels, supporting its potential for developing regenerative therapies for stroke.

Keywords biodegradation, middle cerebral artery occlusion, silk, hydrogels

Residents Subjective Assessment of Their Quality of Urban Life in Lilongwe, Malawi.

Laura MacLean

Purpose -

This study is focusing on the resident's subjective assessment of their quality of urban life. Quality of urban life (QoUL) is a multidimensional phenomenon which studies how the urban environment affects a resident's quality of life. QoUL studies offer information for policymakers and planners to assess their urban environments and contribute to the resolution of urban problems.

Methodology/approach -

165 structured residential interviews were conducted across three neighborhoods in Lilongwe in August 2019. Quantitative analysis has been conducted using SPSS and Microsoft excel. This is then compared with objective data such as government reports and fieldwork observations to relate the two strands of research to discover if there are similarities and differences.

Findings -

The findings from the residents demonstrate that the QoUL varies dramatically between the different neighborhoods in Lilongwe. The fieldwork clarifies that the indicators that were tailored to the context were significant and important within this case-study site.

Practical implications (if applicable) -

One of the main limitations in this PhD thesis is that the research is conducted abroad, therefore the time available for the fieldtrip is constrained, as it would be expensive and time consuming to visit numerous times. As such, the researcher integrated the VR to allow virtual return to the fieldwork sites to tackle this limitation.

Originality/value -

A gap in the current literature of QoUL is that the majority of measurement methods have been developed based on Western samples. Considering the cultural differences between these samples and other parts of the world, this research believes that existing measurement instruments are not suitable for measuring QoUL in other contexts. As such, this research has designed a framework that is tailored specifically to Lilongwe in Malawi. This involved input from an expert panel of Malawian government, academics and community groups to contextualise and tailor the indicators to Lilongwe.

Key words

Quality of urban life | Urban Life | Malawi | Indicators

Paper type -Research paper

Manufacture of Fully Synthetic Liposomes Using Microfluidics

Gillan Berrie

Purpose –

Liposomes have become valuable tools as adjuvants within the field of vaccine development. However, they are difficult to manufacture, and protein encapsulation is dependent on the nature of the phospholipid, (charge, chain length, saturation) ⁽¹⁾. The addition of cholesterol is an important factor in stabilising lipid bilayer integrity for encapsulation efficacy and release of antigen or protein to the target ⁽²⁾. This research seeks to demonstrate the ability to formulate fully synthetic liposomes using SnytheCol[™] a non-animal derived lipid using microfluidic processes.

Methodology/approach -

Liposomes were prepared using the Nanoassemblr[™] Benchtop (Precision Nano systems, Inc., Vancouver, Canada) and a 300 mm Staggered Herringbone Micro mixer. Liposomes were prepared from hydrogenated soy phosphatidylcholine (HSPC) and Cholesterol or Synthecol[™] (2:1 wt/wt). The lipids, were dissolved in ethanol and ovalbumin (OVA; 200µg/mL OVA) was dissolved in an aqueous buffer. The flow rate ratio (FRR) between the aqueous and solvent stream was set a flow rate ratio of 2.5:1 and a total flow rate of 15 mL/min. Solvent and non-incorporated protein was removed using 12 wash cycles of phosphate buffered saline (pH 7.4) by Tangential flow filtration. Liposomes were characterised by measuring size, PDI and zeta potential by dynamic light scattering (Malvern Panalytical, Malvern, UK). Protein encapsulation was determined using Micro BCA assay. All formulations were made in triplicate.

Findings –

Our results show that liposomes can be easily and rapidly manufactured using microfluidics. Liposomes were prepared from HSPC:Chol initially at a range of flow rates between 3:1 and 2:1 and a flow rate of 2.5:1 was selected based on liposomes size and drug loading. At a flow rate of 2.5:1, liposomes were produced that were 76 ± 17 nm in size (PDI <0.25) with protein loading of $34 \pm 13\%$. Using these optimised parameters, liposomes were also prepared where cholesterol was replaced with SynthecolTM (non-animal derived cholesterol), produced liposomes of the same size (76 ± 6 nm; PDI 0.27) and comparable loading (25 ± 9 nm) demonstrating that fully synthetic liposomes can be manufactured without the use of animal derived lipid components.

Key words -

Liposomes, Microfluidics, Vaccines, Scale-up, Nano medicine

Paper type – Research paper

References –

- 1. Briuglia, ML., Rotella, C., McFarlane, A. et al. Drug Delivery and Translational Research (2015) 5: 231.
- 2. Hussain, M., Forbes, N., and Perrie, Y. Pharmaceutics. (2019). 11(1), 39.

Actiology and Risk Factors of Deep Tissue Injury Explained

Marisa Graser

Purpose – The soft tissues covering bony prominences often encounter unique biomechanical challenges. Although not intended to tolerate high loads and deformation, they become part of the weight-bearing structure in surgical and bedfast patients, wheelchair users and lower-limb amputees^{1–4}. Consequently, deep soft tissue layers may be damaged, resulting in Deep Tissue Injury (DTI)⁵. However, the underlying aetiological and risk factors are subject to ongoing debates⁶. Based on a scoping review, the state-of-the-art knowledge on DTI is presented.

Methodology/approach – The focus of the scoping review was on lower-limb amputees as one of the lesser-known populations susceptible to DTI development. The search across the databases Pubmed, Ovid Excerpta Medica, and Scopus identified 16 peer reviewed, English-language studies. The areas of interest were (1) the population-specific aetiology, (2) risk factors, and (3) methodologies to investigate both.

Findings – The results indicate that DTI development is dependent on a complex interplay of mechanical, anatomical, and physiological factors acting on different organisational levels, from the external environment over soft tissue through to single cells. Whilst the loading conditions play a major role, they are strongly influenced by individual determinants. However, methodological limitations, high inter-patient variability, and small sample sizes complicate the interpretation of outcome measures. Additionally, fundamental research on cell and tissue reactions to dynamic loading and on its influence on the vascular and lymphatic systems is missing.

Practical implications – We therefore recommend increased interdisciplinary research endeavors with a focus on closing the identified gaps to widen our understanding of DTI. The results have the potential to initiate much-needed advances in surgical, clinical, and prosthetic practice and inform future pressure ulcer classifications and guidelines.

Key words – pressure ulcer, leg prosthesis, soft tissue injuries, biomechanics, risk factors

Paper type - Research paper

References

- Mak, A. F. T., Zhang, M. & Tam, E. W. C. Biomechanics of Pressure Ulcer in Body Tissues Interacting with External Forces during Locomotion. *Annu Rev Biomed Eng 2010* 12, 29–53 (2010).
- Bader, D. L., Worsley, P. R. & Gefen, A. Bioengineering considerations in the prevention of medical device-related pressure ulcers. *Clin. Biomech.* 67, 70–77 (2019).
- 3. Gefen, A. The biomechanics of sitting-acquired pressure ulcers in patients with spinal cord injury or lesions. *Int. Wound J.* **4**, 222–231 (2007).
- 4. Bogie, K. & Bader, D. Susceptibility of Spinal Cord-Injured Individuals to Pressure Ulcers. in *Pressure Ulcer Research* 73–88 (Springer-Verlag, 2005). doi:10.1007/3-540-28804-X_6.
- National Pressure Ulcer Advisory Panel. NPUAP Pressure Injury Stages. http://www.npuap.org/resources/educational-and-clinical-resources/npuappressure-injury-stages/ (2016).
- Gould, L. J. *et al.* Pressure ulcer summit 2018: An interdisciplinary approach to improve our understanding of the risk of pressure-induced tissue damage. *Wound Repair Regen.* (2019) doi:10.1111/wrr.12730.

Sphingosine Kinase-1 and Cancer

Ryan Brown

The translocation of sphingosine kinase 1 (SK1) to the plasma membrane of cells is required to transform normal cells into cancer cells^{1,2} and this association enables access to its substrate, sphingosine via a gating mechanism involving a lipid binding loop 1 (LBL-1). Plasma membrane association involves an ERK-catalysed phosphorylation of an exposed S225 in the regulatory loop in the enzyme¹. Translocation can also be phosphorylationindependent and regulated by G_{α} in response to stimulation of muscarinic receptors³. Recently, we proposed that SK1 exists in a dimeric guaternary enzyme, with a highly positive charge cluster formed at the interface between protomers, which together with LBL-1 allows docking of SK1 to anionic phospholipids in the plasma membrane in a curvature sensitive manner⁴. Indeed, this has been confirmed experimentally⁵. We also proposed that the Cterminal tail of SK1 might obscure the positive charge cluster to prevent plasma membrane association of the enzyme⁴. Moreover, the C-terminal tail might be displaced by for instance, G_a to allow receptor-mediated regulation of the translocation of SK1. We have therefore investigated the role of the C-terminal tail of SK1 in this process. Carbachol (muscarinic receptor agonist) was shown to induce translocation of wild type (WT) mouse GFP-SK1 to the plasma membrane in an ERK-independent manner in MCF-7L breast cancer cells. Mutant GFP-SK1 (T1-T5), in which 5 amino-acids were sequentially removed from WT GFP-SK1 Cterminal end were over-expressed in MCF-7L cells and these cells were then stimulated with carbachol. The T1 mutant (lacking the last 5 amino-acids at the C-terminal end) failed to translocate to the plasma membrane, while WT and mutant T2-T5 lacking 10, 15, 20 and 25 amino-acids respectively were able to translocate and this was inhibited by the PLD1/2 inhibitor, FIPI and by the G_q inhibitor, YM254890. These findings indicate that both phosphatidic acid and G_q are required for the translocation of WT and T2-T5 mutants in response to carbachol. However, the T1 mutant might be deficient in binding of a protein, other than G_q that enables its translocation in response to carbachol. Therefore, we propose that the last 5 amino-acids at the C-terminus of SK1 might interact with this unidentified protein to unveil the positive charge cluster that can electrostatically bind to phosphatidic acid generated in the plasma membrane by PLD1/2. In contrast, the T2-T5 mutants are likely to contain a C-terminal tail that is sufficiently shortened to expose the positive charge cluster, thereby enabling translocation of SK1 without displacement. Future studies will focus on identification of the protein that interacts with the last 5 amino-acids of SK1 as this might identify a novel interaction site for drugs that can function to block translocation and thereby, act as anti-cancer agents.

Purpose – To identify plasma membrane localisation determinants of sphingosine kinase 1 (SK1)

Methodology/approach – Epifluorescence microscopy of MCF-7L cancer cells transfected with either wild type of mutated SK1

Findings – The T1 mutant (lacking the last 5 amino-acids at the C-terminal end) failed to translocate to the plasma membrane, while WT and mutant T2-T5 lacking 10, 15, 20 and 25 amino-acids respectively were able to translocate and this was inhibited by the PLD1/2 inhibitor, FIPI and by the G_q inhibitor, YM254890. Indicating both PLD1/2 and G_q are important for translocation of SK1, albeit the T1 mutant might be deficient in binding of another protein to enable its translocation which may offer novel anti-cancer agents.

Practical implications (if applicable) – By identifying proteins that bind to the 5 amino-acids lost in the T1 mutant that enables SK1 translocation, we may be able to target this as an anti-cancer agent.

Key words – Cell signaling, cancer, molecular biology, sphingolipids

Paper type – Research paper

References

- 1. Pitson SM, Moretti PA, Zebol JR, Lynn HE, Xia P, Vadas MA, Wattenberg BW. Activation of sphingosine kinase 1 by ERK1/2-mediated phosphorylation. EMBO J. 2003;22:5491-500.
- Pitson SM, Xia P, Leclercq TM, Moretti PA, Zebol JR, Lynn HE, Wattenberg BW, Vadas MA. (2005) Phosphorylation-dependent translocation of sphingosine kinase to the plasma membrane drives its oncogenic signalling. J Exp Med. 2005;201:49-54
- ter Braak M, Danneberg K, Lichte K, Liphardt K, Ktistakis NT, Pitson SM, Hla T, Jakobs KH, Meyer zu Heringdorf D. Galpha(q)-mediated plasma membrane translocation of sphingosine kinase-1 and cross-activation of S1P receptors. Biochim Biophys Acta. 2009;1791:357-70.
- 4. Adams DR, Pyne S, Pyne NJ. Sphingosine Kinases: Emerging Structure-Function Insights. Trends Biochem Sci. 2016;41:395-409.
- 5. Pulkoski-Gross MJ, Jenkins ML, Truman JP, Salama MF, Clarke CJ, Burke JE, Hannun YA, Obeid LM. An intrinsic lipid-binding interface controls sphingosine kinase 1 function. J Lipid Res. 2018;59:462-474.

Explaining Gender Pay Gap in the UK: The Effects of Organisational Determinants

SBS - WEO - Gabriela Gherghina

Purpose: Gender pay gap is a subject that attracts much interest from policy makers, researchers and employers. Calculated as the difference in the average pay between all men and women in a workforce, gender pay gap is directly related to economic inequality (ACAS, 2019). So far, little attention has been paid to what explains the gender pay gap variation at organisational level within a country. This paper seeks to address this gap in the literature and aims to answer the following research question: What determines the gender pay gap variation in the UK? The UK is the appropriate setting to carry out this research because: 1) it is the country with the third highest gender pay gap (23.2%) among high-income countries (ILO 2019) and 2) in 2017 it became one of the first countries in the world to require employers with more than 250 employees to report differences in pay between men and women.

Methodology/approach: To explain the gender pay gap variation between organisations in the UK, this paper focuses on several characteristics. So far, based on best practice and literature on sociology, gender studies, management and organisation studies, there are four crucial dimensions: 1) the organisational approach (gendered composition of senior positions), 2) working time (flexibility on working hours), 3) Human Resources approach (recruitment policies) and 4) payment scheme (salary ranges). To test these effects, this paper conducts analysis at organisational level. The variation of gender pay gap is explained both across organisations and over time (e.g. 2018 compared to 2017, 2019 compared to 2018 etc.). This paper uses a mixed-method approach with two components: 1) Quantitative analysis (clustered time-series regression) that aims to observe trajectories and patterns. For this analysis 600 organisations from public and private sector will be selected based on stratified sampling. Data will be collected from the annual mandatory reports, optional reports of managers and original short surveys conducted yearly with two representatives of each organisation. 2) Qualitative analysis is aiming to provide explanations of the statistical patterns identified (expert interviews with top management respondents from 20 organisations - out of the original 600).

Findings: I intend to present at the conference my analytical framework, no findings are available yet.

Originality/value: A comparative study explaining gender pay gap across organisations is currently missing from the literature. An analysis at organisational level is relevant because the organisation is often the level where decisions about pay are taken and thus the source of the gap. In addition, comparisons between organisations allow the identification of what happens within sectors.

Key words: Gender pay gap, organisations, workplace characteristics, UK

Paper type - Conceptual paper

References:

ILO. 2018. Global Wage Report 2018/19, available at www.ilo.org/wcmsp5/groups/public/---dgreports/--dcomm/---publ/documents/publication/wcms_650553.pdf,last accessed 3 February 2020.

Website ACAS, available at <u>www.acas.org.uk</u>, last accessed 3 February 2020

Microbial Induced Calcite Precipitation as a Viable Ground Improvement Technique

Mary Anderson, Prof Rebecca J Lunn, Dr James Minto, Dr Grainne El Mountassir.

(Department of Civil and Environmental Engineering, James Weir Building, University of Strathclyde, Glasgow, G1 1XJ.)

Traditional ground improvement techniques, such as grouting or compaction, can be invasive, energy demanding and expensive. Microbially induced calcite precipitation (MICP) offers a sustainable alternative by utilizing a natural process, and has therefore been the focus of extensive interest and laboratory research over the past decade. Most of that research has been at laboratory-scale on the factors that affect process efficiency. The use of MICP in the field have been discussed in numerous research papers but remains largely theoretical and examples of field-scale trials are rare.

MICP uses ureolytic bacteria, such as the common soil bacteria *Sporosarcina pasteurii* (*S. pasteurii*), which are given access to an ample supply of urea and calcium chloride. The bacteria hydrolyse the urea into ammonium and carbonate, raising the pH and in the presence of calcium in solution, facilitating the precipitation of calcite crystals (CaCO₃). It is particularly effective when used with fine grained sands as those calcite crystals form a bridge between the individual sand grains, cementing them together and creating a weak bio-sandstone.

This project, through bench-scale column experiments on MICP treated sands, has investigated optimization of the influencing factors of the bacteria concentration, the treatment strategy employed and the number of treatment cycles administered. The influence these parameters have on the ultimate core strength, from unconfined compressive strength (UCS) tests, and the homogeneity of the calcite distribution, have been determined. These results have then been used to design an efficient treatment process to underpin large-scale trials of MICP for ground improvement and erosion protection.

The Techno-economic Assessment of End Life Scenarios in Offshore Wind Turbine

Ali Mohammad Jadali

Abstract: In this study, a techno-economic assessment of end life scenarios of offshore wind turbines based on the Levelised Cost of Electricity (LCOE) realised. The point value as well as Monte Carlo Simulation were–implemented to determine the LCOE for each end life scenarios in offshore wind turbine farm including: Full repowering, partially decommissioning internal cut, partially decommissioning external cut and Full Decommissioning in offshore wind turbine farm. In case the parametric input, the full repowering of the farm with the same capacity found to be the best scenario. To improve the accuracy and reliability of result, the annual payment of CO_2 emissions penalty was added in LCOE; however the full repowering was found to be the best choice which confirms the less negative environmental impact of this scenario. Having the result as quantitative distribution using Monte Carlo simulation provides a quantitative analysis of the risk and uncertainty.

