

## **Poster Abstract**

Research Showcase

College of Science and Technology

MediaCity UK

Wednesday 18<sup>th</sup> June 2014

University of Salford

ISBN: **978-1-907842-56-6**

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## Introduction

Welcome to the College of Science and Technology Research and Innovation Showcase 2014, an event which celebrates the research achievements of our science disciplines.

Our research brings together scientists from architecture and the built environment through to computing, engineering, mathematics and physics and biology, geography and environmental science. We are committed to build on our strengths, and our key vision is to drive research growth and impact through exploitation of the synergy between research, innovation and enterprise.

This year's showcase event includes over 70 posters illustrating the excellent research being pursued, a Dean's prize recognising the achievements of an early career researcher, prizes for the best student and best students' posters and journal papers, and this proceedings of abstracts showing the high quality and range of research in the College of Science and Technology.



Professor Judith Smith

Dean, College of Science & Technology

A handwritten signature in black ink, appearing to read 'Judith Smith'.

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# **IMPACT AREA (1): Biosciences and Digital Healthcare**

# The experiences of learning in a 3D immersive learning environment

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As enhanced technology becomes mainstream and increasingly cost-effective there is evidence of rising interest in the potential of immersive environments (Kapp and O'Driscoll 2010). Salmon (2009) suggests that we explore these environments as a "sandbox in which to experiment" (p 531) and a way to try out new ways of teaching and learning.

The aim of this study was to explore, using qualitative methodology, the experiences of undergraduate occupational therapy students in using a 3D immersive learning environment (Second Life). Ethical approval was obtained from the University of Salford Ethical Approval Panel and the requirements for confidentiality and informed consent were met.

For this study a house was developed within Second Life that represented a typical home simulating the environmental barriers to occupational performance for a wheelchair user. The students were expected to engage with the virtual home to gain a basic understanding of reducing environmental barriers through a process of problem solving using information driven scenarios, as defined by Bignell and Parson (2010). Findings conclude that by actively participating in the virtual environment potential benefits are made to increased immersion and engagement of students in learning activities. It is expected that new skills can be effectively transferred to real life scenarios.

## References

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- Salmon G (2009) The Future for (Second Life) and Learning British Journal of Educational Technology Vol 40 NO 3 526-538
- K.M. Kapp and T. O'Driscoll (2010) Adding a New Dimension to Enterprise Learning and Collaboration Wiley & Sons: San Francisco

# A novel method of interpretation of ELISA data

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Keywords: Echinococcus; diagnostic testing; surveillance; ELISA; mixture models; Bayesian statistics

Echinococcosis is a considerable public health problem amongst people worldwide, yet is asymptomatic in domestic dogs: an important definitive host. To date, surveillance of canine infection has relied largely on ELISA testing of faecal samples for coproantigens released by the worms. Interpretation of the optical density (OD) data resulting from this testing has largely been based upon selection of a single cut-off point, with classification of animals dichotomously as 'infected' or 'uninfected'. However, this approach ignores the fact that infection within a community is rarely homogenous – with most dogs carrying low worm burdens, but some carrying very high burdens.

Mixture models are statistical tools for the identification of subgroups within populations. A Bayesian mixture model comprised of a Gaussian distributed negative group and a Polya Tree distributed positive group was developed in order to improve the interpretation of coproELISA data collected from a community of dogs. It is well known that the coproELISA OD value of *Echinococcus* infected dogs is directly proportional to the log of the worm burden, and therefore a panel of samples from infected dogs of known burden was used to develop a Bayesian linear regression model. The probability of membership in the 'positive' mixture model component and the predicted log worm burden from linear regression were combined multiplicatively in order to create a 'score' for each dog tested. When applied to a panel of dogs of known status, good agreement with the infection status was observed.

As coproantigen sample collection and testing is relatively simple, data collected during routine *Echinococcus* surveillance can be analysed using the method described here. It is hoped that this will allow more accurate estimation of the true prevalence of infection within a community, as well as providing useful information on the distribution of worm burdens and therefore more comprehensive information on infection dynamics within dogs.

# Emetine dihydrochloride hydrate: a potential candidate for repositioning in malaria

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Keywords: Malaria, drug-repositioning, drug interaction analysis, emetine dihydrochloride

Drug repositioning, or the screening of existing drugs for new diseases, is increasingly viewed as an alternate strategy to fast-track drug discovery. Traditional drug discovery pipelines report ever increasing attrition rates despite the costly and time consuming processes involved. The vast repertoire of potential repositioning candidates with proven bioavailability, safety profiles and comprehensive historical information, in the public domain, will prove a vital resource to formulate mechanistic hypotheses on putative targets. Phenotypic screening, using the versatile SYBR Green-based flow cytometric and microtitre assays, of ~700 compounds, selected from two patent-expired drug libraries, yielded a complement of potential antimalarial leads (~ n=60) displaying strong *in vitro* inhibition of the *P. falciparum* K1 strain. Screening data highlighted the anti-amoebic drug emetine dihydrochloride as a potent antimalarial option. The work corroborates a previous study (Lucumi *et al.*, 2010) where IC<sub>50</sub> values of 1 nM were reported in the drug sensitive 3D7 strain of *P. falciparum*. Our data on the multidrug resistant strain reports the retention of nanomolar efficacy with IC<sub>50</sub> values of 47 nM. Despite concerns about toxicity, the nanomolar antimalarial potency, chemical malleability, the killing rate and combinatorial potential of the compound validates its further investigation as a standalone or combinatorial antimalarial candidate. A synthetic modification of the drug (dehydroemetine (Roche)) which structurally differs from emetine dihydrochloride only in a double bond next to the ethyl substituent is reported to retain its anti-amoebicidal properties while producing fewer side effects. Data from fixed-dose and CalcuSyn-based synergy studies and PRR/PCT experiments will be presented.

## Reference:

Matthews, H., Idris-Usman, M., Khan, F., Read, M & Nirmalan, N. (2013) Drug repositioning as a route to antimalarial drug discovery: Preliminary investigation of the *in vitro* antimalarial efficacy of emetine dihydrochloride hydrate. *Malaria Journal*. 12: 359

# Using Lot Quality Assurance Sampling (LQAS) to evaluate the impact of one year of intervention on canine echinococcosis in the Alay Valley, Kyrgyzstan

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Echinococcosis, Lot Quality Assurance Sampling, praziquantel dosing, Alay Valley

Echinococcosis is a neglected zoonotic disease caused by infection with cestode tapeworms in the genus *Echinococcus*. Canids including domestic dogs act as final hosts for *Echinococcus* spp. and humans may become infected by ingesting *Echinococcus* spp. eggs present in the faeces of final hosts. Echinococcosis is characterized by the formation of cysts, and, if untreated, is often fatal. Echinococcosis is a public health concern in Kyrgyzstan, where human cases have increased greatly since the country's independence from the Soviet Union in 1991. In 2011, the World Bank considered echinococcosis to be of sufficient concern to implement an intervention programme which includes providing antihelmintics (praziquantel) for dogs. Dosing of domestic dogs began in the summer of 2012, with an aim to dose all owned dogs four times a year. In order to evaluate this intervention programme, we visited ten communities in the Alay Valley in April 2013 to question local people about the praziquantel dosing regime and sampled owned domestic dogs to test for *Echinococcus* spp. using coproELISA. We used Lot Quality Assurance Sampling (LQAS) to evaluate the control scheme, as this methodology requires a relatively small sample size whilst remaining statistically sound. LQAS requires the setting of thresholds. Based on previous research, we set the praziquantel dosing threshold at 75% of dogs dosed in the previous four months, and, based on pre-intervention sampling, set the canine echinococcosis threshold at 25%. We found evidence that the dosing campaign was failing to reach 75% of dogs in 6/10 communities, and found no evidence that the canine echinococcosis rates had decreased from pre-intervention levels in 9/10 communities. Future work aims to examine the praziquantel dosing and canine echinococcosis in the same communities after two years of intervention.

# A Medical Ultrasound Reporting System Based On Domain Ontology

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Keywords: Ultrasound, Ultrasound Reporting, Ontology, Radiology, Digital Healthcare

Today, there are various ways ultrasound reports are being constructed. These variations in reporting style could impact on the value of the report and the way it is interpreted, which in turn has implications for patient management and decision making. In radiology, a radiologist report is seen as the most ultimate product (Boland, 2007). This is even more pertinent in ultrasound since images produced during the exploration are only representative and have been appropriately selected for the purpose of subsequent discussion (Bates, 2004, p.9). Thus, it is vital that an ultrasound report produced be of good quality. Ultrasound report contains a lot of valuable information that can be very useful in research and education. However, heterogeneous terminologies pointing to the same concept have deterred this effort. The development of ontology allows for these terminologies with commonly accepted definitions to be sorted in a dictionary like framework for knowledge representation (Smith, 2003). This research project aims to develop a medical ultrasound reporting system that uses domain ontology as its knowledge base to support the generation of standardised report. The domain ontology will specifically focus on abdominal ultrasound scanning which includes both the anatomy and pathology of the abdominal areas. The ontology will initially be developed using existing reference terminologies which will later be cross referenced with the terminologies used in the sample reports. The results of this analysis will be used to inform the construct of a complete ontology for ultrasound reporting. It is anticipated that a standardised report based on domain ontology will improve the quality of ultrasound report.

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- Boland, G. (2007). Enhancing the radiology product: the value of voice-recognition technology. *Clinical Radiology*, 62(11), 1127. doi:10.1016/j.crad.2007.05.014
- Smith, B. (2003). *Ontology: philosophical and computational*. In Floridi L (Ed.), *The Blackwell Guide to the Philosophy of Computing and Information*. Oxford: Blackwell Publishers.



# Metagenomic analysis of the gut microbiome of the common black slug *Arion ater* in search of novel lignocellulose degrading enzymes

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Keywords Bioethanol, Metagenomics, Microbiome, Cellulase, Lignocellulose, *Arion ater*

There is increasing pressure on the global community to lower CO<sub>2</sub> emissions, mainly through adopting more sustainable energy sources. Bioethanol derived from lignocellulose is considered to be one of the most promising direct liquid fossil fuel replacements. Cellulose is the most abundant organic compound on the planet, making up approximately 33% of all plant matter making it a logical and sustainable feedstock for bioethanol production. However, lack of adequate carbohydrate active enzymes (CAZymes) has hindered the necessary feedstock transition. Many organisms have overcome the difficulties of lignocellulose breakdown, some having adopted it as their sole source of carbon.

Using Illumina sequencing technology we carried out a metagenomic study of the gut microbiome of the gastropod *Arion ater*, a plant eating pest species, focusing on identification of novel CAZymes. Firstly gut cellulolytic activity was confirmed using zymography and microbial growth plate assays. Gut microbial metagenomic DNA was then extracted, sequenced and *de novo* assembly of the resultant 26,046,645 250bp pair-end reads (totalling 5.8 Gbp) was carried out. Following assembly 108,691 open reading frames were predicted and annotated against the NCBI non-redundant protein database and the PfamA database.

Functional analysis revealed more than 3000 glycoside hydrolase (GH) domains and carbohydrate binding modules (CBM). Of these ~46% are thought to be involved in the breakdown of plant cell wall components with the greatest number targeting hemicellulose and oligosaccharides. 322 of these genes belonged to GH groups targeting long chain hemicellulose and 366 to groups which target the resultant partially digested hemicellulose oligosaccharides. Multiple genes were also identified that target cellulose and pectin suggesting full utilisation of each carbohydrate component of lignocellulose by *Arion ater*.

This research demonstrates the untapped potential of organisms in groups such as the gastropods as treasure troves of novel lignocellulose degrading enzymes for the biofuel industry.

# Medical Ultrasound Images De-speckling Using Adaptive, Spatial and Wavelet Based Hybrid Model: Performance Analysis and Comparison

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Keywords: Ultrasound; multiplicative speckle noise; Spatial; 4<sup>th</sup> order Partial Differential Equation; Anisotropic Diffusion; Adaptive, Wavelet transform, Dual Tree Complex wavelet transform; Plantar Fascia; Performance Metrics.

Ultrasound imaging is a very common and widely used technology for medical diagnosis and prognosis due to its availability, ease-of-use, portability and cost effectiveness when compared to other imaging methods. Moreover, it gives a great hope to many patients suffering from common disorders, as it provides great potential for discovering treatments and cures for the related diseases. However, the big disadvantage of ultrasound imaging is that it produces very noisy and speckled images, usually during the acquisition and transmission processes. This makes ultrasound images hard to define and segment the region of interest, because of its low contrast, the existence of multiplicative speckle noise and the problem of missing or diffusing boundaries making the visual interpretation and quantitative measurements more complicated during diagnosis. In this paper, a hybrid technique is proposed to overcome the previous problems. This proposed model is a combination of Spatial (Speckle Reduction Anisotropic Diffusion based on 4<sup>th</sup> order Partial Differential Equation), Adaptive filters and Wavelet based filters (Dual Tree Complex Wavelet transform (DTCWT)). The experimentation is carried out on real normal and abnormal plantar fascia ultrasound images obtained from Salford Medical Department. The proposed hybrid model is compared with traditional, anisotropic, wavelets based filters and existing hybrid models using different computed performance metrics. Our results showed that the proposed hybrid model is more efficient in reducing noise, preserving edges, boundaries, textures, and producing good quality visual de-noised images compared to other filters.