The most likely outcome of LCOE can be evaluated by implementation of point value, however it is challenging to take into account the impact of modification in one of the variables. Using Monte Carlo simulation provides result as a quantitative distribution and helps to provide the quantitative evaluation of the uncertain investment risk. The economic model of risk aversion utilized in this research to calculate certainty equivalent of LCOE for each end life scenarios. The full repowering scenario was found with less amount of risk premium and certainty equivalent comparing other options.

Keywords: Offshore Wind Turbine (OWT); Life Extension; Levelised Cost of Electricity (LCOE), Risk Premium (RP), Certainty Equivalent (C_{eq})

Paper type Research paper

References

- [1] P. Hou, P. Enevoldsen, W. Hu, C. Chen, and Z. Chen, "Offshore wind farm repowering optimization," *Appl. Energy*, 2017.
- [2] E. Topham, D. McMillan, S. Bradley, and E. Hart, "Recycling offshore wind farms at decommissioning stage," *Energy Policy*, 2019.
- [3] J. Schweizer *et al.*, "Investigating the potential and feasibility of an offshore wind farm in the Northern Adriatic Sea," *Appl. Energy*, vol. 177, pp. 449–463, Sep. 2016.
- [4] A. Myhr, C. Bjerkseter, A. Ågotnes, and T. A. Nygaard, "Levelised cost of energy for offshore floating wind turbines in a lifecycle perspective," *Renew. Energy*, vol. 66, pp. 714–728, Jun. 2014.

- [5] M. De Prada Gil, J. L. Domínguez-García, F. Díaz-González, M. Aragüés-Peñalba, and O. Gomis-Bellmunt, "Feasibility analysis of offshore wind power plants with DC collectiongrid," *Renew. Energy*, vol. 78, pp. 467–477, Jun. 2015.
- [6] L. Castro-Santos, A. Filgueira-Vizoso, L. Carral-Couce, and J. Á. F. Formoso,
 "Economic feasibility of floating offshore wind farms," *Energy*, vol. 112, pp. 868–882, Oct. 2016.
- [7] M. Satir, F. Murphy, and K. McDonnell, "Feasibility study of an offshore wind farm in the Aegean Sea, Turkey," *Renewable and Sustainable Energy Reviews*, vol. 81. Elsevier Ltd, pp. 2552–2562, 01-Jan-2018.
- [8] P. J. Spinney and G. C. Watkins, "Monte Carlo simulation techniques and electric utility resource decisions," *Energy Policy*, vol. 24, no. 2 SPEC. ISS., pp. 155–163, 1996.
- [9] P. E. Morthorst and L. Kitzing, "Economics of building and operating offshore wind farms," in Offshore Wind Farms: Technologies, Design and Operation, Elsevier Inc., 2016, pp. 9–27.
- [10] A. Ioannou, A. Angus, and F. Brennan, "A lifecycle techno-economic model of offshore wind energy for different entry and exit instances," *Appl. Energy*, vol. 221, pp. 406–424, Jul. 2018.
- [11] C. Mattar and M. C. Guzmán-Ibarra, "A techno-economic assessment of offshore wind energy in Chile," *Energy*, vol. 133, pp. 191–205, 2017.
- [12] "Offshore Wind Energy Cost Modeling: Installation and Decommissioning Mark J Kaiser, Brian Snyder - Google Books." [Online]. Available: https://books.google.co.uk/books?hl=en&lr=&id=3n5ylusAE0EC&oi=fnd&pg=PR6&dq =Offshore+wind+energy+cost+modeling++installation+and+decommissioning&ots=rk _WizToN_&sig=1x9fRAajW65bgmV8vMTAFIS9Zgo&redir_esc=y#v=onepage&q=Offs hore wind energy cost modeling installation and decommissioning&f=false. [Accessed: 18-Oct-2019].
- [13] M. J. Kaiser and B. F. Snyder, "Modeling offshore wind installation costs on the U.S. Outer Continental Shelf," *Renew. Energy*, vol. 50, pp. 676–691, Feb. 2013.
- [14] P. Hou, P. Enevoldsen, W. Hu, C. Chen, and Z. Chen, "Offshore wind farm repowering optimization," *Appl. Energy*, vol. 208, pp. 834–844, Dec. 2017.
- [15] E. Topham and D. McMillan, "Sustainable decommissioning of an offshore wind farm," *Renew. Energy*, vol. 102, pp. 470–480, Mar. 2017.
- [16] A. Ioannou, A. Angus, and F. Brennan, "Stochastic financial appraisal of offshore wind farms," *Renew. Energy*, vol. 145, pp. 1176–1191, Jan. 2020.
- [17] P. Vithayasrichareon, I. MacGill, and F. Wen, "Electricity generation portfolio evaluation for highly uncertain and carbon constrained future electricity industries," in *IEEE PES General Meeting, PES 2010*, 2010.
- [18] N. Heck, C. Smith, and E. Hittinger, "A Monte Carlo approach to integrating uncertainty into the levelized cost of electricity," *Electr. J.*, vol. 29, no. 3, pp. 21–30, Apr. 2016.

Investigation of Transient Plasma Photonic Crystals

George Holt

Purpose – High-power, ultrashort pulse lasers have been driving technological innovation and research in many scientific fields for nearly four decades. However, the ever-increasing demand for higher power results in extremely costly and bulky optics. A new family of optical elements based on plasma – transient plasma photonic crystals (TPPCs) [1] – has been proposed, which may provide compact, cost-effective structures able to control and manipulate the extremely intense laser fields of the near future [2].

Methodology/approach – An experimental campaign on the Astra-Gemini laser at the Central Laser Facility has been performed, supported by large-scale particle-in- cell simulations on the national supercomputer, ARCHER.

Findings – Experimental data is currently being analysed, but preliminary results suggest the creation of a controllable, novel plasma structure with useful optical properties.

Research limitations/implications (if applicable) – Development of a novel method of manipulating ultrashort laser pulses that is compact, affordable and damage-resistant would constitute a major enabling technological advancement with far-reaching benefits in research across a broad range of fields, as well as industry and medicine.

Originality/value – No group has demonstrated the ability to manipulate ultrashort laser pulses using a TPPC since the theoretical inception of the idea.

Key words laser plasma ultrashort high power

Paper type - Research paper

References

[1] Lehmann, G. & Spatschek, K. H. Plasma-based polarizer and waveplate at large laser intensity. Phys. Rev. E 97, 063201 (2018).

[2] Sheng, Z., Zhang, J. & Umstadter, D. Plasma density gratings induced by intersecting laser pulses in underdense plasmas. Appl. Phys. B

Sensitivity of Travelling Wave Solutions to Richards' Equation to Soil Material Property Functions

Yaw A. Boakye-Ansah & Paul Grassia

Department of Chemical and Process Engineering, University of Strathclyde, United Kingdom

E-mail: yaw.boakye-ansah@strath.ac.uk

Richards equation [1] models transport of water in unsaturated soils, but requires as input soil material property functions specifically relative hydraulic conductivity and relative diffusivity which are typically obtained from the soil-water retention curve (SWRC) function (expressed in terms of capillary suction head). These properties are given via particular functional forms, with different soil types from sandstone to loam being represented within those functional forms by a free fitting parameter m, typically in the domain m < 1. Travelling wave solutions (profile of height ξ against moisture content Θ) to Richards equation using van Genuchten's [2] form of these soil material property functions diverge to arbitrarily large heights close to full saturation. In this limit ($\Theta \approx 1$), ξ goes to large values (i.e. $\xi >>1$ (large heights)) for both the Richards equation and the foam drainage equation solutions which imply a gradual approach of O towards the saturated state. The { values in Richards equation tend, however, to be larger than those in the foam drainage equation [3, 4], implying an even more gradual approach towards saturation for Richards equation. This results from the relative diffusivity function itself diverging at full saturation the effect of a weak singularity in the SWRC in that limit. However, if the soil material property data are sparse near full saturation, evidence for that divergence may be limited. In this work, the relative diffusivity is rescaled to approach unity at full saturation. This is achieved by removing a singularity from the original van Genuchten SWRC function by constructing a convex hull around it. Hence, a piece-wise SWRC function that predicts capillary suction head approaches zero smoothly at full saturation is derived. Using this SWRC function with the so called Brooks-Corey relative hydraulic conductivity, a new relative diffusivity function which does not diverge at full saturation is derived, and we proceed to obtain travelling wave solutions of Richards equation. We obtain logarithmic relationships between profile of height # and moisture content close to saturation. Predicted profiles are not only smaller than the heights obtained for the original solution of Richards equation which exhibit power law behaviour, but also smaller than the logarithmic foam drainage solutions.

Keywords – Moisture content, drainage, hydraulic conductivity, convex hull, relative diffusivity.

References

[1] L. A. Richards. Capillary conduction of liquids through porous mediums. Physics, 1(5):318– 333, 1931.

[2] M. Th Van Genuchten. A closed-form equation for predicting the hydraulic conductivity of unsaturated soils. Soil Science Society of America Journal, 44(5):892–898, 1980.

[3] G. Verbist, D. Weaire, and A. M. Kraynik. The foam drainage equation. Journal of Physics: Condensed Matter, 8(21):3715–3736, 1996.

[4] S. A. Koehler, S. Hilgenfeldt, and H. A. Stone. Liquid flow through aqueous foams: the node dominated foam drainage equation. Physical review letters, 82(21):4232–4235, 1999.

Paper type – Research paper

Electrical Machines: is Technology Growth Leading to an Unsustainable Future?

Leigh Paterson

Today it is widely accepted that our choices as a society, moreover as a species, are impacting our environment and climate. Policy makers globally are looking to implement guidelines around modern topics such as "sustainability," "carbon neutral" and "renewable energy." As we look to electrify the globe and achieve ambitious targets associated with these themes, has the sudden drive to push technology resulted in unsustainable choices?

In order to achieve climate policy targets, an increase in the uptake of electric transport and renewable energy generators, such as wind turbines, is expected. For these key electrification products, the manufacturing routes are under intense scrutiny, principally for the rare earth permanent magnets which are a crucial component of these electrical machines.

In addition to climate concerns, rare earth elements used in these machines have faced supply chain issues – a decade ago the cost of neodymium increased by approximately 350% over a period of only two years, resulting in global fears of a material shortage and production lull. This economic concern has led to new production avenues being explored, ranging from recovering material from "end-of-life" machines to the exploration of new mining sites for virgin material extraction.

The purpose of this research topic is to create a "circular economy" framework for the manufacture of rare earth permanent magnets. Circular economy is a relatively modern approach which aims to eliminate waste from all aspects of production. In order to fulfil this purpose, existing manufacturing methods for permanent magnets are explored and assessed for their environmental impact, for both virgin material and reclaimed/recycled material routes. This will, in time, include factors such as carbon emissions, energy consumption and physical waste produced. Alternative methods of manufacture will then be sought to create a supply chain which falls within, or as close as possible to, the circular economy ethos whilst also producing permanent magnets to a quality equal to or better than current production.

In the current literature, there are different methods discussed for manufacturing permanent magnets from reclaimed materials, although many of these result in multiple waste streams. In order to make the whole process truly sustainable an innovative approach is required. For that reason, this research aims to provide a novel, original manufacturing process for these materials, considering every step of the route and reducing or eliminating all waste streams.

Purpose – to find a route of manufacture of permanent magnets used in PMEMs which fits within the circular economy theory where possible.

Methodology/approach – assess the existing manufacturing methods for rare earth permanent magnets, including reclaim/recycling methods and determine the current detriment of these processes. Research alternative methods of manufacture using virgin and reclaimed material to create a circular economy framework for the manufacture of permanent magnets.

Originality/value – Although there are currently many attempts at making permanent magnets through a recycling route, this still often encounters losses not fit for a circular economy profile.

Key words – rare earth magnets, permanent magnet electric machines, renewables, circular economy, sustainability.

Paper type – Conceptual paper

Neuromorphic Systems Based on Photonics

Matěj Hejda – Institute of Photonics, Department of Physics, Faculty of Science
 Joshua Robertson – Institute of Photonics, Department of Physics, Faculty of Science
 Julián Bueno – Institute of Photonics, Department of Physics, Faculty of Science
 Antonio Hurtado – Institute of Photonics, Department of Physics, Faculty of Science

Purpose – We focus on the investigation and development of functional components for novel hardware platforms tailored for efficient operation of artificial intelligence algorithms. The functionality of the developed devices is inspired by biological neurons and based on photonic technologies, utilizing light instead of electrons to transfer information. This allows the system to bypass some of the inherent bottlenecks of electronic systems, as well as to add new functionality [1].

Methodology/approach – In our research group, there are currently two main technologies of interest for use as photonic neuromorphic nodes: commercially available *vertical cavity surface emitting lasers* (VCSELs) subject to optical injection and optoelectronic resonant-tunnelling diode (RTD) circuits. We aim to demonstrate properties observed in biological neurons such as excitability [2] (all-or-nothing responses to stimuli) as well as information processing using both single and interconnected devices in feedforward and recurrent network topologies [3].

Findings – Our latest findings experimentally demonstrate neuromimetic dynamical behaviour in a VCSEL, which enables biologically inspired information representation of input stimuli as optical spike trains. All-optical binary-to-spike information encoding with the laser was achieved at ultrafast data rates surpassing 1 Gbps (>7 orders of magnitude faster than in biological neurons), as well as amplitude-to-spiking rate coding for continuous input signals. A manuscript reporting on these results is currently in preparation.

Research limitations/implications – With semiconductor industry slowly approaching physical limits of miniaturization and simultaneously increasing relevance of AI-powered algorithms for all domains of human endeavour, a new class of fast, highly efficient hardware architectures tailored for these algorithm could easily become widely utilized in most data-processing electronic devices. Since this is a young, nascent field of research, we are mainly focusing on proofs-of-concept and developing single and small network models, with the goal of further progressing into complex networks with higher number of elements.

Originality/value – We are currently among few research teams actively focusing on the technology and publishing results on experimental neuromorphic photonic systems in academic journals. Recently, a spin-off company from Princeton University planning to deliver a neuromorphic photonic chip raised 9m USD funding in the first seed round from prominent investors [4]. This further confirms the high interest in this emerging technology from the commercial sector.

Key words: semiconductor lasers, neuromorphic photonics, VCSEL, laser dynamics, artificial intelligence

Paper type – Research paper

References

[1] Ferreira de Lima, T., Shastri, B. J., Tait, A. N., Nahmias, M. A. & Prucnal, P. R. Progress in neuromorphic photonics. *Nanophotonics* **6**, 577–599 (2017).

[2] Robertson, J., Wade, E. & Hurtado, A. Electrically Controlled Neuron-Like Spiking Regimes in Vertical-Cavity Surface-Emitting Lasers at Ultrafast Rates. *IEEE J. Sel. Top. Quantum Electron.* **25**, 1–7 (2019).

[3] Robertson, J., Wade, E., Kopp, Y., Bueno, J. & Hurtado, A. Toward Neuromorphic Photonic Networks of Ultrafast Spiking Laser Neurons. IEEE J. Sel. Top. Quantum Electron. 26, 1–15 (2020).

[4] https://www.technologyreview.com/s/613668/ai-chips-uses-opticalsemiconductor-machine-learning/ [cited 21/1/2020]

Use of a Novel Microfluidic Technology to Accelerate Lipid Nanomedicine Development: From the Lab Bench to GMP

Cameron Webb

Purpose – Currently there are approximately 20 lipid nanomedicines approved for clinical use, yet their manufacture via traditional methods is challenging and this hinders their potential. To address this, we have investigated the application of microfluidics for nanomedicines production. Microfluidics is a flexible process that offers scale-independent manufacturing processes for lipid-based nanomedicines (known as liposomes). To achieve this, our objectives were to compare different microfluidic technologies and to test liposome manufacturing methods with entrapped protein. This thereby outlines a new production method for liposomes that offers ease of scalability from the lab bench to large industrial volumes without any compromise to the formulation.

Methodology/approach – The lipids 1,2-distearoyl-sn-glycero-3-phosphocholine and cholesterol were dissolved in methanol or ethanol at 2:1 w/w (initial lipid concentration 4 or 16 mg/mL mg/mL). Liposomes were produced with different microfluidic architectures using either a staggered herringbone mixer or a toroidal mixer. The flow rate ratio used was 3:1 aqueous:solvent phase at flow rates ranging between 12 - 200 mL/min. The protein ovalbumin, dissolved in a phosphate buffered saline, was added to the aqueous inlet ($250 - 1000 \mu$ g/mL). After production, liposomes were purified using tangential flow filtration (Krosflow Research lii system with a 750 KDa mPES column). Liposome size, charge and uniformity was measured using a Malvern Zetasizer Nano ZS. Protein encapsulation and protein release kinetics was quantified using reversed-phase high performance chromatography (RP-HPLC, Shimadzu 2010-HT, Milton Keynes, UK) connected with a UV detector at 210 nm using a Jupitar 5 μ m C5 300A 4.6 mm i.d x 250 mm length or micro-BCA assay. For GMP production a modified HPLC pump and NxGen cartridge 500 with toroidal mixer architecture was used at a flow rate of 200 mL/min.