# Novel therapies for cancer treatment: designing high affinity and selectivity ligands against SIRT1

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Keywords: DNA Aptamers, Sirtuin1, SELEX

The word 'sirtuin' (SIR) stands for Silent Information Regulator. SIRT1 is the most studied mammalian sirtuin and predominantly localises to the nucleus. Many sirtuin targets are involved in cancer and in many types of cancers, SIRT1 is found to be overexpressed. Recent observations support SIRT1 being both an oncogene and a tumour suppressor, depending on the cancer etiology and type of tissue. To answer the question "How can sirtuins function as both oncogenes and tumour suppressors?" we propose to develop highly selective ligands and study in a range of cancer cell lines the modulated activity of SIRT1. Aptamers are a novel and particularly interesting targeting modality, with a unique ability to bind to a variety of targets including proteins, peptides, enzymes, antibodies and various cell surface receptors. Aptamers are single stranded oligonucleotides that vary in size between 25 and 50 bases long and are derived from combinatorial libraries through selective targeting. They offer unique benefits compared to other targeting agents, in that they bind with high affinity and selectivity, are not immunogenic or toxic and have good clearance from the system, are easily and quickly synthesised using in vitro techniques, and are stable and consistent. The SELEX methodology is based on the idea of following an evolutionary process of selection, partition and amplification rounds to generate nucleic acids as therapeutic reagents. Since DNA molecules adopt stable and intricately folded three dimensional shapes, they are capable of providing a scaffold for the interaction with functional side groups of a ligand.

To test the above hypothesis we plan to follow the specific methodological approaches:

- Identification of aptamers against SIRT1.
- Characterisation of the interactions between selected aptamers and SIRT1 in vitro.
- Characterisation of the interactions between selected aptamers and SIRT1 in a range of cancer cell lines.
- Development of organic ligands against SIRT1 and their comparison with aptamers.

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## G4 quadruplex DNA a target for novel drugs

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Keywords; Flavonoid, Antimicrobial, Drug Design, Click Chemistry, Quadruplex DNA

The rise of drug resistant pathogens has become a global issue which threatens the wellbeing of the entire human race. Resistance in pathogens has arisen in recent years due to the excessive and reckless use of antimicrobials in areas such as agriculture, where antimicrobials are mixed into animal feed to minimize illness, and as preventative medicine. If the issue of resistance is left unchecked a point will soon be reached where no effective antimicrobial treatments remain. Currently the last resort methods of treating infection rely on the combination of several antimicrobial drugs, however certain strains of pathogens, such as the 'superbug' MRSA (*Methicillin-resistant staphylococcus aureus*), have begun to appear with resistance even to these powerful treatments. It is imperative that a new generation of antimicrobial treatments are produced soon in order to remain one step ahead of the ever evolving pathogens. This project aims to produce a new generation of antimicrobial drugs by modifying naturally occurring flavonoid compounds.

By using one pot acylation procedures, flavonoids can be generated with specifically positioned functional groups allowing for the addition of linker compounds with varying chain lengths to be attached. The attachment of these linkers will be used for the synthesis of bis-flavonoids. These new compounds have the potential to intercalate into double stranded DNA disrupting key processes and replication making them an ideal antimicrobial drug.

Preliminary data produced through testing on a single bis-flavonoid compound showed that, compared to a single flavonoid molecule, the binding affinity to duplex DNA was increase 20,000x and with the specific target quadruplex DNA a further 4 fold increase was seen.

The bis-flavonoids could also be engineered in order to produce a greater response at a desired target site.

# EVALUATION OF E-HEALTH SYSTEM IN DEVELOPING COUNTRIES

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Keywords: eHealth, Health Information System, Information System, developing countries, developed countries, Healthcare management, service quality.

Information system supports different types of decisions at different levels of organization hierarchy. In recent years the need for faster searching of records or information in database and the need for properly cataloguing records has become essential especially in health care systems. This is mainly aimed at overcoming the challenges faced by delays when creating, retrieving and updating records and likewise the challenges of multiple duplication of data or information of single patient causing confusion in information retrieval.

The study is therefore aimed to evaluate the existing eHealth systems in both developed and developing countries, exploring their various approaches, uses, strength and challenges. This will enable the research to enhance the in-depth knowledge of eHealth appreciation and application by identifying the factors/components that helps to integrate an efficient and quality eHealth system to the applying countries. The study furthermore, helps to discuss the pros and cons of the implementation and application of ehealth in the applying countries as well as identifying the possible ways to better improve on these existing systems, their approaches and uses.

This is because it is observed that developing countries are yet to appreciate the benefit of eHealth system even though there is awareness. This is because they lack the in-depth understanding of the relevance of its implementation and application, due to this the quality of the citizens in developing countries as been below standard as well as the economic growth of these countries.

Therefore, the study aims to help develop a framework that will enable the full acknowledgement and appreciation of eHealth system that could be implemented and applied in various health care sector of these countries. This is because we aimed to improve the quality of the citizen and likewise allow a quality output of patients by applying a system that supports quick decision-making in the health sector of these developing countries.

## Fusion Proteins as Selective Cancer Therapy

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Keywords: Cancer, Sialic acid, Lectin, Mistletoe, Fusion protein, Glycan affinity.

One of the most common post-translational modifications is covalent attachment of carbohydrates to proteins. At the cell surface, molecular recognition events involved in cancer metastasis are mediated by sugar moieties of glycoproteins. Evidence from both patient (histochemical analysis) and experimental work (tumor models) show that the metastatic tumor phenotype is associated with altered sialylation of tumor cell surfaces. Structural domains that recognize and bind specific carbohydrates without altering the recognized sugars are usually called lectins. Mistletoe lectin isoform I (MLI), from *Viscum album*, is an example which has strong binding affinity for sialic acids especially  $\alpha$ 2,6 sialic acid.

In the present study, mistletoe lectin isoform I chain B (MLB) was targeted through conducting polymerase chain reaction (PCR) for cDNA which was reverse transcribed from the extracted *V. album* RNA. The targeted sequence was successfully amplified with a size corresponding to the predicted size (789bp). Several sequencing reactions were performed to determine the identity along with quality and quantity of the targeted PCR product. Mutagenesis of plasmid DNA was performed and the resulting DNA was transformed in chemical competent bacteria. The DNA was extracted and sequenced to confirm correct mutagenesis. The sequence data showed a clear indication that the insert is our desired gene product allowing us to go on to design a fusion protein. Both *N*- and *C*- terminus fusion strategies were used to assemble constructs of the MLB chain fused to GFP in the pGFPuv expression vector. The expression vector was then transformed to a specific strain of *E. coli* (BL21) and the expression of the target gene/ fusion was successfully carried out. The same mechanism will be used to generate negative and positive control fusion proteins. Finally the GFP-MLB fusions will be screened against a range of cancer cells lines in order to confirm MLB binding to the tissue and to confirm MLB-fusion crossing the cell membrane.