Findings – Our results show that liposomes produced by both microfluidic mixers gave high protein loading (30-40%) with small sizes (50-60 nm) and homogenous (<0.2 PDI) liposome formulations with comparable protein release rates. Using the new toroidal mixer technology, we are able to produce these liposome formulations at up to 200 mL/min giving the facility for high-throughput scale-independent production. From these findings, we have successfully shown that we can manufacture lipid nanomedicines from lab-bench through to GMP-scale using the same process parameters without impacting on the formulation attributes. This provides a rapid and low-cost manufacturing process for nanomedicines thereby supporting the rapid translation of nanomedicines from bench to bedside.

Key words: Manufacturing, Nanomedicines, Liposomes, Microfluidics, Drug Delivery

Paper type - Research paper

Protein Glycation Detected by Changes in its Intrinsic Fluorescence

Rhona Muir

Purpose –

Diabetes is a chronic, progressive disease characterized by elevated blood glucose levels[1]. Previous studies have used skin auto-fluorescence as a means of studying glycation induced changes both in diabetic patients, and healthy controls [2][3]. This work however focusses on steady state fluorescence measurements, which are limited in that they are not able to fully explain the excited state kinetics. Understanding these kinetics will allow the mechanics of glycation to be more fully understood, and so help in the search for anti-glycation factors that could prevent AGE formation. This could then prevent the diabetic complications that can ultimately lead to premature death in diabetic patients.

Methodology/approach -

Time-resolved emission spectra were used to track how glycation affects the intrinsic fluorescence of collagen and NADH. In collagen two fluorophores were studied; tyrosine (excitation at 279nm) and collagen crosslinks (excitation 339nm). In NADH there is only one excitation band at 339nm. The fluorescence decays obtained were then modeled using various methods to see clearly the spectral changes that were occurring.

Findings -

When considering the behavior of tyrosine in collagen, the results suggest that glycation doesn't have a huge effect on its fluorescence. This could be due to the fact that the percentage of tyrosine residues in collagen is very small when compared to the other amino acids present [4], and so glycation is not influencing its fluorescence hugely.

When considering collagens intrinsic crosslinks, the difference between the glycated and unglycated samples is much more obvious, suggesting that 339nm is the excitation wavelength to study further when assessing skin fluorescence for detecting complications of diabetes.

The main conclusion regarding NADH, is that the widely accepted 2-exponential model is perhaps not the best representation of its fluorescence decay. Non-Debye functions can potentially give a more accurate depiction of the processes occurring during the fluorescence decay of NADH.

Originality/value -

Although previous work [2][3] has been done using skin auto-fluorescence as means of detecting complications of diabetes, this all relies on steady state fluorescence spectroscopy. These type of measurements are not able to give as much insight into the molecular processes as time-resolved measurements can for a number of reasons. For example, overlapping spectra of individual species in the sample [5] are missed in steady state spectra, and time-dependant processes are averaged in steady state spectra [6], and so could be overlooked.

Here we report the changes in collagen and NADH auto-fluorescence due to glycation using time-resolved emission spectroscopy (TRES). TRES are fluorescence emission spectra obtained at discrete times throughout the fluorescence decay [7]. This technique is able to overcome the above mentioned limitations of steady state spectra.

Key words

Glycation, time-resolved fluorescence sensing, diabetes

Paper type

Research paper

References

[1] Nathan D M and Edic D 2014 The Diabetes Control and Complications Trial / Epidemiology of Diabetes Interventions and Complications Study at 30 Years : Overview *Diabetes Care* **37** 9–16

[2] Meerwaldt R, Graaff R, Oomen P H N, Links T P, Jager J J, Alderson N L, Thorpe S R, Baynes J W, Gans R O B and Smit A J 2004 Simple non-invasive assessment of advanced glycation endproduct accumulation *Diabetologia* 47 1324–30

[3] Meerwaldt R, Hartog J W L, Graaff R, Huisman R J, Links T P, Hollander N C Den, Thorpe S R, Baynes J W, Navis G, Gans R O B and Smit A J 2005 Skin Autofluorescence, a Measure of Cumulative Metabolic Stress and Advanced Glycation End Products, Predicts Mortality in Hemodialysis Patients *J. Am. Soc. Nephrol.* **16** 3687–93

[4] Bolboac S D and Jäntschi L 2007 AMINO ACIDS SEQUENCE ANALYSIS ON COLLAGEN Bull. USAMV-CN

[5] Loefroth J E 1986 Time-resolved emission spectra, decay-associated spectra, and species-associated spectra *J. Phys. Chem.* **90** 1160–8

[6] Lakowicz J R 2006 Principles of Fluorescence Spectroscopy (Springer)

[7] Easter J H, DeToma R P and Brand L 1976 Nanosecond time-resolved emission spectroscopy of a fluorescence probe adsorbed to L-alpha-egg lecithin vesicles *Biophys. J.* **16** 571–83

Real-time Simulations of a Future Low-Carbon University Campus Microgrid

Jonathan Fallman

Purpose – Targets for deploying low carbon and climate-resilient energy systems are becoming more ambitious and with Glasgow City making clear its intention to become carbon neutral by 2030 [1], the opportunity for the University of Strathclyde (UoS) to make a direct, local impact is increasing. This presentation will discuss preliminary results from real-time simulations of the UoS John Anderson campus power network functioning as it does today, and as a future microgrid capable of self-sustaining during a loss-of-mains.

Methodology/approach – Microgrids are systems of distributed energy resources (DERs) and loads connected to a controllable network capable of islanding. [2] These have been identified as an important solution to cost and security of supply in future power networks with high penetration of renewables and low-carbon loads. Microgrids can reduce emissions by utilising renewable or efficient CHP generation located near to end-users; enable active "prosumer" behaviour, accelerating the sustainable transition; and facilitate sectoral integration via multi-energy vector planning. [3]

A Real-Time Digital Simulator (RTDS) has been used to test the stability response and overall resilience of the system to a loss-of-mains (LoM). Three models of the campus microgrid have been investigated using this approach: (i) a Present-Day campus model, containing 3.4 megawatt CHP generator, back-up diesel gensets and 504 megajoule battery energy storage (UPS and V2G); (ii) Future Scenario A, which contains PV generation and **x2** energy storage, based on existing investment plans; and (iii) Future Scenario B, which takes a high-ambition investment approach and includes **x10** energy storage capacity, compared to the Present-Day.

Findings – A simplified electrical model has been developed based on the campus 11 kV distribution system, with loads divided across 7 nodes and fed from a 33/11 kV Scottish Power substation. Campus metering data was processed to produce 7-dimensional vectors of increasing magnitude, each representing the demand for 10% (876 hours) of the year.

This presentation will propose a loss-of-load probability metric, termed LoM Survival Utility, expressing the resilience contribution of alternative generation/storage deployments, drawing on ENTSO-E fault statistics [4] in order to compute it. Results will be presented showing that the Present-Day campus is incapable of self-sustaining after a LoM outside of Office Hours, whereas models representing future campus scenarios A and B are able to remain functional immediately after a LoM for more than 90% of the year and 100% of the year, respectively. Further analysis using the LoM

Survival Utility, shows that the probability of outliving a loss-of-mains during Office Hours is $2.4(\pm 0.2)\%$ for the Present-Day campus, rising to $56(\pm 6)\%$ for Future Scenario A, and is $85(\pm 5)\%$ for Future Scenario B.

These improvements are found to be attributable to the addition of substantial battery energy storage, which facilitates flexibility and balancing across a range of timescales.

Research limitations/implications – The study has proven that improvements in LoM Survival Utility can be obtained from the addition of substantial battery energy storage, which facilitates flexibility and balancing across a range of timescales.

Practical implications – The investment strategy of the University is expected to benefit from the development of evidence which can be used within a engineering cost-benefit appraisal approach.

Originality/value – Overall, this study supports the paradigm that microgrids and Smart Local Energy Systems (SLES) will be crucial for enabling greater resilience in the power system, as well as producing engaged energy users and lowering the grid carbon intensity.

Key words Microgrids, Resilience, Net-Zero, Energy Storage

Paper type – Research paper

References

- [1] Glasgow City Council, "Council Sets Target Of Carbon Neutral Glasgow by 2030," Sep-2019.
- [2] R. H. Lasseter, "MicroGrids," in *IEEE Power Engineering Society Winter Meeting*, 2003, pp. 305–308.
- [3] CIGRE WG C6.22, "Microgrids 1: engineering, economics, & experience Capabilities, Benefits, Business Opportunities, And Examples Microgrids Evolution Roadmap," *Electra*, no. 283, pp. 71–75, 2015.
- [4] ENTSO-E, "Grid Disturbance and Fault Statistics," 2009.

A Comprehensive Investigation on the Electrical Resistivity Variance of Thin Ply Hybrid Composites and its Correlation to Internal Micro Fibre Damage & Fragmentation – A Headway in Developing Next Generation SHM Sensor

Sheik Abdul Malik

Engineering primary structures require a substantial initial capital investment and must be frequently inspected with timely interventions scheduled to detect damage before they achieve a critical size and enact a repair to maximise the service life. In most cases, the inspection process is performed manually and involves on-site skilled human operators closely inspecting the entirety of a structure. This is very time consuming and an expensive process which can put the operators in high-risk situations. Previously, work has been done to present a hybrid composite sensor for indicating overload of a structure by exhibiting a change in their appearance when loaded in tension over a predefined strain value [1]. This research advances on developing the sensor further in order to achieve active structural monitoring and damage detection. Work has been carried out to supplement the features of the sensor and exploit its electrical behaviour. Through experimental testings it is demonstrated that the sensor generates a remotely detectable electrical changes as well as the visual indication to certain damage/loading scenarios. The project lays foundation on expanding the understanding of the sensory material response and envisages a working prototype of the sensor which will be capable of cautionary indications when subjected to overload or suffered from hidden internal damage.

The hybrid composite sensor is comprised of unidirectional carbon/epoxy layers with a low failure strain sandwiched between glass/epoxy layers with higher failure strain [2]. This is co-cured with a thin copper sheet embedded on top of the carbon layer on each ends. This technique is newly developed in order to minimize contact resistance and establish a reliable electrical connection within the specimen. Originally the sensor displays a black dark colour, as the intact carbon layers absorb most of the incident light passing through the translucent glass layers. The hybrid sensor when attached to a substrate or subjected to loading on a component, after exceeding the failure strain of the 'sensing' carbon layer, develops an internal crack due to the

fragmenting of the carbon fibres. This crack formed will result in the incident light being reflected from the locally damaged glass/carbon interface. Hence the sensor produces a change of appearance due to light stripes formed around cracks in the carbon layer. This mechanism for change of appearance in the overload sensors is subjugated to draw a direct correlation to electrical conductivity of the material and its dynamic response to different loading conditions are methodically examined.

Purpose - Advancement of the patented SHM Visual Overload Sensor

Methodology/approach – Experimental Mechanical Testing of newly manufactured specimen

Findings – Novel Electrical response behaviour that has not been seen in Composite materials previously

Research limitations/implications – Further experimental testings required to fully understand material behaviour

Practical implications - A step forward in prototyping the SHM sensor

Key words - Electrical Conductivity, Fragmentation, Hybrid Composite, Mechanical Testing, Structural Health Monitoring

Paper type - Research paper

References

[1] T Rev, M Jalalvand, J Fuller, M Wisnom, G Czél, A simple and robust approach for visual overload indication - UD thin-ply hybrid composite sensors, Compos Part A, V121:376-385

[2] Czél G, Jalalvand M, Wisnom MR. Design and characterisation of advanced pseudo-ductile unidirectional thin-ply carbon/epoxy–glass/epoxy hybrid composites. Compos Struct 2016; 143:362–70

Evaluation of Random Forest and Ensemble Methods at Predicting Complications Following Cardiac Surgery

Linda Lapp

Purpose – To develop a robust and reliable predictive model for severe postoperative complications in cardiac surgery. Complications after surgery are common and can have an important impact on patients' quality of life [1], increase hospital length of stay [2] and healthcare costs [3]. Such predictive model would be extremely useful for managing patient flows and clinical resources in surgical care.

Methodology/approach – Patients undergoing cardiac surgery at the Golden Jubilee National Hospital were analysed (n=3700 clinical records). Patient characteristics, preoperative variables about patients' cardiac status, comorbidities and surgical variables were analysed. Complications reported in the database were categorised into four categories (no/mild/moderate/severe) based on their impact on hospital length of stay, patients' quality of life and cost of care.

We evaluated five machine learning methods (random forest (RF), AdaBoost (AB), gradient boosting model (GBM) and two stacked models) to solve a binary classification task: i.e. whether a patient is likely to have a severe postoperative complication ('yes' or 'no or other').

The performance of the models was evaluated based on the area under the receiver operating characteristic (ROC) curve (AUC), sensitivity, specificity, and positive (PPV) and negative predictive value (NPV). Our aim was to have the highest possible sensitivity and negative predictive value.

Findings – In this study, 48.65% of the patients had a recorded postoperative complication. Of these: 7.05% had mild complications, 36.65% moderate complications, and 4.95% severe complications after cardiac surgery.

Of all patients, 59.65% had a CABG, 26.49% had a valve surgery, and 13.86% had a combined CABG and valve surgery. The mean age was 66.7, with a median of 68 years. Most of the patients were men (73.22%).

RF and GBM had the highest sensitivity (0.852 and 0.875, respectively) when predicting severe complications. These two models also had the highest negative predictive values (0.923 and 0.920, respectively). This means that these models can recognise patients with severe complications over 85% of the time. Also, if the test is negative, the probability that the patient actually does not have a severe complication is over 92% for both RF and GBM.

Research limitations/implications – Currently there is no single nomenclature of surgical complications. Hence, when comparing our results with the literature, studies have a different definition for "morbidity", which includes a different set of combined complications. The reporting of different complication outcomes in the scientific literature therefore prevents the objective comparison of the performance of these predictive risk models.

Practical implications – Either of the presented models could help a clinician to identify patients who are at risk of having severe postoperative complications in order to allocate resources or avoid high-risk treatments.

Originality/value – Although there are numerous preoperative risk models predicting mortality, such as EuroSCORE [4] and EuroSCORE II [5], there are currently no validated surgical preoperative risk scoring systems available which can predict generic surgical complications and their severity [6, 7].

Key words Predictive modelling, cardiac surgery, complications, machine learning

Paper type – Research paper

References

- 1. Pinto, A., Faiz, O., Davis, R., Almoudaris, A., Vincent, C.: Surgical complications and their impact on patients' psychosocial well-being: A systematic review and meta-analysis. BMJ Open. 6, (2016).
- 2. Knapik, P., Ciesla, D., Borowik, D., Czempik, P., Knapik, T.: Prolonged ventilation post cardiac surgery tips and pitfalls of the prediction game. J. Cardiothorac. Surg. 6, 158 (2011).
- Eappen, S., Lane, B.H., Rosenberg, B., Lipsitz, S.A., Sadoff, D., Matheson, D., Berry, W.R., Lester, M., Gawande, A.A., Barry Rosenberg, M., Stuart Lipsitz, M.A., David Sadoff, S., Dave Matheson, B., William Berry, M.R., Mark Lester, M., Atul Gawande, M.A.: Relationship Between Occurrence of Surgical Complications and Hospital Finances. JAMA. 309, 1599–1606 (2013).
- 4. Roques, F., Michel, P., Goldstone, A.R., Nashef, S.A.M.: The logistic EuroSCORE. Eur. Heart J. 24, 1–2 (2003).
- 5. Nashef, S.A., Roques, F., Sharples, L.D., Nilsson, J., Smith, C., Goldstone, A.R., Lockowandt, U.: EuroSCORE II. Eur. J. Cardio-Thoracic Surg. 41, 734–744 (2012).
- 6. Moonesinghe, S.R., Mythen, M.G., Das, P., Rowan, K.M., Grocott, M.P.: Risk stratification tools for predicting morbidity and mortality in adult patients undergoing major surgery: qualitative systematic review. Anesthesiology. 119, 959–981 (2013).
- 7. Barnett, S., Moonesinghe, S.R.: Clinical risk scores to guide perioperative management. Postgrad. Med. J. 87, 535–541 (2011).
A Risk Predictive Tool for Clostridioides Difficile

Ansu Joseph

Purpose – *Clostridioides difficile* is a spore forming anaerobic bacteria that can reside asymptomatic in the gastrointestinal tract. The bacteria transforms into its activated form following the consumption of antibiotics especially 4C antibiotics (clindamycin, co-amoxiclav, ciprofloxacin and fluoroquinolones), colonializes the gut and start to produce toxins that cause diarrhoea, abdominal pain, and colitis. Currently in Scotland following the introduction of the antibiotic stewardship, the incidence of CDI has been reduced, nevertheless, there are around 1500 incidences of CDI annually. In order to support clinicians during antibiotic prescribing a mathematical algorithm has been created using Scottish patient data from 2010 to 2013 that will predict the risk of the patient to develop CDI in the following 12 months. This paper revolves around the process undertaken for the development of a risk prediction tool using the mathematical algorithm created.

Methodology/approach – In order to develop a risk predictive tool, clinicians from primary and secondary care have been interviewed to understand their perception on CDI, their relationship with technology during consultations and their requirements for a possible risk predictive tool for CDI. All the interviews were guided through the Consolidated Framework for Implementation Research, the Guideline Implementation with Decision Support and the Technology Acceptance Model. These implementation frameworks were used for the compilation of the semi structured interview questions and for the analysis of the emerged themes. This was followed by the development of a test version which is currently being tested to obtain feedback on its usefulness, ease of use and layout.