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# Glucocorticoid Receptor Interactome

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Computational Biology      Systems Biology      Leukaemia      Glucocorticoids

Glucocorticoid hormones are used in the treatment of a variety of diseases, due to their diverse range of effects. Acute lymphoblastic leukaemia (ALL), the most common form of childhood cancer, is one such disease treated by glucocorticoids (GCs). Although there has been much success in the treatment of ALL with GCs, drug resistance remains a problem, despite the accumulated knowledge of the signalling networks underlying the GC actions through the glucocorticoid receptor (GR). Systems biology offers the opportunity to gain a holistic view of protein interaction networks, whilst also allowing for the generation of predictions through *in silico* knockouts which can be validated through conventional laboratory approaches. Systems biology has shown great success in identifying novel signalling pathways. Here we present the preliminary model of the GR interactome, constructed through MATLAB using the add-on CellNetAnalyzer, and visualised through Cytoscape. The model currently consists of 56 nodes representing genes and proteins that interact with the GR as well as inputs such as a glucocorticoid. During curation tissue-specific reactions were built into the model, leading to nine forms of the model each reflecting a cell type, with a tenth reference model consisting of all interactions. Currently there are 87 interactions in the model overall. Interactions were extracted automatically from the STRING database using the UltraEdit text editor, and then manually curated by literature mining to remove false positives. The curated interactions were imported into CellNetAnalyzer and the dependency matrices were generated, showing 2304 dependencies. These dependencies changed depending on the cell type. Future work will be directed towards expanding and connecting this model to drugs or processes like apoptosis, to detecting potential therapeutic targets, whilst also validating it through analysis of microarray data from ALL patients, paving the way for personalized treatment.



# **Antimicrobial Sensitivity of Methicillin-Resistant *Staphylococcus aureus* (MRSA) isolates collected from healthcare and community facilities in Libya**

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**Keywords:** Antibiotic resistance, fusidic acid, Libya, MRSA

The prevalence of MRSA in healthcare and community settings in Libya was studied in clinical specimens submitted to the microbiology laboratories at Tripoli Central Hospital, Tripoli Trauma / Accident Hospital, Tripoli Medical Centre and Tripoli Burn Hospital. Antibiotic susceptibility patterns were determined using the Kirby and Bauer disc diffusion susceptibility testing method. The prevalence of Inpatient Healthcare Associated MRSA (IP-MRSA), Outpatient-Healthcare Associated MRSA (OP-MRSA) and community carried MRSA (CC-MRSA) was 43%, 37% and 38% respectively. All the isolated strains of MRSA displayed resistance to fusidic acid and strains had multiple drug resistance (MDR) to 2- 9 antibiotics for IPMRSA, 2-7 antibiotics for OP-MRSA and 2-6 antibiotics for CC-MRSA. The most frequent MDR was resistance to fusidic acid, ciprofloxacin, streptomycin and clindamycin. This study has shown that MRSA is equally prevalent in inpatient, outpatient and community settings. Analysis of a survey of the availability of antibiotics showed a lack of restrictions on the supply of antibiotics and widespread use by the general public which may be responsible for the fusidic acid resistance. Preliminary examination of MIC's and PCR for the presence of fusidic acid resistance determinants (Fus A, B, C) suggest that the incidence is mainly low-level resistance.

# **Anti-platelet effect of Corilagin isolated from *Phyllanthus niruri* L.: in vitro and proteomics study**

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Keywords: *Phyllanthus niruri* L., corilagin, platelet aggregation, anti-platelet, proteomics

*Phyllanthus niruri* L. is an indigenous plant of tropical areas which is known to possess various therapeutic properties and thereby has been used widely as a traditional remedy in many countries [1]. In our study, we found that crude extracts of this herbal medicine showed an activity in preventing the formation of platelet aggregates. Furthermore, We isolated Corilagin (beta-1-O-galloyl-3,6-(R)-hexahydroxydiphenoyl-d-glucose) as one of the major compounds contained in 50% methanol extract of this plant that significantly inhibited platelets aggregation in-vitro. However, there are only a limited number of reports available so far to explain the anti-thrombotic activity of Corilagin and therefore the mechanism of this inhibitory effect is still not clear [2, 3] . To address this question, we performed in-vitro platelet aggregation and proteomics approach to investigate corilagin activity on platelet aggregation as well as protein alterations in the aggregation event with or without the presence of Corilagin.

As the result, we have detected more than 500 protein features from 1D and 2D gel images. The image analysis showed that there were differences of density of 131 proteins in the presence of corilagin. As the majority of platelet proteins are cytoskeletal (22%) and signaling (26%) proteins which are strongly related to platelet activation and aggregation events, we found that corilagin addition into ADP-induced platelet aggregation changed the expression of platelet proteins that correspond to these proteins. More than a half of the proteins are acidic with pI value within the range of 4-7 [4]. Therefore, we proposed that corilagin activity is strongly related to the inhibition of platelet cytoskeleton rearrangement and/or signaling pathway during platelet aggregation.

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# Characterisation of lipoproteins in *Staphylococcus aureus*

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Keywords: Lipoproteins, *Staphylococcus aureus*, Methicillin-resistant *Staphylococcus aureus*.

*Staphylococcus aureus* is an extremely successful opportunistic bacterium capable of causing a wide range of hospital-acquired and community-acquired infections, and is becoming increasingly virulent and resistant to antibiotics. Various methods have been used to analyse the pathogenic behaviour of *S. aureus* including genomics, transcriptomics, and proteomics. Due to the broad ranging functionality of cell wall lipoproteins in *S. aureus*, which comprise a large family of membrane-anchored proteins and which perform various roles in bacterial activity and attract a particular interest to investigate their virulence and survival influences in the course of host infection. Little is known about the biochemical functions of many individual lipoproteins and their proteomics has not been investigated in detail. The initial part of this study was to find out whether the encoded cell wall lipoproteins that been identified have the same molecular characterisation among all *S. aureus* strains, and examined their expressions under different growth conditions. PCRs and qPCR experiments were performed to analyse the genetics and the expression features for some of the Lpp genes, the PCR results show high similarity in Lpp genetic structure among the examined strains, whereas qPCR outcomes were varied in Lpp genes expression within different growth phases and between the examined strains. Phylogenetic trees from multiple Lpp genes were generated in two different ways, in one, genes sequences were concatenated into a one alignment, which was then analysed to generate the strains tree, while in the second, phylogeny trees were inferred individually from each gene, a consensus of these genes phylogeny was used to represent the Lpp distribution of *S. aureus*.

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# Inactivation of bacteria on TiO<sub>2</sub> and SiO<sub>2</sub> surface coatings with Ag or Cu

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Titanium dioxide is a semiconductor with a band gap of 3.2 eV. [1] The major processes that occur upon absorption of a photon of light with sufficient energy to bridge the bandgap e.g. UVA generates an electron in the conduction band and a hole in the valence band. Electron and holes recombine in the bulk or can then diffuse and migrate to the surface where they can react to give highly reactive oxygen species (ROS) such as •OH and O<sub>2</sub>•<sup>-</sup> these are responsible for the destruction of organic pollutants including microorganisms.[2] One potential application is the production of self-sterilizing surfaces. Inclusion of metals with antimicrobial activity such as Ag and Cu enhances the antimicrobial effect and gives activity in the dark as well as in UVA illumination.[3] Coatings prepared with Ag and Cu with SiO<sub>2</sub> rather than TiO<sub>2</sub> are antimicrobial but do not have photocatalytic activity. The different types of surface will be compared for the inactivation of bacteria and their potential application in production of self-disinfecting surfaces will be discussed.