Findings – Clinicians in primary care have demonstrated great interest in the tool being integrated into their prescribing systems, which would require the tool to automatically extract the patient data. The benefit of having the tool integrated is that it would save clinicians the time to search for the patient data and to input it manually into the tool. However, this is not possible in secondary care as there isn't an accurate Electronic Health Record to be used to integrate the tool. Therefore we have created a low fidelity prototype design for primary care to be integrated into their system while for secondary care we have developed a test version in a website format that can be accessed through their phones or computers. The tool informs clinicians of the current risk of the patient to contract CDI compared to the general population of the same age and gender and the risk score if 4C antibiotics or Non-4C antibiotics (all other antibiotics) are prescribed.

Originality/value – The paper describes the processes involved to develop a risk predictive tool for CDI for Scottish health care that aims to support clinicians during antibiotic prescribing.

Key words – Digital tool, *Clostridium difficile*, Antibiotics, Implementation Science, Scotland.

Paper type –Research paper.

A Systematic Approach to Silk Nanoparticle Manufacture in Semi-Batch Format

HASS-SIPBS - Saphia Matthew

Purpose -

Silk nanoparticles provide a promising therapeutic delivery system.^{1–7} Aqueous silk desolvation in an organic anti-solvent is a well-reported bottom-up approach for silk nanoparticle manufacture.^{2,6} However, there is a lack of information related to scaling-up this technology. Here, we analyze how parameters, including scale and standing time in mother liquors, affect silk nanoparticle production in a semi-batch format.

Methodology/approach -

Nanoparticles were manufactured by desolvation in semi-batch format using a constant anti-solvent:silk ratio, informed by previous studies.³ By controlling the rate and height of silk addition to the anti-solvent, our syringe pump-based design improved standardization of desolvation over a 20-fold scale-up and a variety of particle standing times in the mother liquor. The effect of scale and standing time on nanoparticle size distribution and zeta potential was quantitative by dynamic light scattering (DLS). Silk secondary structure was analysed by Fourier-transform infrared spectroscopy (FTIR).

Findings -

The total scale was an important parameter affecting nanoparticle size (1.8 mL > 29.1 mL > 42 mL total volume). Since anti-solvent diffusion enables silk nucleation and β -sheet formation,^{3,8,9} the higher turbulence generated in greater volumes may enhance solvent diffusion and faster silk self-assembly: resulting in smaller nanoparticles. Varying the nanoparticle standing time in the mother liquor between 0 and 24 hours did not significantly affect physicochemical properties, indicating slow particle growth kinetics.

Research limitations/implications -

The study has potential limitations which could be addressed in future work. Due to time and cost restraints, desolvation was conducted using a small sample size of precursor silk solutions (n = 3). This may have resulted in nanoparticle properties being subject to bias: impacting our observations. Further, nanoparticle manufacture was undertaken with laboratory-scale equipment. Consequently, the relationship

between desolvation scale and nanoparticle size may overestimate the influence of total volume using pilot-plant technology. Further optimization on large scales warrants application of the appropriate industrial methodology.

Practical implications -

Scale-ability and reproducibility of silk nanoparticle manufacture in semi-batch format at the laboratory-scale requires consideration of total volume, reactor geometries and anti-solvent properties.

Originality/value -

Understanding the parameters influencing nanoparticle formation in semi-batch format is paramount for pharmaceutical applications. Historically, reproducibility of nanomedicines from laboratory to pilot-scale has hindered route to market.⁹ The volume of laboratory-scale nanoparticle desolvation, and the standing time prior to purification, are parameters which are often overlooked. There is a lack of literature offering a simple analysis of nanoparticle formation upon scale-up, and the growth kinetics of silk nanoparticles.⁶ This work will aid in moving semi-batch desolvation from laboratory to pilot-scale.

Key words

Silk fibroin, silk nanoparticles, semi-batch manufacture, laboratory-scale manufacture

Paper type – Research paper

References

- (1) Wongpinyochit, T.; Uhlmann, P.; Urquhart, A. J.; Seib, F. P. PEGylated Silk Nanoparticles for Anticancer Drug Delivery. **2015**, *16*, 3712–3722. https://doi.org/10.1021/acs.biomac.5b01003.
- (2) Wongpinyochit, T.; Johnston, B. F.; Philipp Seib, F. Manufacture and Drug Delivery Applications of Silk Nanoparticles. *J. Vis. Exp.* **2016**, *2016* (116), e54669. https://doi.org/10.3791/54669.
- (3) Wongpinyochit, T.; Totten, J. D.; Johnston, B. F.; Seib, F. P. Microfluidic-Assisted Silk Nanoparticle Tuning. *Nanoscale Adv.* **2019**, *1* (2), 873–883. https://doi.org/10.1039/c8na00208h.
- Totten, J. D.; Wongpinyochit, T.; Seib, F. P. Silk Nanoparticles: Proof of Lysosomotropic Anticancer Drug Delivery at Single-Cell Resolution. *J. Drug Target.* 2017, 25 (9–10), 865–872. https://doi.org/10.1080/1061186X.2017.1363212.
- (5) Wongpinyochit, T.; Johnston, B. F.; Seib, F. P. Degradation Behavior of Silk Nanoparticles Enzyme Responsiveness. 2018, 4, 942–951. https://doi.org/10.1021/acsbiomaterials.7b01021.
- (6) Seib, F. P.; Jones, G. T.; Rnjak-Kovacina, J.; Lin, Y.; Kaplan, D. L. PH-Dependent Anticancer Drug Release from Silk Nanoparticles. *Adv. Healthc. Mater.* **2013**, *2* (12), 1606–1611. https://doi.org/10.1002/adhm.201300034.
- (7) Mottaghitalab, F.; Farokhi, M.; Shokrgozar, M. A.; Atyabi, F.; Hosseinkhani, H. Silk Fibroin Nanoparticle as a Novel Drug Delivery System. *J. Control. Release* 2015, 206, 161–171. https://doi.org/10.1016/j.jconrel.2015.03.020.
- (8) Lu, Q.; Zhu, H.; Zhang, C.; Zhang, F.; Zhang, B.; Kaplan, D. L. Silk Self-Assembly Mechanisms and Control From Thermodynamics to Kinetics. 2012, 13, 826–832. https://doi.org/10.1021/bm201731e.
- (9) Galindo-Rodríguez, S. A.; Puel, F.; Briançon, S.; Allémann, E.; Doelker, E.; Fessi, H. Comparative Scale-up of Three Methods for Producing Ibuprofen-Loaded Nanoparticles. *Eur. J. Pharm. Sci.* 2005, 25, 357–367. https://doi.org/10.1016/j.ejps.2005.03.013.

Development and Modelling of Innovative Devices for the Seismic Protection of Buildings

Alessandra Orfeo

The earthquake-resistant design strategy aimed to protect a structure from the damaging effects of an earthquake consists of introducing supports that isolate the structures from the shaking ground. An effective simulation of the behavior of these supports is essential, since the integrity of isolated structures depends heavily on their response. The device object of this study is an elastomeric bearing which consists of alternating layers of steel plates and rubber, interposed between the base of the structures and the foundation. One measure to characterize the size of a layer of elastomer in bearings is the shape factor, a dimensionless ratio defined as the ratio of the loaded area to the area free to bulge for an individual rubber layer.

The bearings used in the common applications are characterized by a medium-high value of shape factor (10-20), which means that they provide higher stiffness in the vertical direction but flexibility in the horizontal direction. They are usually expensive, large and heavy. The high cost is attributed to the labour involved in steel plate and rubber sheets assembling and the cost of materials: high quality natural rubber, steel and bonding agent [1]. The aim is to further explore rubber bearing isolators as a way to achieve an economic three-dimensional isolation of structural systems. This could be very useful for critical facilities, such as nuclear power plants or hospitals, where it is necessary to provide effectively protection to sensitive equipment from both vertical and horizontal ground motion [2]. One way to reduce the cost of laminated bearings and increase their use for three-dimensional seismic isolation is by minimizing the number of reinforced steel plates, which are used to provide vertical stiffness to the isolators, thus resulting in bearing with low shape factor (LSF).

Finite element (FE) modelling strategy has been developed for modelling LSF bearing. The proposed modelling strategy is calibrated and validated based on a previous experimental test program [3]. First, double shear tests results are used to calibrate the parameters of the hyperealstic constitutive materials models used for describing the rubber layers. Subsequently, the quasi-static tests carried out on the bearings under constant vertical loads and cyclic horizontal displacement amplitudes are simulated. Finally, comparisons are made between the response of an isolated steel frame prototype with bearings evaluated experimentally in a shaking table tests and the response obtained by using the 3D numerical model.

The good agreement between the model prediction and experimental data provides strong support for the developed FE model and the assumed laws describing the rubber material behaviour.

The proposed modelling strategy can be used to achieve a deeper understanding of the mechanical behaviour of these devices under combined axial and horizontal loads, to develop and validate simplified modelling approaches and to numerically investigate the behaviour of systems isolated with the devices.

Key words isolation system, FE simulations, seismic response, building protection

Paper type – Research paper

References

[1] J. M. Kelly, "Base Isolation: Linear Theory and Design," *Earthquake Spectra*, vol. 6, no. 2. pp. 223–244, 1990.

[2] I. D. Aiken, J. M. Kelly, and F. F. Tajirian, "Mechanics of Low Shape Factor Elastomeric Seismic Isolation."

[3] F. Cilento, R. Vitale, M. Spizzuoco, G. Serino, and A. Muhr, "Dynamic behaviour in compression and shear of low shape factor rubber blocks," *Ing. Sismica*, vol. 36, no. 2, pp. 86–102, 2019.

Protein Delivery to The G.I Tract: Microfluidics as a Scale-independent Production Platform for Protein Loaded Nanoparticles

Neil Forbes

Purpose – With over 200 FDA approved products, protein-based therapies form an integral component to healthcare systems, encompassing ameliorative treatments, diagnostic tools and vaccines. However, in order to mitigate some challenges associated with protein delivery, a suitable delivery system, such as liposomes may need to be used. While a number of liposome based products have made it to market, a lack of efficient manufacturing platforms has become a bottleneck for some products. This study aims to produce protein loaded liposomes in a scale-independent manner for G.I delivery in respect to oral vaccination.

Methodology/approach – Liposomal formulations were prepared by microfluidics (Nanoassemblr[™], Precision Nanosystems), lipids were dissolved in methanol and protein was dissolved in Phosphate buffered saline or TRIS buffer. After liposome production, solvent and free unbound protein was removed using tangential flow filtration (KR2i TFF system, Spectrum Labs). A Malvern Zetasizer Nano-ZS was used to characterise z-avg, PDI and zeta potential. Protein loading was determined by BCA as per manufacturer's instructions (following liposome blank removal). Invivo efficacy of the oral vaccines was determined through oral administration (gavage) in female C57BL/6 mice (5 immunisations at 1 week intervals) to determine systemic IgG and mucosal IgA responses.

Findings – Liposomal formulations DSPC:Chol, DSPC:Chol:PS and niosomal formulation MPG:Chol:PS entrapping 1 mg/mL ovalbumin manufactured through microfluidics and purified by tangential flow filtration resulted in particle sizes of ~76 nm, ~93 nm and ~70 nm respectively with unimodal distribution (<0.3 PDI). Cationic liposomal formulation (DSPC:Chol:DOTAP) with 1 mg/mL ovalbumin surface adsorbed was ~197 nm (0.17 PDI). All formulations tested resulted in comparable results, with no significant differences observed between formulated and free ovalbumin for systemic IgG and mucosal IgA response.

Key words - Microfluidics, Liposomes, Vaccines, Oral Delivery

Paper type - Conceptual paper

Experimental Study of Cutting Two Separate Thin Steel Sheets Simultaneously Using Plasma Machining, Parameters Optimisation and Response Prediction

Adel Gani

This research Paper investigates the ability of using plasma machining for cutting simultaneously two parallel thin layers at different gap distances. The main aim of this work is to identify whether this technology can be more appropriate than using a circular saw to process a three-dimensional structure material such as double layers, box sections or rails. This research is aimed at those working in the automotive industry. Test models were built for the experiments with 0.7mm thick sheets cold rolled steel deep drawing DCO1 grade which are used in the automotive industry. First, a series of cuts were carried out varying the plasma parameters mainly cutting speed, intensity, pressure, also we included the gap distance between the two sheets as an input variable, followed by an additional tests to optimise the process and minimise the deformation and heat affected zones (HAZ) on the top sheets by adopting the Taguchi method, specimens collected were quality assessed for Kerf, dross, hardness change, offset distance between the top and bottom cut edge, distortion and HAZ. A triple scan camera 3D ATOS was used to analyse the deformation and then the samples were mounted, polished and etched with 5% Nital acid before measuring the HAZ size with an optical microscope, all the data were gathered and displayed in the tables below. Results revealed that plasma could be an alternative tool if optimised but it is dependent on the tolerances and the quality required. Analyse of variance (ANOVA) showed that the input-controlled parameters which had the most influence on the top sheet distortion and HAZ were respectively intensity and gap. It was found that a mathematical model could be constructed to predict approximatively the response for both phenomenon.

Cutting simultaneously a double layered structure using the plasma approach has never been explored in the past and was believed to be impossible, therefore the idea of this research was to fill the knowledge gap on whether the plasma technology was able to cut multi-layered parts and also look at the possibility of reusing the energy remaining after exiting the top layer to perform an additional cut through the neighbouring layer.

Key words: Plasma cutting, double sheet, parameters optimization, surface deformation, Heat Affected Zones.

Dual Species Bosonic Quantum Gas Microscopy

Ilian Despard

The relentless advancement of new and improved technologies relies heavily on the ability to comprehend their inner workings. Solid state materials, such as high Tc superconductors or complex semiconductor mixtures are extremally difficult to simulate on a classical computer as the time required for a simulation to run quickly outreaches the age of the universe, therefore other methods are required.

Atomic gas microscopy provides a quantum analogy to these complex systems while allowing for fast measurement times to be combined with complete environmental and atomic control. Trapping single Rubidium atoms within an optical lattice allows for a semi real-world system to be simulated. This is achieved thanks to the full control of optical systems that allow for the atoms individual positions to be controlled as well as their interaction strengths with neighbouring atoms. In realism however, a system very rarely contains just a single atom in a square lattice. Our experimental setup aims to realise duel species Rubidium within a variety of lattice orientations such that several interesting non-equilibrium quantum dynamical problems can be probed. This will enable a new generation of complex real world systems to be studied on a state of the art quantum simulator which has a greater level of control and flexibility compared to other simulators of the same type.

Key words: Quantum gas microscope, Quantum simulation

Paper type: Research paper

A Hidden Treasure: Exploring Partisan Communication

Emanuela Romeo

Purpose -

As part of my research project, which deals with several little-known, neglected or misreported aspects of the Italian Resistance (1943-1945), I had the opportunity to collect and analyse many documents produced by the partisans themselves during the war period. At that time communication was difficult, in particular for people who were considered outlaws. Nevertheless, the partisans produced an incredibly large quantity of papers.

The majority of the letters they exchanged were written by hand, while other documents, in particular leaflets and underground press, were typed with a typing machine. However, both the letters and the underground press were delivered in the same way, by couriers who risked their lives carrying papers from a place to another, usually in mountain areas. Reading the letters the partisans exchanged, the underground papers they published, the leaflets they spread gives us the opportunity to observe their day-to-day activities closely and have a better understanding of many aspects of their struggle which otherwise would have passed unnoticed.

Methodology/approach -

Qualitative, micro-history

Findings –

Analysing the documents produced by the partisans clearly emerges that they needed to communicate for many different reasons. In their letters they not only exchanged useful informations (about the enemy's movements, e.g.), but discussed organisational matters or quarrelled (about jurisdictional issues e.g.). They also wrote leaflets and published underground papers in which they described their life in the partisan formations, explained their motivations, expressed their ideas and ideals, as well as their hopes for the future. They even wrote lyrics and poems.

In conclusion, it is possible to state that communication, no matter how difficult or risky, was essential to them. Bringing back to life their words and discuss it in public is an important achievement for my research project, as I believe that partisan papers still have something to tell to the people of the twenty-first century.

Originality/value -

My research project is almost entirely based on unpublished documents collected in different Italian Archives. This large amount of documents allows me to investigate many forgotten and misreported aspects of the partisan struggle. More importantly, the papers I collected in the Archives are essentials to gain an insight into what the rank and file partisans thought, to understand which were their motivations and expectations.