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# **Observation of global transcriptional alteration in *Staphylococcus aureus* during stringent response by next generation sequencing (RNA-seq)**

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Keywords; *Staphylococcus aureus*, Mupirocin, stringent response, next generation sequencing (RNA-seq)

The stringent response is a physiological state that bacteria exhibit to survive when they encounter nutrient limitation. In this circumstance, the bacteria can economise their nutrient consumption by reducing its replication, metabolic and other activities to a minimal rate until the surrounding environment is improved.

Mupirocin is a topical antimicrobial that been used to treat *S.aureus* associated wound infection and to decolonise *S.aureus* from nasal carriage in hospital. It targets protein synthesis in bacteria by inhibiting the synthesis of the isoleucyl-tRNA synthase IleS resulting in isoleucine lacks and accumulation of uncharged tRNA that consequently triggers stringent response in *S.aureus*. Little is known about the stringent response in *S.aureus*, in particular the effects of long term exposure to sub-inhibitory concentrations of mupirocin have not been studied.

In this work, the sub-inhibitory concentration of mupirocin influence on the transcriptional profiles throughout 1, 12 and 24 has been observed by RNA-sequencing technique. Results revealed that, this inhibitory concentration is adequate to trigger stringent response up to 12 hours of exposure. *S.aureus* recovered from the stress and displayed at 24h similar growth rate and transcriptional profile to normal growth condition at 12h. Comparison between time points transcriptional profile showed interesting alteration on *S.aureus* genes regulation including those that involved in virulence factors.

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**IMPACT AREA (2):**

**Digital, Media and  
Information  
Technology**

# Chemistry of Graphene at High Pressure and Temperature

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Keywords: graphene, graphane, hydrogenated graphene, functionalised graphene, high pressure, diamond anvil cell

There is much interest in graphene-based electronics due to the material having a high room-temperature carrier mobility, but development is limited by a lack of intrinsic band gap in graphene. Through functionalization with hydrogen, a bandgap can be introduced to graphene – either by partial hydrogenation or by complete hydrogenation (i.e. formation of graphane) and patterning of nano-ribbons into the graphane.

Some hydrogenation of graphene has been achieved using atomic hydrogen, with the drawbacks that only one side of the graphene flake is exposed to the hydrogen.[1]

We present new techniques for activating the reaction between hydrogen/deuterium and graphene using combined high pressures and temperatures. Graphene samples on a copper substrate have been subjected to hydrostatic pressures of 7 GPa using a diamond anvil cell and temperatures up to 200°C in hydrogen and deuterium atmospheres. The Raman spectrum of the graphene has been observed before and after the process and changes characteristic of a hydrogenation are observed – the carbon D peak associated with sp<sup>3</sup> nature bonding becomes more prevalent as more hydrogen atoms bond to the carbon 2p<sub>z</sub> orbitals in the graphene layer. A variety of pressure-temperature combinations have been employed in an attempt to find specifically the necessary conditions for hydrogenation/deuteration and to maximise the extent of the reaction and it has been shown that the reaction will not take place at ambient temperature, even under pressures of up to 9 GPa.

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# THE EFFECT OF SECURITY ISSUES IN B2C E-COMMERCE ON CUSTOMERS' BEHAVIOUR: THE CASE OF SAUDI ARABIA

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Keywords: B2C E-Commerce, Saudi Arabia, security, payment systems.

B2C E-Commerce (EC) is becoming the driving force for several businesses. Its development, usage and acceptance vary from country to country and has realized its best use in the developed countries while its adoption is slow in developing ones with fewer customers engaging with it. The current research looks at the implementation of B2C EC in Saudi Arabia (SA) and improves on previous studies that did not cover all aspects and usage of EC. A lack of trust due to security, privacy and payment systems were identified as the main barriers for the lack of development of EC in SA. A better and improved understanding of the Internet and its risks among EC users in SA made them aware of the need to improve security to fully support the implementations of EC in SA.

This Research attempts to develop an overall framework to improve the development, usage and acceptance of EC in SA and is based on a comparative study between Saudis customers living in SA and those living in the United Kingdom. The study aims at answering the question on whether the environment plays a key role and impact on online activities. The work reported in this poster deals only with customers living in SA and focuses on security and payments methods factors.

Quantitative data was collected from a sample of 606 Saudis living in SA. Trust in both security and payment methods were tested. The results confirm that customers are concerned by the security of their personal data and prefer to deal with merchants that are clear with their security and payment procedures when engaging in online transactions.

# Improving Electronic Programme Guide in the IPTV System

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Keywords: IPTV, Electronic Programme Guide, Recommendation System, User Context.

IPTV could be defined as a system for delivering television content to users over the infrastructure of the Internet. The problem of the limited bandwidth has been overcome by the broadband networks developed by the telephony companies. This has led to an expansion of TV content, resulting in a huge number of programmes being broadcast every day and at any time that can be viewed on TVs, computers, Tablets and smart phones. This expansion of digital content means that users need a longer time to find the programme which they are interested in. For this reason, an EPG (Electronic Programme Guide) can help them to preview and select various available programmes and interactive TV services by listing different information about the programmes and showtimes. However, current EPGs are restricted in their search capabilities and a new type of universal EPG is needed for today's online world. Our new EPG aims to meet this need by combining television and Internet in order to provide interactive and personalized TV for users. Regardless of the source of TV content, our system will either offer the target programme to the user or schedule information about when it will be available. Integration with a user's social and online networks will provide an added level of personalization to support a recommendation system that will complement traditional techniques such as content-based and collaborative filtering with taking into account the user's context. Realising this vision of a new type of EPG will need many stages of searching, parsing and interpreting programme metadata to display the final information in a readable and acceptable format according to the user's context.

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# Software Reference Architecture for Wireless Sensor Networks

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Keywords: Wireless Sensor Networks, Software Engineering, Software Reference Architecture, System Evaluation, System Metrics, Development Framework.

Wireless Sensor Networks have become a hot topic due to their potential for a wide range of applications. However, these networks have limitations in terms of resource constraints such as power source, and processing power. Moreover to these limitations, the development process of a WSN application requires knowledge in the available hardware that can be used, the operating system functions and software stack that fits to the available hardware and Knowledge in the application area [1]. Most of the current methods concerning wireless sensor network development are platform-dependent [1], where it is not a trivial process to reuse them in another application or environment. Due to the fact that most of wireless sensor networks focus on the implementation issues and use an experience-based method [1], there is no clear and well defined software engineering methodology for developing this kind of systems [2,3]. The objective of this research can be summarised as Design and implement a generic software architecture, which can be used as a reference model. In order to realise the above objective, the project intends to answer the following three research questions.