Key words

Italian Resistance, Communication, Underground press

Paper type – Research paper

References

- Battaglia, R. (1964) *Storia della Resistenza italiana. 8 settembre 1943-25 aprile 1945*. Torino: Einaudi.
- Contini, G. (1997) *La memoria divisa*. Milano: Rizzoli.
- Cooke, P. (2015) L'eredità della Resistenza. Storia, cultura, politiche dal dopoguerra a oggi. Roma: Viella.
- Dondi, M. (2004) La Resistenza tra unità e conflitto. Vicende parallele tra dimensione nazionale e realtà piacentina. Milano: Mondadori.
- Filippetta, G. (2018) *L'estate che imparammo a sparare. Storia partigiana della Costituzione*. Milano: Feltrinelli.
- Ganapini, L. (1999) La repubblica delle camicie nere. Milano: Garzanti.
- Klinkhammer, L. (2007) *L'occupazione tedesca in Italia 1943-1945*. Torino: Bollati Boringhieri.
- Mira, R. (2011) *Tregue d'armi. Strategie e pratiche della guerra fra nazisti, fascisti e partigiani.* Roma: Carocci.
- Osti Guerrazzi, A. (2012) Storia della Repubblica sociale italiana. Roma: Carocci.
- Pavone, C. (2006) Una guerra civile. Saggio storico sulla moralità nella Resistenza. Torino: Bollati Boringhieri.
- Peli, S. (1999) La Resistenza difficile. Milano: FrancoAngeli.
- Peli, S. (2004) La Resistenza in Italia. Storia e critica. Torino: Einaudi.
- Peli, S. (2014) Storie di Gap. Terrorismo urbano e resistenza. Torino: Einaudi.
- Peregalli, A. (1991) *L'altra Resistenza: il PCI e le opposizioni di sinistra*, 1943-1945. Genova: Graphos.
- Tarizzo, D. (1969) Come scriveva la Resistenza. Filologia della stampa clandestina 1943-1945. Firenze: La Nuova Italia.

Effective Heritage Building Maintenance Strategies Using H-Bim

Saiful Fazli Ramli

Purpose – Many heritage buildings stay in poor conditions with indications of critical building defects because the issue of maintenance management is not sufficiently resolved. To date, many countries has spent quite a large amount of money on conserving heritage buildings, however only a few years after major conservation efforts, the buildings continue to deteriorate. Therefore, the aim of this research is to develop a set of effective methodologies for service life prediction to be used by heritage building conservation in maintenance approach. It is also to improve and utilise the technology of Heritage Building Information Modelling (H-BIM) as a sustainable maintenance information resource for future.

Methodology/approach – This paper reviews the current building maintenance practices for buildings adopted by heritage professionals and owners of heritage buildings in managing the maintenance of the building after a conservation process. This paper is part of ongoing research aimed at developing an H-BIM framework for heritage maintenance to support accurate survey data with recording of value, service life assessment, analysis of materials and structure in real-time data. This approach presents the research methodology of quantitative data collection through Service Life Assessment (SLA) Methods and integrated with H-BIM process.

Findings – The proposed H-BIM Framework is significant for its potential benefit in sustaining and predicting the service life of heritage buildings. It could serve as a basis to heritage professionals, heritage organisations and owners to prepare and manage maintenance plans of their heritage buildings.

Originality/value – In this research, the analysis and discovery of new methodologies of service life prediction on heritage building and conservation would be the main contribution to support primary interpretation defined by international charters and guidelines. In addition, this study will utilise the H-BIM technology to enhance heritage maintenance strategies and effectiveness in building conservation practice.

Key words HBIM, Service Life Assessment, Maintenance, Life Cycle, Building Conservation

Paper type Research paper

References

Abdul-Rashid, R., & Ahmad, A. G. (2011). The Implementation of Maintenance

Works for Historical Buildings - A review on the Current Scenario. *Procedia Engineering*, *20*, 415–424. https://doi.org/10.1016/j.proeng.2011.11.184

- British Standards Institution. (2013). Maintenance. In *British Standard: Guide to the Conservation of Historic Buildings* (pp. 28–29). England: BSI Limited.
- Chen, C. J., Juan, Y. K., & Hsu, Y. H. (2017). Developing a systematic approach to evaluate and predict building service life. *Journal of Civil Engineering and Management*, 23(7), 890–901. https://doi.org/10.3846/13923730.2017.1341956
- Douglas, J., & Ransom, B. (2007). *Understanding Building Failures* (3rd ed.). London: Taylor & Francis.
- English Heritage. (2013a). *English Heritage. Practical Building Conservation. Conservation Basics*. London: Ashgate Publishing.
- English Heritage. (2013b). Managing Maintenance & Repair. In *Practical Building Conservation: Conservation Basics* (pp. 244–245). London: Ashgate Publishing.
- Feilden, B. M. (1994). Preventive Maintenance of Historic Buildings. In *Conservation of Historic Buildings* (2 Ed., pp. 217–231). Great Britain: Bath Press.
- Forsyth, M. (Ed.). (2007). Maintenance in Conservation. In *Understanding Historic Building Conservation* (pp. 185–198). Oxford: Blackwell Publishing.
- Gargaro, S., Giudice, M. Del, & Ruffino, P. A. (2018). Towards a Multi-Functional HBIM Model. *Scires-It*, 8(2), 49–58. https://doi.org/10.2423/i22394303v8n2p49
- Grant, A., & Ries, R. (2013). Impact of Building Service Life Models on Life Cycle Assessment. *Building Research and Information*, *41*(2), 168–186. https://doi.org/10.1080/09613218.2012.730735
- Hazards, P. (2007). Durability and Service Life Assessment. In *Understanding Building Failures* (3rd Ed., pp. 141–142). Taylor & Francis.
- ICOMOS. (1964). The Venice Charter 1964. In *ICOMOS*. https://doi.org/10.3109/01443615.2011.552340
- ICOMOS. (2013). The Australia ICOMOS Charter for Places of Cultural Significance Australia ICOMOS Incorporated International Council on Monuments and Sites. Retrieved from http://australia.icomos.org/
- ICOMOS New Zealand. (2010). ICOMOS New Zealand Charter for the Conservation of Places of Cultural Heritage Value. *ICOMOS New Zealand Charter*, (v), 1–11. Retrieved from http://icomos.org.nz/wp-content/uploads/2016/08/NZ_Charter.pdf
- James, D., & Bill, R. (2007). Durability and Service Life Assessment. In Understanding Building Failures (3rd Editio, pp. 138–143). London: Taylor & Francis.
- Jordan-Palomar, I., Tzortzopoulos, P., García-Valldecabres, J., & Pellicer, E. (2018). Protocol to Manage Heritage-Building Interventions using Heritage Building Information Modelling (HBIM). *Sustainability (Switzerland)*, *908*(10). https://doi.org/10.3390/su10040908

Young People's Political Activism: Themes and Structures of Youth Political Participation in England and Scotland

Silvia Behrens

Purpose -

How and why do young people organise themselves in order to strive for political or social change? Youth participation in the UK was identified as the second lowest in a transnational study among EU countries based on cumulative data from the European Social Survey 2002-2010 (Sloam, 2016). Against the backdrop of shifting political environments and emerging new social and political movements, this project will examine the issues and structures of young political engagement in the UK and the factors impacting this specific part of British civil society.

Methodology/approach -

The study aims to implement a two-step mixed method approach. First, a quantitative online survey will map out issues young people in Scotland and England are concerned with and find out with which networks and structures they are, potentially, engaged. In order to then proceed to a more focused and in-depth qualitative dimension, a youth advisory board will be established to review the process of conceptualisation and to give advice on how access participants. The qualitative research will include semi-structured interviews with focus groups of young politically active people in locations in both Scotland and England.

Findings -

This is a conceptual paper for a PhD research project. Data has not been collected yet, but the student can present a proposed research design at the Doctoral Symposium.

Research limitations/implications (if applicable) -

The terms 'political participation' and 'activism' as well as the concept of 'youth' need to be defined in order to establish a framework for the subsequent empirical research.

Practical implications (if applicable) -

A youth advisory board will be introduced for the conceptualisation of the study, which will also support the process of recruiting participants.

Originality/value -

Building upon existing youth participation research, this project takes up open questions on behavioural incentives and personal motivation to engage politically as well as organisational structures of young political civil society to depict political activism of young people in the UK in greater detail. The findings will be provided to policy-makers and audiences in civil society sector alike, contributing not only to the academic debate but also to the development of strategies to foster youth political participation and to find ways of connecting with distinct actors of the field.

Key words youth participation, political activism, non-electoral participation, political organisations, young civil society

Paper type – Conceptual paper

References

Albacete, G. (2014) Young people's political participation in Western Europe. London: Palgrave Macmillan.

- Barrett, M. and Brunton-Smith, I. (2014) 'Political and Civic Engagement and Participation: Towards an Integrative Perspective'. *Journal of Civil Society*, 10 (1), pp. 5-28.
- Cammaerts, B. et al. (2014) 'The Myth of Youth Apathy'. American Behavioral Scientist, 58 (5), pp. 645-664.
- Curtice, J. (2017) *Has Brexit Reshaped British Politics?* London: The National Centre for Social Research. Available at: https://whatukthinks.org/eu/wp-content/uploads/2017/12/EU-Briefing-Paper-12-Brexitand-the-election_V2.pdf (Accessed: 15 December 2019).
- Curtice, J. and Simpson, I. (2018) *Why Turnout Increased in the 2017 General Election.* London: The National Centre for Social Research. Available at: https://www.bsa.natcen.ac.uk/media/39222/why-turnout-increased-in-the-2017-general-election.pdf (Accessed: 02 December 2019).
- Dempsey, N. and Johnston, N. (2018) Political disengagement in the UK: who is disengaged? London: House of Commons Library. Available at: https://researchbriefings.parliament.uk/ResearchBriefing/Summary/CBP-7501 (Accessed: 02 December 2019).
- Eichhorn, J. and Bergh, J. (2020) *Lowering the Voting Age To 16: Learning from Real Experiences Worldwide.* Cham: Palgrave Macmillan US.
- Evers, A. and Essen, J. (2019) 'Volunteering and Civic Action: Boundaries Blurring, Boundaries Redrawn'. Voluntas: International Journal of Voluntary and Nonprofit Organizations, 30 (1), pp. 1.
- Harris, A., Wyn, J. and Younes, S. (2010) 'Beyond Apathetic and Activist Youth: "Ordinary" Young People and Contemporary Forms of Participation'. *Young*, 18 9-32.
- Henn, M. and Sharpe, D. (2016) Young people in a changing Europe: British youth and Brexit 2016. Bournemouth University, Poole: Dorset Digital Print Ltd.
- Matthews, H. (2001) 'Citizenship, Youth Councils and Young People's Participation'. *Journal of Youth Studies*, 4 (3), pp. 299-318.
- Norris, P. (2004) 'Young People and Political Activism: From the Politics of Loyalties to the Politics of Choice?' *Young people and democratic institutions: from disillusionment to participation.* Report for the Council of Europe Symposium, Strasbourg, Harvard University.
- Pickard, S. (2019) Politics, Protest and Young People: Political Participation and Dissent in 21st Century Britain. London: Palgrave Macmillan.
- Pickard, S. and Bessant, J. (2018) Young People Re-Generating Politics in Times of Crises. Cham: Palgrave Macmillan.
- Pontes, A.H., M.

Griffiths, M. (2018) 'Towards a Conceptualization of Young People's Political Engagement: A Qualitative Focus Group Study'. *Societies*, 8 (1), pp.

- Prosser, C. et al. (2018) Tremors but no Youthquake. Measuring changes in the age and turnout gradients at the 2015 and 2017 British General Elections. Available at: http://www.britishelectionstudy.com/bes-impact/the-myth-of-the-2017-youthquakeelection/#WtmJmExFw2w (Accessed: 15 Jan 2020).
- Sloam, J. (2016) 'Diversity and voice: The political participation of young people in the European Union'. *The British Journal of Politics and International Relations,* 18 (3), pp. 521-537.
- Sloam, J. and Henn, M. (2019) Youthquake 2017. The Rise of Young Cosmopolitans in Britain. Cham: Palgrave Macmillan.
- Vromen, A. (2017) Digital Citizenship and Political Engagement. The Challenge from Online Campaigning and Advocacy Organisations. London: Palgrave Macmillan.

Predictive Control of Heaving Compensation System Based on Machine Learning Prediction Algorithm

Ming Zhang

Department of Naval Architecture, Ocean and Marine Engineering, University of Strathclyde, Glasgow, UK

Abstract: With the increase of the offshore wind turbine installation and ship on-board loading, unexpected wave induced motions impacts many engineering operations. Horizontal motions on the sea surface can be offset by dynamic positioning system and heave motion is controlled by heave compensation system. Active heave compensation (AHC) system is applied in practical engineering application to improve safety and efficiency loading in harsh sea condition. Model predictive control further improves the performance of active heave compensation system. Machine learning prediction algorithm is a widely used model-free method in the field of data analysis. This paper proposes a predictive control strategy of active heave compensation system with machine learning prediction algorithm. To verify the proposed predictive control strategy, a predictive active compensation model is presented and a Proportion-Integration-Differentiation (PID) control with model predictive control is adopted. The reliability of the Back Propagation Neural Network and (BPNN) and Long Shortterm Memory Recurrent Neural Network (LSTM RNN) prediction algorithms is proved and different algorithms are chosen for regular and irregular wave conditions. The influence of the predictive motion to the compensation performance is analysed comparing the predictive feedforward cases with the real-data feedforward cases. The machine learning based predictive control is reliable for the active heave compensation system. The optimal prediction horizon of feedforward step is 2-step forward regardless different structure motion frequency and sampling frequency. In regular structure motion case, the compensation system with BPNN predicted motion can reduce the amplitude to 6.5% of the reference motion, while 5.5% with real-data feedforward control and 25% with feedback control. The amplitude of payload motion is proportional to the structure motion frequency and inversely proportional to the sampling frequency. The phase deviation is insensitive to both the structure motion frequency and the sampling frequency. In irregular structure motion case, the amplitude of payload motion is compensated to 2.9% of the reference motion with 2-step LSTM feedforward control.

Key words: active heave compensation system, predictive control strategy, machine learning, BPNN, LSTM RNN.

Understanding Blockchain Technology: a Survey of Supply Chain Network in Nigeria

Salisu Alhaji Uba (Salisu.uba@Strath.ac.uk) and Robert Ian Whitfield

Department of Design, manufacturing and Engineering Management, University of Strathclyde, Glasgow UK

Purpose -

Blockchain technology possesses the potential to disrupt industrial practice in the next decade. From the supply chain point of view, it mitigates the risk of intermediaries, increases transparency and provenance. However, the technology is still at exploratory stage; concentration was centered on the potential and implication. Lack of understanding of the technology could be a factor that can hinder its adoption. This paper aims to survey among supply chain professionals the level of awareness of the blockchain technology in the supply chain and to identify if lack of the awareness of the technology is a barrier to adoption of the technology.

Methodology/approach -

A comprehensive literature review was conducted and online survey consisting of 250 professional from the Supply Chain Network in Nigeria was conducted. The data were analyzed using descriptive statistics.

Findings -

The literature review shows that the technology is relatively new and focuses on the financial aspect of the application, also known as the bitcoin. However, efforts are being made over the years to integrate the potential to some key supply chain objectives and develop user cases across different functions in the supply chains. In Nigeria, the knowledge and understanding of the technology are low as the majority of the professional have less understanding of the technology, especially in the supply chain context. The study also found that the lack of knowledge and understanding of the technology is a barrier to the adoption in supply chain.

Research implications -

The findings of the lack of understanding of the blockchain technology in supply among the supply chain professional have implication for both the practice and academia. First, it is a call for more effort to create a network that will create an understanding of the technology and value it can offer to supply chain professionals. This will help in the speedy adoption. Second, for companies working on the Blockchain solution to consider the knowledge aspect of the implementation by embedding the culture of enhance knowledge and understanding of the technological know-how of the system. Finally, a call for the academic community for more research on blockchain in the supply chain, especially to grow this body of knowledge

Originality/value -

This is one of the first studies to examine the level of awareness of the blockchain technology in Nigerian context through empirical study. The study has also identified areas that will increase cases of adoption of the technology; therefore, that can serve as a guide to companies working on blockchain for supply chain.

Keywords: Blockchain; Supply Chain Network; Nigeria

References

Dujak, D. and Sajter, D., 2019. Blockchain applications in supply chain. In SMART supply network (pp. 21-46). Springer, Cham.

Brody, P., 2017. How blockchain is revolutionizing supply chain management. Digitalist Magazine, pp.1-7.

Tribis, Y., El Bouchti, A. and Bouayad, H., 2018. Supply chain management based on blockchain: A systematic mapping study. In MATEC Web of Conferences (Vol. 200, p. 00020). EDP Sciences.

Saberi, S., Kouhizadeh, M. and Sarkis, J., 2019. Blockchains and the supply chain: Findings from a broad study of practitioners. IEEE Engineering Management Review, 47(3), pp.95-103.

Calzadilla, J.F. and Villa, A., 2017. Systematic Literature Review of the use of Blockchain in Supply Chain

Appliance Usage Detection from Smart Meter Data Using Supervised and Unsupervised Non-Intrusive Load Monitoring

Mohammad Khazaei

Climate change and awareness of energy efficiency encouraging end user and network operator towards management the load that needs diagnostic of the loads. Monitoring load of individual appliances using individual appliance sensors in a house or a commercial building is often impractical and expensive, load disaggregation via NILM (Non-Intrusive Load Monitoring) offers a non-intrusive, purely computational, software-based approach to separate aggregate load obtained from a single electricity meter into individual appliance loads. NILM methods can be divided into supervised and unsupervised techniques (though hybrid, semi-supervised approaches are also possible). Supervised NILM techniques require a labelled dataset of appliance consumption data for training and unsupervised approaches do not require training data. In this study, we evaluate the robustness of two unsupervised and two supervised methods for NILM for a range of appliances, namely kettle, oven, hob/cooker, fridge, freezer, fridgefreezer, washing machine, dishwasher, tumble dryer, microwave. Firstly, we validate our methods using the public REFIT and REDD datasets, training and testing on the same dataset, and compare results with the literature. We then resample all datasets to the sampling rate, carry out aforementioned NILM experiments in order to assess whether we can use transfer learning to detect these appliances in an unknown dataset obtained from industry. We present our findings in terms of which appliances can be disaggregated reliably using transfer learning from known public datasets, and which NILM methods are preferable.

This is the first step towards assessing safety in the house, e.g. due to appliances not being switched off or appliance malfunction. Indeed, in a study by the BBC following the Greenfell fires, it was found that malfunctioning appliances cause almost 12,000 fires in Britain in just over 3 years. These are attributed to washing machines, tumble dryers, dishwashers, cookers, fridge-freezers, toasters and microwaves. With NILM we hope to identify these faulty signatures and catch them before it is too late.

Key Words: NILM, ANN, Decision Tree, DBscan, K-Means

Paper type –Research paper

REFERENCES

- 1- Altrabalsi, H., Stankovic, V., Liao, J., & Stankovic, L. (2016). Low-complexity energy disaggregation using appliance load modelling. *AIMS Energy*, *4*(1), 884-905.
- 2- Al-Waisi, Z., & Agyeman, M. O. (2018, September). On the Challenges and Opportunities of Smart Meters in Smart Homes and Smart Grids. In Proc. 2nd Int. Symposium on Computer Science and Intelligent Control (p. 16). ACM.
- 3- Bian, D., Kuzlu, M., Pipattanasomporn, M., Rahman, S., & Shi, D. (2019). Performance evaluation of communication technologies and network structure for smart grid applications. *IET Commun.*, 13(8), 1025-1033.

- 4- Buzau, M. M., Tejedor-Aguilera, J., Cruz-Romero, P., & Gómez-Expósito, A. (2018). Detection of non-technical losses using smart meter data and supervised learning. IEEE Transactions on Smart Grid, 10(3), 2661-2670
- 5- Depuru, S. S. S. R., Wang, L., Devabhaktuni, V., & Green, R. C. (2013). High performance computing for detection of electricity theft. International Journal of Electrical Power & Energy Systems, 47, 21-30.
- 6- Elafoudi, G., Stankovic, L., & Stankovic, V. (2014). Power disaggregation of domestic smart meter readings using dynamic time warping. In *6th Int. Symp. Communications, Control and Signal Processing (ISCCSP), 2014* IEEE.
- 7- Kolter, J. Z., & Johnson, M. J. (2011). REDD: A public data set for energy disaggregation research. In Workshop on Data Mining Applications in Sustainability (SIGKDD), San Diego, CA (Vol. 25, No. Citeseer, pp. 59-62).
- 8- Murray, D., Stankovic, L., Stankovic, V., Lulic, S., Sladojevic, S. (2019). Transferability of neural network approaches for low-rate energy disaggregation. *ICASSP IEEE Int. Conf. Acs., Speech & Sig. Proc.* pp. 8330-8334
- 9- Murray, D., Stankovic, L., & Stankovic, V. (2017). An electrical load measurements dataset of United Kingdom households from a two-year longitudinal study. *Scientific Data*, 4, 1-12. https://doi.org/10.1038/sdata.2016.122
- 10- Zhao, B., Stankovic, L., & Stankovic, V. (2016). On a training-less solution for nonintrusive appliance load monitoring using graph signal processing. *IEEE Access*, 4, 1784-1799
- 11- Zhao, B., He, K., Stankovic, L., & Stankovic, V. (2018). Improving event-based nonintrusive load monitoring using graph signal processing. *IEEE Access*, 1-15. https://doi.org/10.1109/ACCESS.2018.2871343

Building Epidemiological Models Using Fragmented Information: A Case Study of Wuhan Coronavirus in 2020

Wang Zhao

Purpose – Along with the outbreak of the novel coronavirus in Wuhan, China in January 2020 is the rising suspicion about the real number of people infected. Although the nationwide number of confirmed diagnosis is officially updated almost every hour, it does not necessarily reflect how many people have been infected by the same time, for reasons including a long incubation period and a limited testing capability. Epidemiological models (Kermack and McKendrick, 1932) could be used to estimate the real-time situation, as in this case in Wuhan (Imai et al, 2020). However, information for model building available at the beginning phase is often limited, fragmented, and with questionable reliability, and there is often little time to organize and validate information. This work tries to use a mixed modelling approach combining system dynamics (SD), agent-based modelling (ABM), and/or Bayesian Networks (BN) to reveal the mechanisms and structures underlying an outbreak of pestilence, with a focus on the additional ability such an integration could offer to utilizing and validating fragmented information.

Methodology/approach – This study follows the philosophical paradigm of critical realism (CR) and thus assumes that we understand the real mechanisms beneath the actual facts through our observation of events, which are only part of the fact. It further believes that we can perfect our understanding by testing it against newly acquired information. The study uses a hybrid model-building method to represent the development of understanding, in which multiple modelling paradigms (such as SD and ABM) are employed as in Schieritz (2002) and Wurth et al (2017) to ensure that the real world could be studied from multiple levels and perspectives and a broader range of information could be used.

Findings – This study expects to build an epidemiological model for the spread of coronavirus in Wuhan, China and to inspire more discussions on the benefit of an integrative modelling approach in terms of utilising information and facilitating people's understanding of the real world.

Research limitations/implications – Limitations of this study include the general limitation of any modelling approach that 'all models are wrong, but some are useful (Box, 1976)'. The selected modelling paradigms may not be the most suitable approach, and a critical discussion on the selection is needed to make this limitation clear.

Practical implications – This work is for learning purpose and therefore in its current plan does not seek to advice any policy-making process.

Originality/value – Methodologically this work explores the opportunity of combining multiple frequently used modelling paradigms. It also contributes to the epidemiological study by offering an account for a public health emergence. More importantly, this work will be contemporaneous with the progress of the situation, which from a chronological perspective could reveal how understandings develop over time.

Key words – Epidemic; Coronavirus; System Dynamics; Agent-based Modelling

Paper type – Research paper

References

Box, G.E., 1976. Science and statistics. Journal of the American Statistical Association, 71(356), pp.791-799.

Imai, N., Dorigatti, I., Cori, A., Riley, S. and Ferguson, N.M., Estimating the potential total number of novel Coronavirus cases in Wuhan City, China.

Kermack, W.O. and McKendrick, A.G., 1932. Contributions to the mathematical theory of epidemics. II.—The problem of endemicity. Proceedings of the Royal Society of London. Series A, containing papers of a mathematical and physical character, 138(834), pp.55-83.

Schieritz, N., 2002, July. Integrating system dynamics and agent-based modeling. In Proceedings of the XX International Conference of the System Dynamics society.

Wurth, B, Howick, S & MacKenzie, N 2017, 'Fostering collaborations by managing different proximity dimensions: a hybrid system dynamics/agent-based model for academic entrepreneurship in innovation ecosystems' Technology Transfer Society Conference, Arlington, United States, 2/11/17 - 4/11/17.

Pedagogical Reduction and The Power of The Image: Propaganda and The Post-Truth Era

Nicola Robertson

Purpose - It is not unfair to suggest that we live in the apex of the photographic age, where the ubiquity of technology allows for the instantaneous capture and dissemination of images across the globe. The image can be powerfully exploited to show what the creator wishes the audience to see; that which has been captured remains eternally spotlighted, while that which lies outside of the frame remains obscured. This is not dissimilar to the concept of pedagogical reduction, where the educator shows the student what they deem to be important and, consequently, obscures what is unimportant.

Given the similarity between pedagogical reduction and the power of the image (to show the necessary and obscure all else); and given the use of the image as a tool of propaganda (Berger, 1980) and its prominence in our post-truth society, it is pertinent to now ask whether propaganda itself can be considered pedagogical.

Methodology/Approach - In order to ascertain whether we can justify a description of propaganda as pedagogical, and how we can apply this to post-truth, a hermeneutic inquiry will be conducted into each of the four main concepts in the paper: pedagogical reduction, image, propaganda, post-truth. Once each concept is fully delineated, comparisons are made between each to identify areas of similarity and difference which may offer a speculative answer to the research question. As the concept of image is involved, visual examples feature throughout.

Findings - There is a thread running through this paper concerning our relationship with truth. Pedagogical reduction and the reduction in images make both concepts inherently untrue, yet we accept these untruths with little question. However, if untruths are found in the political sphere (propaganda) or on social media (post-truth), the creators are held to account, often virulently. In answering the overall question, the differences between types of truth will be implicitly addressed. An understanding of how we relate to truth has implications for everyone, not least researchers aiming to communicate with a variety of audiences.

Originality/Value - The potential alignment of education (and its hitherto perceived positive value) (Peters, 1966) with propaganda (and its hitherto perceived negative value) (Taylor, 1942) may encourage disruptive discourse in which common ideas around both concepts come to be questioned. We can then go further as we apply the notion of pedagogical reduction to what we may describe as post-truth – how much does post-truth resemble propaganda, and, as such, can it also be described as pedagogical?

Key words Education, Images, Propaganda, Post-truth, Truth

Paper type – Conceptual paper

References

Berger, J. (1980). About Looking. London: Bloomsbury.

Peters, M. (2017). Education in a post-truth world. *Educational Philosophy and Theory, 49*(6), pp. 563-566.

Taylor, W. (1942). What is propaganda? Coll

Assessing the Impact of Marketing Automation on Customer Engagement in a Business-to-business Setting

Sissi Lehto

Purpose – Within the marketing and service research, customer engagement has been acknowledged as a key research priority (Marketing Science Institute, 2018; Brodie et al., 2019). The topic area is growing fast, as technological developments including especially big data, automation, and artificial intelligence, enable the formation of new forms of engagement and extending the range of actors involved in value creation (Storbacka et al., 2016). In addition, companies are increasingly looking for ways to foster engagement, known as engagement marketing strategies (Harmeling et al., 2017). However, the consequences of our increasingly technology-dependent environment on B2B relationships are yet not fully understood (Hofacker et al., 2019). The proposed research seeks to contribute to this research area by exploring the role of marketing automation in influencing customer engagement in business-to-business settings.

Marketing automation is a software tool used to automate simple marketing tasks including for example email marketing, campaign management and customer data integration (Bagshaw, 2015). Enabled by the recent developments in information technology, marketing automation has quickly gained popularity among companies aiming to improve the effectiveness of their marketing efforts. These efforts are in line with a growing interest in digital marketing technologies and devices, and the ways data can be exploited in the rapidly changing market environment. In particular, companies are currently emphasising the importance of building digital relationships with their customers (Kannan and Li, 2017). The proposed study aims to build on this knowledge, by focusing on marketing automation, and its influence on customer engagement.

Methodology/approach – For this study, an exploratory qualitative research approach will be adopted, and phenomenological interviews will be utilised as the main method for data collection. These interviews will be held with digital marketing managers who have experience with marketing automation and who work in organisations offering knowledge intensive business services, such as business consulting.

Findings – Data collection will commence in March/April 2020.

Originality/value – Technological developments such as marketing automation offer various benefits to organisations operating in the B2B sector. These benefits include increased efficiency, that stems from the creation of a more streamlined and cost-efficient workflows through automation (Buttle & Maklan, 2019) as well as the ability to personalise interactions with a large number of prospects (Kantrowitz, 2014). Therefore, through transforming the customer-company interactions, marketing automation has the potential to improve customer engagement, as ability of the algorithm to carry out multiple tasks simultaneously beats human

efficiency. As the algorithms develop and become smarter, these tools will be able to predict the customers' next steps, and respond accordingly to actions (Grossberg, 2015). On the other hand, in a B2B environment, relationships are characterised by complexity (Marcos-Cuevas et al., 2016). Replacing the human element with technology may result in unintended consequences, raising questions related to the role of the human actor in maintaining and developing business relationships, and the resulting consequences on engagement if the human actors are replaced with machines. To the best of my knowledge, this study represents the first of its kind to explore these questions.

Key words - Digital Marketing, B2B, Customer engagement, Marketing Automation,

Paper type – Research paper

References

Bagshaw, A. (2015) What is marketing automation? Journal of Direct, Data and Digital Marketing Practice, 17 (2), pp.84-85.

Brodie, R. J., Fehrer, J. A., Jaakkola, E., & Conduit, J. (2019). Actor Engagement in Networks: Defining the Conceptual Domain. Journal of Service Research, 22(2), 173-188.

Buttle, F. & Maklan, S. (2019) Customer Relationship Management: Concepts and Technologies. 4th edition. Abingdon, Routledge.

Grossberg, K.A. (2015) Marketing's Moment of Truth - In Search of a New Solution. Waseda Business & Economic Studies. [Online] o. Jg. (51), 1–16. Available from: https://core.ac.uk/download/pdf/46895946.pdf.

Kannan, P. and Li, H. (2017) Digital marketing: A framework, review and research agenda. International Journal of Research in Marketing, 32 (1), pp.22-45

Harmeling, C. M., Moffett, J. W., Arnold, M. J., & Carlson, B. D. (2017). Toward a theory of customer engagement marketing. Journal of the Academy of Marketing Science, 45(3), 312-335.

Hofacker, C., Pillai, K., Golgeci, I & Gligor, D. (2019). Digital Marketing and Business-to-Business Relationships, Special issue call for papers from European Journal of Marketing. Available:http://www.emeraldgrouppublishing.com/products/journals/call_for_pa pers.htm?id=7890. Last accessed 11th of July 2019.

Kantrowitz, A. (2014) The CMO'S guide to marketing automation. Advertising Age. 85 (17), 1–3.

Marcos-Cuevas, J., Nätti, S., Palo, T. & Baumann, J. (2016) Value co-creation practices and capabilities: Sustained purposeful engagement across B2B systems. Industrial Marketing Management. [Online] 56, 97–107. Available from: doi:10.1016/j.indmarman.2016.03.012.

Marketing Science Institute (2018), Research Priorities 2018-2020. Cambridge: Marketing Science Institute.

Storbacka, K., Brodie, R. J., Böhmann, T., Maglio, P. P., & Nenonen, S. (2016). Actor engagement as a microfoundation for value co-creation. Journal of Business Research, 69(8), 3008–3017.

Representation of Hijras in the Postcolonial Indian Fiction

Rukhsar Hussain

Purpose – To increase awareness about non-binary sexualities from global South

Methodology/approach – Use literary analyses as an approach to investigate into representations of non-binaries in South Asia

Findings – Their fictional representations fall in the trap of 'illusion' by representing hijras as central figures and yet never challenging the system

Originality/value – The paper's originality lies in the fact that it studies hijra representations in relation to recent judicial laws and government policies in India.

Key words - Hijras, South-Asian-sexualities, Third gender

Paper type- Conceptual paper

Representation of hijras and their social marginalization in postcolonial India is linked with colonial history and has remained in dialogue with the state since then. However, they have come to occupy a deeply active place in the Indian political space, since early this century, with the rise in international funding, growing activism and revisions in government policies. Supreme Court's decision in 2014 followed by the parliamentary bills is representative of the political spur regarding the 'third gender' in These uprisings have marked a progressive shift in the ways hijras are India. represented in literature. Arundhati's Roy novel, The Ministry of Utmost Happiness, is the most recent literary example representing hijras. It not only gives voice to hijra characters, but also responds sharply to the contemporary Indian politics surrounding non-binary people. However, the novel seems to succumb to the dominant ideology at various places. For instance, hijras literally exist on a graveyard in the plot. How positive then are these representations? Are they really progressive or are they merely a reflection of what is happening in the real world? Do they too fall in the trap of 'illusion' by representing hijras as central figures and yet never challenging the system? Indeed, queer representation is inseparable from the rise of neoliberal agendas in the Indian subcontinent. Government policies and laws have become essential to hijra experiences in postcolonial India without which any writing or reading on 'hijras' makes no real sense. Therefore, this paper, while looking at The Ministry, critically engages with the recent parliamentary bills which seem to bring hijras and other non-binary groups back into the mainstream of the society, while their agenda remains to 'rehabilitate' them according to dominant social or gender norms. Identities which do not disturb the 'normalised' narrative of the state are recognized as the 'third gender' by the current right-wing government. Their inclusion, far from suggesting acceptance from the state, becomes a macrocosm of how the state actually 'includes' queer subjects within its system only to create an illusion.

Privacy: A Means to Protect Competition or Advance Consumer Welfare or Innovation?

Arletta Gorecka

Purpose – The research attempts to bring elements of legal certainty to the debate about relationship between competition law and personal data protection. The research places its emphasis on the latest EU legal development and analyses whether privacy could be seen as element enhancing innovation, consumer welfare or the competitive process, based competition law goals.

Methodology/approach – The methodology adopted for this chapter is doctrinal and socio-legal methodologies. These methodologies are relevant to demonstrate the legislative changes in the EU competition law sphere and to assess the impact on privacy on the goals of competition law.

Findings – The recent debate on intersection of competition law and privacy, followed by the rise of Big Data, constitutes a major challenge for to the existing competition legal framework. Arguably, the breaches of privacy and data protection law might affect the welfare of individuals, as well as influence the democratic processes. The unprecedented magnitude of data collection could raise challenges for both society and legislation, as it has emerged that personal data is seen as a tradable commodity (World Economic Forum, 2011) placing companies in a position where the data help them to achieve a stronger position in a market. In this respect, it is important to consider the impact of privacy on competition law, which appears to be multidimensional.