1. What level of abstraction and information hiding can be offered through the design process of WSN applications in order to reduce the complexity of the system?
2. What are the main performance measures that can be used to evaluate and analyse software architectures of wireless sensor network applications?
3. What rules and guidelines can be offered to developers to help them through the process of developing wireless sensor network applications?

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# Monitoring SLA's QoE of SaaS

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Keywords: QoE, Cloud computing, SaaS, KPI

One of the most significant current discussions in Cloud Computing provisioning is the Service Level Agreement and its application in ensuring supplied cloud computing services. The way of providing distributed services has been re-defined as a consequence of using cloud computing which has introduced new challenges to both providers and consumers.

Measuring the quality of cloud computing provision from the consumer's point of view is important in order to ensure that the service conforms to the level specified in the agreement; this is referred to as Quality of Experience. There has been some effort in measuring the Quality of Service as a method for assuring the service level in cloud computing[1]. One of the challenges with measuring the Quality of Experience parameters is that many of the parameters are subjective, which makes it difficult to define a quantified metric for instrumenting the supplied service[2]. This abstract describes a work-in-progress research to define a quantified metric that can be used as a performance measure to benchmark SaaS applications in cloud computing. Such a metric will be useful to both cloud providers and consumers for ensuring that the delivered services meet the user needs.

Defining one metric for the QoE is very important as it can be used as an index to benchmark the SaaS applications in the cloud from the perspective of the consumer as well as to ensure the conformance with the SLA. Such a metric will be instrumental in determining what level of service has been delivered.

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# Implementation of Differentiated Service Packets Marking by Using Network Function Virtualisation (NFV)

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Keywords: Quality of Service (QoS), Differentiated Services (diffServ), Packets Marking Algorithms, Cloud Computing and Network Function Virtualization (NFV).

In recent years, with the rapid development of multimedia applications over the Internet “such as distance learning, video conference, and voice over Internet protocol (VoIP) and so on”, the important of Quality of Service (QoS) technologies has increased rapidly. The Internet is based on IP networks which support a single best effort service, all data packets are forwarded with same priority. Differentiated Services network is a model that addresses the QoS requirements of the multimedia applications by defining a set of service classes with corresponding forwarding rules in each routing decision point.

The objective of this research is to define the factors that have an effect on packet marking in differentiated services networks such as: Delay at the network core, sending target rates and interaction between mixed traffic. The second purpose of this research is to propose a marking algorithm that takes in consideration the effect of these factors. The implementation of the traditional packet marking functions for differentiated services networks is essentially done at the edge routers of differentiated service domains. This research proposes a method to implement this function virtually by using a simulation software program that runs on a virtualization infrastructure (Cloud) where all edge routers of differentiated services domains are connected to this virtualization infrastructure.

This research aims to develop the Quality of Service (QoS) of differentiated services networks by achieving a fair distribution of excess network bandwidth among traffic flows when there is surplus capacity of bandwidth in the network. In addition, it will achieve fairness in packet degradation among flows in case of network capacity is not enough to provide the required target rates of traffic flows.

# Energy Efficient Routing in WSN based on Virtualization

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Keywords: Wireless Sensor Networks (WSN), Energy consumption, Routing Function, Network Function Virtualization (NFV).

The aim of this research is to investigate the possibility of using NVFs to virtualize routing function to help reducing the network's power consumption and increasing its lifetime. A Wireless Sensor Network is a type of wireless network consisting of a group of tiny, low power and cost nodes which coordinate with each other to perform a specific function[1,2]. The characteristics of WSN are different from those of other types of wireless network because it is application dependent[1]. The most important issue in WSN is energy consumption, which determines the network lifetime[3]. Sensor nodes' energy can be consumed in various fields such as communication (include both transmission and receiving) sensor nodes consume most of their power on transmitting data , sensing, data processing, collision and overhead[3]. In WSN design and according to the characteristic mentioned previously, there are many routing functions that may be considered for reducing communication between nodes and thus reducing energy consumption; these routing functions can be implemented using various routing protocols and algorithms[4]. Network Function Virtualization is a new approach of network virtualization that helps to reduce the hardware, power and space requirement of the design, manage and deploy any network functions[5,6]. NFV is different from Network Virtualization because it virtualizes only the network functions not the entire network[5,6]. The project intends to answer the following research questions: Which routing function(s) will be suitable to reduce communication between nodes and thus will reduce the energy consumption and suitable to be virtualized, implemented and validated using NFV? Depending on the selection function, which protocol or algorithm will be selected? How can the application of NFV in WSN reduce the energy consuming?

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# Audio Information Mining-Pragmatic Review, outlook and a universal open architecture

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Keywords: Audio content, segmentation, classification, feature extraction, indexing, Information Mining.

Soundtracks of multimedia files are information rich, from which much content-related information and metadata can be extracted. There is an immense amount of audio data available, nonetheless usability of the data is limited: There is a pressing need for automated classification, recognition and information mining of audio content. Classification, indexing and audio information mining poses a significant and challenging research problem.

There exist many individual algorithms for the recognition and analysis of speech, music or event sounds, allowing for embedded information to be retrieved or represented in a semantic fashion. A systematic review shows that a universal system that can extract the maximum amount of information.

There are three reasons impeded the development of the universal system.

- (1) Compatibility issues of industry led developments hinder reusability of certain software applications.
- (2) Develop bespoke systems that could address particular applications.
- (3) Existing algorithms typically work with a single class of sound, e.g. speech, music or even sounds. Classification is often exclusive, losing much information where two or three classes overlap.

Soundtracks are typically a mixture the aforementioned three different types of signals, and sometimes overlapped. Suitable segmentation and classification therefore become essential pre-processors for lossless audio information retrieval and metadata generation.

The project addresses these identified issues by developing a high-level architecture that employs non-exclusive classification and signal cleaning techniques to achieve lossless information retrieval, a universal system architecture to take third party software or plug-

ins (subject to the rights and license) and a mixture model of speech, music and event sounds to hypothetically include all types of sounds that carry semantic meanings.

As a major step towards a universal audio information mining system, this project is currently focused on the universal architecture and non-exclusive classification. Detailed design of system architecture and principles can be found in the poster.

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# Feature selection in Meta learning framework

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Keywords: Meta learning; feature selection; supervised classification; algorithm selection.

Feature selection is a key step in data mining. Unfortunately, there is no single feature selection method that is always the best and the data miner usually has to experiment with different methods using a trial and error approach, which can be time consuming and costly especially with very large datasets. Hence, this research aims to develop a meta learning framework that is able to learn about which feature selection methods work best for a given data set. The framework involves obtaining the characteristics of the data and then running alternative feature selection methods to obtain their performance. The characteristics, methods used and their performance provide the examples which are used by a learner to induce the meta knowledge which can then be applied to predict future performance on unseen data sets. This framework is implemented in the Weka system and experiments with 26 data sets show good results.