The aspects of personal data protection have had a numerous impact on the framework of competition law — from the anticompetitive agreements to abuse of dominance or merger control. Yet, the privacy concerns do not immediately result in anticompetitive conducts. To certain extent the acquisition of data could create competition law infringement, data violation might also harm consumers as they are objected to unfair trading practices, competition and upset innovation processes. The EU Commission's practice might be analysed through three different phases: ignorance of data, identification of parallel pathways between competition law and data protection, and the third phrase recognised by the Member State practice — recognition of data in the competition sphere.

Practical implications (if applicable) – Competition law's pedigree aims at ensuring competition in a relevant market. The papers attempts to demonstrate whether privacy should be seen as an objective of competition law, assessing whether competition law should be used to achieve broader macroeconomic goals. The research attempts to reconsider the goals of competition law through the lens of the digital economy, as well as consider the modern social trends like sustainability.

Originality/value – This research presents a legal overview of the EU Commission and the EU Member State approach to the relationship of data protection and competition law debate. The research focuses whether privacy could be seen as element enhancing innovation, consumer welfare or competition processes, based on the goals of competition law and acknowledging dynamic nature of data protection. It will provide two sides of arguments, namely: privacy as a competitive and innovative parameter, and — a consumer welfare parameter.

Key words privacy, data protection, EU competition law, digital economy

Investigation of Collaborative Supply Chain Drivers: A Case Study Nigerian Oil and Gas Industry

Moses Chijioke Olisah

The purpose of this research is to investigate and identify the drivers of supply chain collaboration, which intended to contribute to the successful relationship among the supply chain members of the Nigerian oil and gas industry. The goals and objectives of the study is providing future research direction and provides a guide for oil and gas industries on ways to achieving sustainable collaboration between the suppliers and organisations.

A systematic literature review was employed to investigate the different drivers of Supply Chain Collaboration covering many sectors and subsectors of Nigeria oil and gas industry in order to identify the existing collaborative approach and relationship within the suppliers and organisations.

The identify problem include a lack of awareness creation on policies, a lack of trust and partnerships, communication between the suppliers and organisation, which is compounded by the types of training and orientation, culture and language barriers.

Literature revealed that seven drivers would effectively facilitate Supply Chain Collaboration in oil and gas industry such as information sharing, trust, top management, competition, incentive alignment, stakeholders' involvement and joint decision making. The study further suggested that the drivers of Supply Chain Collaboration should be adopted and fully implemented in order to achieve efficient and sustainable supply chain system in oil and gas industry.

This research is limited to published literature and a used of organisation database information, but it is importance because it provides a direction for future research, which the researcher intend to investigate the identify challenges further using a qualitative approach to acquire robust and sufficient understanding about issues affecting supply chain collaboration in Nigerian oil and gas industry.

Keywords: Supply Chain Collaboration, Drivers of Supply Chain Collaboration, Partnership and Relationship, Nigerian Oil and Gas industry,

Physicochemical Characterisation of PLGA Nanoparticle Protein Corona using Orthogonal Techniques

Kiri Thornalley

Nanomedicines offer exciting opportunities to treat unmet clinical needs, but significant challenges in the bench to clinic translation of nanomedicine research remain; this evident by the lack of nanoparticle-based medicines in the clinic.¹ One of these challenges concerns an understanding of the biological fate of nanomedicines following administration. Intravenously-administered nanomedicines come into contact with a wide variety of biomolecules, including proteins, which subsequently adsorb onto the surface of the nanoparticle forming a 'protein corona'.² It is known that the protein corona forms rapidly, but various parameters of the protein corona vary over time.³ Development of better understanding of the physicochemical effects of the protein corona on nanoparticle characteristics offers the scope for developing better models (lab-on-a-chip and *in silico*) of nanoparticle-protein complex interactions with biological systems. Better models of biological fate will also support the achievement of the 3R's principles; these are to reduce, refine and replace the use of animals within clinical research.⁴

We report the evaluation of changes in Poly (lactic-co-glycolide) (PLGA) nanoparticle physicochemical characteristics following treatment with serum. PLGA and PLGA-PEG nanoparticles were incubated in serum at ambient and physiological temperatures for various durations. Treated nanoparticles were characterized using multiple particle metrology tools including: dynamic light scattering, nanoparticle tracking analysis and resonant mass measurement to evaluate changes in particle characteristics following corona formation.

For the first time, these tools have been applied to the *in-situ* interpretation of changes occurring in nanoparticle physicochemical characteristics following corona formation. Some of these parameters include particle size distribution, particle concentration, and the surface charge of nanoparticles following incubation in serum. Findings from this work offer the scope to determine how corona formation impacts the kinetics of drug release, mechanism of cellular uptake and circulation times. Through a better understanding of the protein corona impact on particle characteristics, nanomedicines can be reverse-engineered to exhibit improved tissue distribution and efficacy.



Key words (max 5): Nanomedicine, protein corona, physical chemistry, particle metrology

References

- 1 C. L. Ventola, Pharm. Ther., 2017, 42, 742–755.
- 2 F. Barbero, L. Russo, M. Vitali, J. Piella, I. Salvo, M. L. Borrajo, M. Busquets-Fité, R. Grandori, N. G. Bastús, E. Casals and V. Puntes, *Semin. Immunol.*, 2017, **34**, 52–60.
- 3 A. L. Barrán-Berdón, D. Pozzi, G. Caracciolo, A. L. Capriotti, G. Caruso, C. Cavaliere, A. Riccioli, S. Palchetti and A. Laganà, *Langmuir*, 2013, **29**, 6485–6494.
- 4 W. M. S. Russell and R. L. Burch, *The principles of humane experimental technique.*, Methuen & Co. Ltd., London, 1959.

Application of Artificial Neural Network and Expert Systems for Enhanced Reliability in Predictive Ship Machinery Health Condition Monitoring

Abdullahi Daya

Ship owners in both the civil and the defence sectors have relied on preventive and planned maintenance systems for the last half of the 20th century and the case still remains the same. There are several reasons for these unwillingness towards adopting better maintenance strategy be it on board or fleet wise. Some of which are high cost of sensors installation, resistance to change or perceive high cost of training maintenance staff. Nonetheless, some of the major issues with the practice of either preventive or planned maintenance system is the high cost of spare parts inventory besides the litany of maintenance work requiring extended man hours and operational interruptions that add lots of pressure on available resource. It is widely believed that a shift from this traditional maintenance approaches is required in the shipping industry in order to improve machinery and system reliability hence overall availability. Recent research output has shown that Condition Based Maintenance has emerged as the most prepared maintenance strategy due mainly to the improvement in availability and capabilities in sensor technology enabling multiple and efficient data collection. Therefore, this coupled with the ability in machine learning algorithm capable of predicting failure, remaining useful life, fault identification to mention but a few; will revolutionise maintenance. On the other hand, condition based maintenance goes beyond prediction and data trending it also entails identifying components dependability and performance degeneration as it relates to components/equipment in a system/machinery. Accordingly, this research will review some technological trend in ship maintenance technology looking into the application of machine learning algorithms for fault diagnostics and prediction as well as application of other expert system in reliability and dependability analysis. The research would thereafter demonstrate the application of Artificial Neural Network in predictive machinery health condition monitoring and the utilisation of expert systems such as Dynamic Fault Tree Analysis and Bayesian Belief Networks for reliability and dependability analysis respectively.

Purpose – To reduce the cost of maintenance while improving system availability through the identification of maintenance critical components.

Methodology/approach – The methodology consist of 3 distinct but linked steps aimed at predicting failure, identifying impact and dependencies of components to failure as well as the reliability of equipment / component in the system. The approach involves the use of Artificial Neural Network (ANN) for predictive analysis on machinery data, Bayesian Belief Network (BBN) for component dependencies and impact on failure and reliability/availability analysis on the same machinery using Dynamic Fault Tree Analysis (DFTA).

Key words: Condition Based Maintenance (CBM), Preventive Maintenance (PM) Planned Maintenance System (PMS), Predictive Machinery health condition Monitoring, Artificial Neural Network (ANN), Dynamic Fault Tree Analysis (DFTA), Bayesian Belief Network (BBN), Reliability, Dependability

BIM-based Building Code Compliance Checking System

Silpa Singharajwarapan

Building designs in Thailand are currently checked manually against a frequently changing and increasingly complex set of building code and regulations. Manual code checking is a major task for both designers and enforcers, often leading to ambiguity, inconsistency in assessments and delays in the overall construction process. With the advanced technical capabilities provided by Building Information Modelling (BIM) systems, the potential for a new generation of automated code checking tools is gaining attention by the building industry to improve the efficiency of building design and procurement. As manual checking of building designs for compliance against building codes is complex and prone to human error with significant cost implications, it is surmised that automated compliance checking would not only prove beneficial to designers but to also building certifiers, consultants, building code authorities, specification writers and builders. Ongoing research within the Architecture, Engineering, and Construction (AEC) industry and academic institutions have produced many pilot prototypes and even commercialised Automated Building Code Compliance Checking System.

However, the conventional Automated Building Code Compliance Checking Systems always contain many limitations. Firstly, they do not offer BIM revision modelling, which means users need to perform manual cross-referencing; manually locating the reported compliance issues and revising the identified requirements from the Code checking application in the BIM-authoring application. This manual revision is always creating potential for error and delay in the process. Secondly, conventional systems only offer checking for formal building code within a scope of objective geometry data rules (i.e. building code that can be express as a ruleset of acceptable range of arithmetical value for a given building codes along with informal regulations that inform building design from the code checking process cannot be checked by the current conventional systems and should be manually checked.

This research aims to remedy the limitations in conventional Automated Building Code Compliance Checking Systems by developing an automated BIM revision adjustment after the compliance checking process. It will also consider the informal and subjective Thai building codes to be included via interdependent selection process, manual verification, and other techniques.

Purpose – Investigating and evaluating solutions to the limitations of conventional Automated Building Code Compliance Checking Systems. Then, developing an automated BIM revision adjustment considering the informal and subjective Thai building codes.

Methodology/approach -

• Literature review: Thai building code, Thailand's informal law and regulations with potential to inform building design, Building Information Modelling (BIM) in Thailand and international AEC Industry, Parametric Modelling in BIM, Automatic query decision programming, and others.

• Evaluating the current conventional (commercial/research) Automated Building Code Compliance Checking Systems: usage, platform architecture, limitations, and results deliveries/report.

• Developing an automatic BIM revision adjustment following the compliance checking process. The research will test a suitable code structural framework, Parametric modelling solution, and best practice for implementing revision decision dialog.

• Validating the developed BIM system using case studies. Applicable and significant subjective Thai building codes and other non-formal regulations set will be evaluated and selected to be examined. Extended techniques via interdependent selection process, manual verification, and other are reviewed and test within the applicable selected codes and regulations.

Research limitations/implications – At this stage of the research, Thai Building Code is the main code to be considered for this research due to funding conditions.

Practical implications – Research findings could inform or suggest new technique to be developed and integrated in commercialised Automated Building Code Compliance Checking System.

Originality/value – Extended modelling capability and code interpretation techniques within Automated Building Code Compliance Checking System.

Key words (max 5)

Automated Building Code Compliance Checking System

Building Information Modelling (BIM)

Parametric Modelling

Thai Building Code

References

Author unknown. (1979). Building Control Act, B.E. 2522.

Author unknown. (2007). Energy-saving building plan permit and licensing Handbook, B.E. 2535 [revision B.E. 2550].

Author unknown. (2015). Thailand BIM Guideline 2015. Bangkok, Thailand: ASA Publishing.

Ding, L., Drogemuller, R., Jupp, J., Rosenman, M. and Gero, J. (2004). Automated Code Checking. CRC CI International Conference, Gold Coast, Australia.

Drogemuller R., Woodbury R. and Crawford J. (2000). Extracting representation from structured text: initial steps. w78-2000-302.

Fenves S. J., Garrett J. H., Kiliccote H., Law K. H. and Reed K. A. (1995). Computer representations of design standards and building codes: U.S. perspective. The International Journal of Construction Information Technology, Vol 3, No 1, pp. 13-34.

Greenwood, D., Lewis, S. and Lockley, S. (2010). Contractual Issues in the Total Use of Building Information Modelling. in Barrett, P.

Kaewmeesang, T., Damrianant, J. (2015). A study of Building Information Modelling for Construction-Drawing Production. Research and Development Journal Volume 26 Issue 2 April-June 2015. Bangkok, Thailand: Thammasat University.

Kotpalee, R. (2016). A Guideline for Developing As-Built Building Information Modeling (BIM) Models. Master Thesis.Bangkok, Thailand: Chalalongkorn University.

Li, Y. (2015). Automated Code-checking of BIM models, Master in European Construction Engineering Master. University of Cantabria, Santander.

Maissa S., Frachet J. P., Lombardo J. C., Bourdeau M. and Soubra S. (2002). Regulation checking in a virtual building. CIB w78 conference 2002.

Martins, A. M. (2013). LicA: A BIM based automated code-checking application for water distribution systems. Automation in Construction, pp. 12-23.

Nawari, N. O. (2011). A framework for automating codes conformance in structural domain. Journal of Computer and Information Technology.

Nawari, N. O. (2012). Automated Code Checking in BIM Environment. In the Proceedings of the 14th International Conference on Computing in Civil and Building Engineering, Moscow, Russia, 27-29 June 2012.

Nawari, N. O. (2018). Building information modelling: automated code checking and compliance processes. Boca Raton, FL, USA: CRC Press, Taylor & Francis Group.

Ngowtanasawan, G. (2016). A causal model of BIM adoption in the Thai architectural and engineering design industry. International High- Performance Built Environment Conference – A Sustainable Built Environment Conference 2016 Series (SBE16), iHBE 2016.

Tanparitkul, S., Sawadsuk, N. (2015). Building Information Modeling (BIM): Using and Adoption Pathways in Thailand. The 20th National Convention on Civil Engineering 8-10 July 2015, Chonburi, Thailand.

Woodbury R., Burrow A., Drogemuller R. and Datta S. (2000). Code checking by representation comparison. CAADRIA: Proceedings of the 5th Conference on Computer Aided Architectural Design Research in Asia, pp. 235-244, CASA, Singapore.

Protein Release and Characterisation from Silk Fibroin Hydrogels formed by Electrogelation and Sonication

Gemma Egan

Purpose – Silk is a biomaterial that has been used for surgical sutures, meshes and scaffolds ^[1]. It can also be processed into hydrogels. The secondary structures of silk are: silk I, soluble silk containing extended helices or random coils; silk II, which has a high beta sheet content providing stability and mechanical strength; and silk III, which contains threefold polyglycine II-like helices. ^{[2][3]} The aim of the present study was to generate physically crosslinked silk hydrogels with tuned secondary structures and to assess the quantity and structure of silk lost from hydrogels when submerged in buffer.

Methodology/approach – *Bombyx mori* silk was reverse engineered into a silk fibroin solution, which was then processed into a silk hydrogel. First, the sericin was removed from the raw silk (i.e. degumming) and the high-order silk fibroin structure was disassembled by dissolving the fibres in lithium bromide. Next, the silk fibroin solution was dialysed against water to remove the lithium bromide salt. The silk solution was then self-assembled into a hydrogel using either sonication or a DC current (i.e. an e-gel).^[4]

The difference in silk content of both hydrogel types was determined by gravimetric analysis of dried samples. The secondary structure of the hydrogels was determined using Fourier Transform Infrared Spectroscopy and deconvolution was performed to quantify the beta sheet fraction of the silk fibroin.

The e-gel and sonicated hydrogel were submerged in water or PBS for 72 hours at 37°C. The quantity of silk protein lost from both hydrogels was determined by monitoring the protein content in solution. Samples were also subjected to Fourier Transform Infrared Spectroscopy.

Findings – The e-gel contained up to 15% more silk, although there was some batch to batch variability. In contrast, silk was quantitatively incorporated into the sonicated silk hydrogel. The sonicated hydrogel showed a higher percentage of beta sheets than the untreated silk solution, indicating that the structure of silk had shifted to silk II. In contrast, the e-gel contained fewer beta sheets and more alpha helices and turns which indicates the structure had similarities to silk I. The e-gel contained less random coil and more side chains.

The e-gel samples lost more silk over the incubation period in both water (>35% of starting silk content) and PBS (50% of starting silk content) than the sonicated hydrogel (0.6% and 0.4% in water and PBS respectively). The e-gel had a rapid release of silk over the first 6 hours followed by little release in the subsequent 48 hours in both water and PBS. In contrast, the sonicated gel had a steady release over the full 72-hour period. The secondary structure of the leached silk from both the e-gel and the sonicated hydrogel showed similar content of beta sheets, amorphous turns and random coil.

Originality/value – Silk can be reverse engineered to a silk fibroin solution which can be further processed into physically crosslinked hydrogels with a tuned secondary structure. When these hydrogels are incubated in both water and PBS silk is released, with a greater release seen from e-gels. Tuning silk release opens up new biomedical applications for these silk hydrogels.

Key words (max 5) Silk, Fibroin, Hydrogel, Secondary Structure

References

- 1. Seib, FP (2018) Reverse-engineered silk hydrogels for cell and drug delivery. Therapeutic Delivery 9, 469-487
- 2. Holland, C. et al., (2018) The Biomedical Use of Silk: Past, Present, Future. Advanced Healthcare Materials, 8(1).