A central problem in data mining is to identify which features of the data are most useful for obtaining good results. Hence, many methods have been developed to improve the feature selection process, such as wrapper methods, filter methods, and methods that use fuzzy rough sets. Unfortunately, there is no dominating feature selection method that works best in all cases. One direction of research is to continue to seek the ultimate feature selection method that always works well. Another approach, taken by this research, is to accept that one method does not fit all requirements, but instead aim to identify which method works best for a given data set. However, this is not easy, since details of which algorithm works best under different circumstances is not known. Thus, we have a meta learning problem, namely: *Can we automatically learn which feature selection algorithm works best for different circumstances?*

# Automatic Detection of Arabic Causal Relations

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Keywords: Information Retrieval, Pattern Matching, Discourse analysis, Information Extraction

Most of the studies presented for mining semantic relation focused on the detection of causal relation since it is a fundamental relation in many discipline such as text generation, information extraction and question answering systems. Furthermore, it is closely relates of some relation (TEMPROAL and INFLUENCE). Many studies have been conducted for other languages in order to locate causations in text; a number of them used hand-coded patterns and domain specific knowledge bases. Other systems employed machine learning approaches in order to automatically construct syntactic patterns [1][2]; however these studies exploited knowledge resources available for the language they addressed, e.g. (large annotated corpora, WordNet, Wikipedia...). Moreover, these studies restricted their work to extracting a one kind of lexico-syntactic patterns such as  $\langle NP1 \text{ verb } NP2 \rangle$ . Unfortunately, Arabic Language, so far, lacks mature knowledge base resources upon which machine learning algorithms rely. Also, the restriction to one type of syntactic patterns is unable to cover the great diversity of syntactical structure of the Arabic language. The aim of this work is the automatic detection and extraction of causal relations that are explicitly expressed in Arabic text. A set of linguistic patterns were derived so that they refer to the presence of cause-effect information in sentences from open domain text. The patterns were constructed based on different sets of syntactic features extracted by analyzing large untagged Arabic corpora so that parts of the sentence representing the *cause* and those representing the *effect* can be distinguished. The extracted patterns reflect strong causation relations and can be very useful in the future for systems adopting machine learning techniques in acquiring patterns that indicate causation in text.

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# **An Adaptable and Personalized E-learning System Based On Freely Available Resources on the WWW**

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Keywords: E-learning system, ontology, Personalized E-learning

E-learning means to get the education at any time or at any place and physical presence in class is not mandatory. Nowadays various e-learning programs have been used by many people all over the world. However, high diversity of the learners on the Internet poses new challenges to the traditional “one-size-fit-all” learning model, in which a single set of learning resource is provided to all learners.

The research aims to develop of an intelligent system that support online course design based solely on the information extracted from available resources on the WWW. The overall architecture of the system will be designed to allow the application of the system to various educational fields.

In order to achieve the research aim, first, a full review of existing works on automatic knowledge extraction from the WWW for educational purposes or related topics. This will be followed by the full design of the system architecture for extracting the ontological information from available resources on the WWW. The purpose of this system, a personalized Learning Planner System (PLPS), is to deliver recommended learning materials to learner who may have different backgrounds, learning styles and learning needs. Finally, the design and implementation of data integration modules for the various knowledge and data extracted from the WWW will be developed. The design of an initial ontology to support the knowledge domain of a pre-selected area (Computer Science/Software Engineering) will be used to improve information retrieval, organize and update specific learning resources. The evaluation of the system will use a case study for the design of computer science programmes.

# Use of Game-Based Learning to Enhance Higher-Order Thinking

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Keywords: Learning theory, gaming technology, higher order thinking, critical thinking, problem solving, cognitive load theory, constructivism theory, memory, autonomy learning, motivation, curiosity, long-term memory, short-term memory, Human Computer Interaction (HCI), e-learning.

The focus of the research is to explore and discover if learning through gaming can enhance learners' attitudes (curiosity, motivation and autonomous learning), cognitive skills (critical thinking and problem solving) and memory activities (short-term memory, long-term memory and cognitive load). Learning theories such as the constructivism theory promote four basic concepts: (1) people can learn by doing, (2) they can learn by interacting with the learning environment (Kauchak & Eggen, 2003; Fox, 1972), (3) they understand by constructing, and (4) they learn by engaging in the learning activity to improve understanding and experience (Yang & Chang 2013). Furthermore, the cognitive load theory explains the processes and capacity of short-term memory (Chandler and Sweller 1991). Chandler and Sweller suggest that short-term memory transfers information to long-term memory in order to reduce cognitive load. Gaming technology seems to have the potential to be tested against the constructivist learning theory concepts. Learning by doing involves interaction and engagement with the activity (playing the game); furthermore, cognitive concepts and creativity in constructivism and cognitive load are employed to meet the challenges of games to find solutions through memory processes.

The research aims to explore if a game-based learning environment can enhance learning attitude, long-term memory and higher-order thinking.

Hypotheses to be tested:

H1: A game-based learning environment can enhance autonomy and independent learning.

H2: A game-based learning environment can enhance curiosity to learn.

H3: A game-based learning environment can motivate learners to learn.

H4: A game-based learning environment reduces the load on short-term memory and improves long-term memory capacity

H5: A game-based learning environment can enhance critical thinking.

H6: A game-based learning environment can enhance problem-solving skills.

Method:

The research will use a mixed methodology which will include both quantitative and qualitative approaches for collecting and analyzing the data. Furthermore, the research will depend on an experimental strategy by comparing text-based learning and game-based learning. The research will use interview techniques as a qualitative data collection approach. Furthermore, the research will adopt an observational strategy which will help in the analysis of the impact of gaming technologies on learners by monitoring the learners during the experiment. Through collecting and assessing the information which will be gathered in the research, it is anticipated that the study will be able to describe the best way for using gaming technology as an e-learning tool.

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# Local Based Services by Clustering Distributed Databases in Mobile Networks

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Keywords: Local based services, Localization, mobile network, GSM, UMTS, and LTE

The appearance of different technologies such as wireless networks, Internet, Geographical information systems (GIS) and Global Positioning Systems (GPS) have introduced a new technology called Location Based Service (LBS). Location Based Services can be defined as the ability to find a mobile user geographically and deliver services to the user based on his/her location.

Location Based Services (LBS) are developing rapidly in the mobile and IT fields according to (*eMarket Association 2011*). LBS has a variety of applications that can be offered to organizations such as government, emergency service, commercial and industrial organizations for example, traffic information, breaking news, tracking and way finding.

In this research, GIS databases will be added to the mobile network infrastructure, the database contains information about the services in a specific location, this information will be sent to the user, when requested, by using Data over Voice (Dov) even if the user has no internet connection.

The research will be tested first by Opnet simulation program, then it will be implemented by hardware component, and if any mobile operator collaborated in this research the system will be tested on a real mobile network.

The benefits of this research is that the user can get any information for a location easily even if the user has not connected to the internet, another benefit comes to the mobile operator who has this feature when competing with other companies.