^{3.} Qi, Y. et al., (2017) A Review of Structure Construction of Silk Fibroin Biomaterials from Single Structures to Multi-Level Structures. International Journal of Molecular Sciences, 18(237).

^{4.} Liesk, G. et al., (2010) Electrogelation for Protein Adhesives. Advanced Materials, 22(6).

To what extent is science a creative discipline, and how far is that reflected in the teaching vs the learning of science in Scotland?

Maria Egizia De Pascale

Purpose – The aims of the study are to explore to what extent science is a creative discipline, if the Curriculum for Excellence allows teachers to teach science in a creative way, and how this is reflected in the teaching and learning of science in Scotland.

Methodology/approach – The research involves the secondary school science teachers. They will be invited to participate in semi-structured interviews and to allow the attendance of the researcher to some of their lessons. The interview data and the observations will be investigated through the interpretative phenomenological analysis (IPA).

The interpretative phenomenological analysis is a qualitative research method, based on the interpretation of an individual meaning-making of a certain experience (phenomenon), and whose philosophical roots cross the ones of the philosophy of science. This technique is double interpretative, as it is an interpretation of another person interpretation, but also phenomenological, interpretative, and idiographic, as it focuses on the detailed study of a specific case. In the interpretative phenomenological analysis, the subjective truth outweighs the objective one, as the participant is considered an expert of the phenomenon under study.

A theoretical framework of the characteristics of creativity has been constructed by the researcher. This is based on extensive philosophical and historical readings and it will be used to analyse the degree of creativity shown by teaching material and in teachers' views of creativity in lesson.

This is set in the context of a creative Curriculum for Excellence, which has intentionally focused on creativity, seeing it as a quality that needs to be enhanced in students, as well as used by teachers in the development of their programmes and assessments. This research intends to look at how science teachers have responded to Curriculum for Excellence.

Findings – The researcher will document the teachers' creative approach in science teaching ending up analysing any discrepancy between the aspirations of the Curriculum for Excellence and the teachers experience of the curriculum. The answers to the semi-structured interviews combined with the teaching material and the lessons

observation will allow to analyse the effect of the Curriculum for Excellence on science teaching, and an evaluation of the extent to which it has fulfilled its intentions.

Practical implications – An analysis of the response of the secondary school science teachers both through interviews and an analysis of the teaching material, and the lesson observation will explore the extent to which the Curriculum for Excellence aspiration for creativity has being fulfilled by science teachers. It will also probe the causes of any discrepancies that are identified between policy and practice.

Originality/value – This study will focus primarily on creativity, as it has been recognized as impacting upon individuals' quality of life, and responsible for the economic well-being of an individual.

Key words – Science teaching; Creativity; Curriculum for Excellence; Scotland

References

- Amabile, T. M. (1998). HOW TO KILL CREATIVITY. (cover story). *Harvard Business Review*. https://doi.org/10.4135/9781446213704
- Education Scotland. (2019a). Curriculum for Excellence: Science. Experiences and Outcomes. Retrieved from https://education.gov.scot/Documents/sciences-eo.pdf
- Education Scotland. (2019b). The purpose of the curriculum. Retrieved from https://education.gov.scot/education-scotland/scottish-education-system/policyfor-scottish-education/policy-drivers/cfe-building-from-the-statement-appendixincl-btc1-5/the-purpose-of-the-curriculum
- Fuller, S. (2004). *Kuhn vs. Popper: the struggle for the soul of science*. New York: Columbia University Press.
- Guilford, J. P. (1967). The nature of human intelligence. In *McGraw Hill*. https://doi.org/10.4018/978-1-59904-426-2.ch007
- Koestler, A. (1969). *The Act of Creation*. The Danube Edition Hutchinson of London.
- Runco, A. M., & Albert, R. S. (2010). Creativity Research. A Historical View. In J. C. Kaufman & R. J. Sternberg (Eds.), *the Cambridge Handbook of Creativity* (pp. 3–19). Cambridge University Press.
- Smith, J. A., Flowers, P., & Larkin, M. (2009). interpretative phenomenological anlaysis. Theory, Method and Research. In *SAGE Publications Ltd*.
- Wallas, G. (1926). The art of thought. Book. https://doi.org/10.1038/nature08284

Developing an Optical Accordion Lattice with Variable Lattice Spacing for Quantum Simulation

Matt Mitchell

Purpose – Computational simulations of quantum many-body systems are problematic due to the complexity quickly exceeding what current supercomputer resources permit. Instead, we are using ultracold atoms to simulate transport in many-body systems in condensed matter physics such as electron gasses in solid crystals.

Methodology/approach – We create our crystal analogue potentials using standing waves produced by interfering coherent laser beams. This produces a potential of uniform peaks and troughs with a constant lattice spacing which is stable over time.

In this poster, I will report on our technical advancements for design and construction of an optical accordion lattice which provides a variable lattice spacing by adjusting the angle between our laser beams. This tunability allows us to adjust the lattice spacing to be suitable to the problem and to our detection process with an optical imaging system.

Research limitations/implications – With the accordion lattice we are going to study quantum tunnelling, the transport of atoms from one lattice site to another through a potential barrier. Also, we are interested in the heating of the trapped atoms and the created band structure of the accordion lattice. We hope to use our quantum simulation to further the understanding of transport problems such as high temperature superconductivity.

Key words (max 5) – "Quantum Simulation", "Transport Problems", "Ultracold Atoms", "Quantum Gasses", "Experimental Physics"
Cortical Activity of Relevance

Zuzana Pinkosova

Introduction – Understanding relevance is an essential aspect of human-information interaction within the context of Information Retrieval (IR) (Mizzaro, 1997; Saracevic, 2007; Schamber & Eisenberg, 1988). Despite the significance and importance of this concept (Schamber & Eisenberg, 1988), relevance is still not completely understood (Mizzaro, 1997). Recent research employing brain imaging (i.e. Allegretti et al., 2015; Moshfeghi et al., 2013; Moshfeghi & Pollick, 2018) was able to bring novel insights and significantly contributed towards the understanding of this complex phenomenon through the investigation of user's subjective relevance perception of retrieved information. These studies have found significant differences in brain activity when the user judged information as relevant vs. non-relevant. However, these studies have examined relevance as a whole, and its cognitive, affective or/and situational aspects (Saracevic, 2007) have not yet been examined in details. This work ais to focus and explore the link between the cognitive aspects of relevance and user's subjective relevance and user's subjective relevance and user's subjective relevance perception.

Hypothesis – Based on the previous literature, we hypothesise that participants' binary relevance judgements will differ significantly based on their previous knowledge. This is based on findings of past research suggesting that brain activation differs during the integration of incoming information that are related to what is already known, comparing to the unknown information (Maguire, Frith and Morris, 1999). Hence, the findings might provide support the concept of cognitive relevance (Saracevic, 2007) and suggest that differences in cognitive processes play an important role in relevance perception.

Methodology – We investigate our hypothesis through conducting a user-based study where we gather physiological and behavioural signals to gain a better understanding of the participant's experience during the relevance judgement task. In this study, participants will engage in Question Answering (Q/A) Task, while their brain activity will be recorded using an electroencephalogram (EEG). We will examine the effect of cognitive factors, such as participant's previous knowledge, on participants' relevance judgements, provided on binary scale (relevant vs. non-relevant).

Practical implications

Being able to gain a better understanding of cognitive relevance might lead to the improvement of user-system interaction, increasing search success. Further understanding of neural signatures of relevance might provide valuable insight into personalisation within IR (Kelly & Belkin, 2004). This could also lead to a significant contribution to the improvement of information systems (Moshfeghi, Triantafillou, and Pollick, 2019).

Originality/value – In this study, we extend previous work focused on brain activity associated with relevance, by investigating complex cognitive aspects of relevance. This study is the first to incorporate relevance theory and a neuroscience approach to investigate the neural correlates of cognitive relevance.

Key words – Relevance Judgement, Cognitive Relevance, EEG, Brain Signals, Information Processing

References

- [1] Allegretti, M., Moshfeghi, Y., Hadjigeorgieva, M., Pollick, F.E., Jose, J.M. and Pasi, G., 2015, August. When relevance judgement is happening? An EEG-based study. In Proceedings of the 38th International ACM SIGIR Conference on Research and Development in Information Retrieval (pp. 719-722).
- [2] Kelly, D. and Belkin, N.J., 2004, July. Display time as implicit feedback: understanding task effects. In Proceedings of the 27th annual international ACM SIGIR conference on Research and development in information retrieval (pp. 377-384).
- [3] Maguire, E.A., Frith, C.D. and Morris, R.G.M., 1999. The functional neuroanatomy of comprehension and memory: the importance of prior knowledge. Brain, 122(10), pp.1839-1850.
- [4] Mizzaro, S., 1997. Relevance: The whole history. Journal of the American society for information science, 48(9), pp.810-832.
- [5] Moshfeghi, Y., Pinto, L.R., Pollick, F.E. and Jose, J.M., 2013, March. Understanding relevance: An fMRI study. In European conference on information retrieval (pp. 14-25). Springer, Berlin, Heidelberg.
- [6] Moshfeghi, Y. and Pollick, F.E., 2018, April. Search process as transitions between neural states. In Proceedings of the 2018 World Wide Web Conference (pp. 1683-1692).
- [7] Moshfeghi, Y., Triantafillou, P. and Pollick, F., 2019, May. Towards predicting a realisation of an information need based on brain signals. In *The World Wide Web Conference* (pp. 1300-1309).
- [8] Saracevic, T., 2007. Relevance: A review of the literature and a framework for thinking on the notion in information science. Part III: Behavior and effects of relevance. Journal of the American Society for information Science and Technology, 58(13), pp.2126-2144.
- [9] Schamber, L. and Eisenberg, M., 1988. Relevance: The Search for a Definition.Howard D

Urbanisation in Post-Conflict Contexts: Urban Development and Reconstruction in Post-Conflict Cities. Benghazi Libya 2010-2020, As a Case Study.

Saleh Almogrbe

This research aims to investigate the relationship between urban development and reconstruction in a post-conflict context. It utilises Benghazi Libya 2010-2020 as a case study. A key objective is to determine the key factors driving rapid urban development, with analysis of the spatial-temporal effects of urban growth in Benghazi city during and post-conflict.

The approach of investigation is a qualitative method based on the examining the international experience; other cities around the world since the second WWII which have experienced the same condisition, This will enable an understanding of how each city dealt with these crises to make a recovery and reconstruction. This will involves a discussion the role of displacement of people and communitis in the urban development process during and post conflicts.

Semi-structured interviews with a sample of academic specialists and experts in urban planning and infrastructure, in the city, to explore the process of development and reconstruction after the conflict. Also, in order to study the social effects driving urban development, a an attitude survey will be conducted for a sample of residents Benghazi to find out the causes and motives of urban growth post-conflict. The process of measuring physical urban growth by is analysed by Geographic Information System with the use of high resolution satellite images.

The aniticipated results will be in the form of multiple outcomes that include: comparative analysis of post-cnflict reconstruction in various cities, a demonstration of the phases of reconstruction and urban development in Benghazi city, articulating the role of local authorities of Benghazi. The ultimate outcome will be the development of a model addressing the challenges of post-conflict which will be validated and tested with a view to inform future growth.

Key Words: Benghazi - Libya - Post-Conflict - Reconstruction - Urban Development.

Advanced Manufacturing for Vascular Graft Sealant Technology

Kirsty Goudie

Terumo Aortic is a global leader in the design and manufacture of vascular grafts for open surgery, currently producing 120,000 synthetic grafts per year for life-saving arterial replacement to treat patients with aortic disease. A key component of the market success of these products is the gelatin impregnation sealing technology which makes the grafts impermeable to blood leakage when implanted but which degrades over a period of approximately 14 days in-vivo to allow unimpaired tissue incorporation into the matrix of the graft.

Gelatin is a polypeptide which is made up of amino acid monomer units. Currently, to achieve optimum properties Terumo Aortic use a mixture of non-succinylated and succinylated gelatin in a 1:1 ratio. Succinylation is a chemical modification of the lysine amino acid residue. This gelatin modification blocks crosslinking sites and allows the degree of crosslinking to be controlled.

Despite the critical importance of this gelatin technology for its surgical products, the company is currently reliant on external suppliers for the production of modified gelatin (succinylated gelatin) which is an integral part of the graft production process. Succinylated gelatin was widely used in the photographic industry for film, however due to a more digital approach this industry has declined leading to difficulties with supply of this modified gelatin.

Therefore, it is important to understand the succinylation chemistry that occurs at the lysine residue of gelatin and determine the optimum conditions for this process. It is also important to compare the properties of laboratory succinylated gelatin with gelatins currently used within Terumo Aortic and to ensure the process is transferable to a larger scale in order to maintain supply of this critical raw material. If further supply chain issues occur Terumo Aortic may need to be able to do it themselves.

Key words (max 5) Gelatin, gelatine, succinylation, lysine, modification

References

C. D. Qiao, J. L. Zhang, X. G. Ma, W. L. Liu and Q. Z. Liu, *International Journal of Biological Macromolecules*, 2018, **107**, 1074-1079.

T. Liu, G.-F. Zhang, W.-B. Zhou and Z.-G. Su, *Chinese Journal of Analytical Chemistry*, 2007, **35**, 43-48.

A Novel Approach to Integrate Ant Colony Clustering into Data Visualization Accounting Dashboards to Improve the Appraisal Efficiency and Accuracy of Executive Decision Making.

Thomas Rashford

Purpose – This paper examines the research opportunities for the use of "Ant Colony Clustering" in developing a novel data visualization approach for executive decision making in accounting dashboards particularly in mega construction projects that require complex data visualization solutions. This approach is based on a swarm-intelligent method used for clustering problems visually that is primarily inspired by ant colonies behaviour.

Methodology/approach – The researcher examines literature at the confluence of accounting, operations research, data visualization, and Information systems to identify current research themes. An analysis is presented of 38 accounting, operations research, data visualization and information systems journals from 2006-2017 to identify key themes emerging. The themes are used as a conceptual matrix to transform current data visualization approaches into an ant colony-clustering algorithm that mimics managerial decision-making represented in accounting dashboards.

Findings – A work in progress, the initial findings indicate an acceptance of data visualization transformation for accounting decision making, yet the research is still in the very early stages to yield the necessary body for data analysis required for the primary research question.

Research limitations/implications – The inclusion of "Big Data" may enable the capturing of more relevant implications of data visualization integration in decision-making dashboards, however, with the complexity and unique uses of information systems, generalization of traditional data visualization dashboards can lead to inconsistently scattered outcomes.

Practical implications – The study highlights opportunities for data visualization in accounting dashboards that can potentially improve the appraisal efficiency of executive decision making especially utilizing big data. This has the potential to improve our understanding of current visualization approaches in accounting and management research.

Originality/value – Increased research in implications for data visualization in accounting dashboards can potentially improve the efficiency of executive decision making in mega projects and in turn can lead to improvements in industry practices and frameworks for future accounting dashboard system design.

Key words (max 5) Data Visualization, Accounting Dashboards, Executive Decision Making, Ant Colony Clustering, Optimization.

References

Abraham, L. and Appiah, O. (2006) 'Framing News Stories: The Role of Visual Imagery in Priming Racial Stereotypes', *Howard Journal of Communications*, 17(3), pp. 183–203. doi: 10.1080/10646170600829584.

Abubakar, A. M. *et al.* (2017) 'Knowledge management, decision-making style and organizational performance', *Journal of Innovation & Knowledge*.

Adjei-Kumi, T. and Retik, A. (1997) 'A library-based 4D visualisation of construction processes', in *Proceedings. 1997 IEEE Conference on Information Visualization (Cat. No. 97TB100165)*. IEEE, pp. 315–321.

Agor, W. A. (1989) *Intuition in organizations: Leading and managing productively*. Newbury Park, CA: Sage.

Aho, J. (2006) Confession and bookkeeping: The religious, moral, and rhetorical roots of modern accounting. SUNY Press.

Akinyemi, B., Okoye, A. E. and Izedonmi, F. (2015) 'History and development of accounting in perspective', *International Journal of Sustainable Development Research*, 1(2), pp. 14–20.

Blum, C. (2005) 'Ant colony optimization: Introduction and recent trends', *Physics of Life reviews*, 2(4), pp. 353–373.

Dorigo, M., Birattari, M. and Stutzle, T. (2006) 'Ant colony optimization', *IEEE computational intelligence magazine*, 1(4), pp. 28–39.

Dorigo, M. and Blum, C. (2005) 'Ant colony optimization theory: A survey', *Theoretical computer science*, 344(2–3), pp. 243–278.

Dorigo, M. and Di Caro, G. (1999) 'Ant colony optimization: a new meta-heuristic', in *Proceedings of the 1999 congress on evolutionary computation-CEC99 (Cat. No. 99TH8406)*. IEEE, pp. 1470–1477.

Dorigo, M. and Stützle, T. (2003) 'The ant colony optimization metaheuristic: Algorithms, applications, and advances', in *Handbook of metaheuristics*. Springer, pp. 250–285.

Dorigo, M. and Stützle, T. (2019) 'Ant colony optimization: overview and recent advances', in *Handbook of metaheuristics*. Springer, pp. 311–351.

Dosi, G. (1982) 'Technological paradigms and technological trajectories: a suggested interpretation of the determinants and directions of technical change', *Research policy*, 11(3), pp. 147–162.

THANK YOU #DSMS2020



DRG Doctoral Researchers Group