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# **E-BUSINESS TECHNOLOGY TRANSFER TO THE GHANAIAN CONSTRUCTION INDUSTRY – THE DYNAMISM OF TWO CULTURES**

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Although construction industry experts and researchers have devoted considerable attention to the many challenges faced by the construction industry everywhere very little is known about these challenges in the developing countries construction industries particularly in Ghana. These challenges are present alongside many socio-economic issues and weak technological know-how within the construction industries in developing countries. This paper considers technological know-how as major challenge facing construction industries in developing countries particularly the Ghanaian construction industry. This has several limitations, mostly concerning communication difficulties among project teams resulting in delay time and transactional difficulties. This weak technological know-how issue has to be resolved. Technology transfer has emerged as an important factor in resolving business and managerial concerns within the construction industries in developing countries. Technology transfer involves cross-border activity with the main purpose of enhancing the technological capacities of local contractors in respond to the rapidly changing economic environment. Technology transfer in this context could be viewed in the form of knowledge (soft technology), skills and tools (hard technology) which usually come from developed countries to developing countries through construction project activities. Therefore, the objective of this paper is to assess the influence of foreign culture in supporting transfer of e-business technology to the Ghanaian construction industry. In view of this, a total number of eleven (11) semi-structured interviews were conducted as follow: three (3) foreign firms, two (2) expert interviews and six (6) local contractors (collaborators). This research involved an interpretivist approached based on qualitative data in order to have an in-depth understanding of the objective of this paper and have insight into how practitioners perceives the roles of two cultures in the transfer of e-business technology to improving performance in the construction industry in Ghana. Content analysis shows the important role that foreign culture play within the context of e-business technology transfer. They also indicate several arguments on the need to address the identified barriers to enable the industry to harness the full potentials of e-business.

**Keywords:** Technology transfer, construction industry, developing countries, foreign culture, e-Business Technology

# Context-Aware Framework for Inferring User Identity in Pervasive Computing Environment

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**Keywords: Identity, Context-aware, pervasive computing, ubiquitous computing, authentication**

Context-Awareness is defined as the ability of the system to provide adequate services for users and applications based on the situated context. Services should be aware of their users' context and automatically adapt to changing context (Bolchini, Schreiber, & Tanca, 2007). Context-aware systems are varying in the way they interact with users, the way they interpret the context of their entities and the actions they take. Context-awareness is used in a variety of applications including security related ones, where the current situation of a user may be used to identify risks or vulnerabilities.

A number of researchers have employed context-awareness in security applications. Some argued that it is challenging to deploy prediction and security in ubiquitous computing environments. Firstly, Al-Karkhi(2012) developed an approach (known as NIAS), to infer the user's identity by monitoring their behaviour while interacting with the environment. However, NIAS assumes that a user is expected to perform recurrent activities on a daily basis. This leads to a fixed set of rules based on certain parameters (identity, time, location). Although NIAS can adapt and learn new rules, it takes a long time to learn new behaviour. Emmanouilidis, Koutsiamanis, & Tasidou (2012) argued that inferring users' preferences by monitoring their activity, whilst interacting with the smart environment, is usually a challenging undertaking. Finally, Krumm (2009) stated that it is challenging to create security and privacy mechanisms that adequately take into consideration the technical as well as the usage challenges of ubiquitous systems.

The novelty of our approach is to build a framework to enhance the performance of the identity inference process and reduce the learning process time in the previous work. The proposed framework will benefit the user by allowing them to focus on high-level activities without having to interrupt what they are doing every time they cross a domain boundary, improve the system's performance by reducing the initial learning process needed to build

the user's history, and improve reliability by reducing the number of false alarms in case there is insufficient knowledge about the user to make a decision.

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# **IMPACT AREA (3):**

## **Energy**



# Gaining Energy Independence with Energy Security with the use of Direct Current Voltage

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Keywords, Energy Independence, Energy Security, Direct Current Voltage, City Resilience, disaster resilience,

Policy makers have to deal with global issues like sustainability, carbon emissions, and energy-for-all. Renewable technology is a means to tackle these issues. New investment continually leads to new innovations, and with increases in their production economies of scale can be reached. Every home device that employs electronics operates on DC voltage. In a conventional renewables system, direct current (DC) voltage is generated, is then inverted to alternating current (AC) voltage, and then transformed back to DC for consumption in the device. The current system therefore has inherent inbuilt loss factors with an unnecessarily high carbon footprint.

DC electricity offers technical as well as sociological advantages over AC voltage. This research looks at the socio-technical advantages of using all-DC systems to supply the built environment. The use of DC systems is our niche innovation. The main technical advantages are that the expensive inverter and AC-to-DC transformers will no longer be needed. This allows for a cheaper and more efficient system. There are strong sociological advantages for the use of a distributed DC electrical system both in the developing world as well in the developed world. It can provide access to electrical energy for the 1.4 billion people who at this time do not have access, which will have a positive effect on their lives and livelihood. There are many societal problems which are directly affected by energy policy some of which are; the need for energy security, energy independence, fuel poverty, GDP growth, pre-disaster resilience and post disaster management, carbon emissions and global warming, fuel and water supply, and a more sustainable food chain. These problems are seen as socio-technical landscape pressures. By understanding how these landscape pressures and niche innovations combine to change the regimes, we can enable the transition to DC voltage systems.

# Molecular Dynamics Simulations of Cascades in Nuclear Graphite

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Keywords: Nuclear, Graphite, Cascades, Molecular Dynamics

Graphite is widely used as a moderator in nuclear reactors, however, despite its importance to the nuclear industry there have been virtually no molecular dynamics (MD) simulations of radiation damage in graphite. Understanding the radiation processes in graphite is a key factor in extending the life span of the current advanced gas-cooled nuclear reactors in the UK. The research will also provide crucial information to aid with next-generation nuclear technology such as the high-temperature graphite-moderated reactors, which was recently selected for development in the USA.

We have performed what is perhaps the first systemic study of the effect of radiation damage in nuclear graphite using MD. The Environment Dependent Interaction Potential<sup>1</sup> has been employed to describe the chemical bonding whilst short-range interactions have been modelled using the Zeigler-Biersack-Littmark Potential. The effects of radiation damage in the nuclear graphite have been modelled using cascade simulations. Cascade simulations have been computed over a range of different temperatures, directions and energies with each cascade producing a unique result.

Cascade simulations have revealed that nuclear graphite behaved in a manner distinct from metals and oxides, with the cascades primarily generating point defects. Each cascade is directionally dependent and produces a unique result. Point defects generated from the cascades support basic theory and the density-functional-theory results obtained by Heggie *et al.*

We have produced cascades with diamond, glassy carbon, high and low-density amorphous carbons under the same initial conditions as the nuclear graphite. Results from the pure carbon simulations differ comprehensively from those of the nuclear graphite. Cascade simulations in other pure carbon materials highlight the uniqueness of nuclear graphite.

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# **CASCADE (Collaborative Action towards Societal Challenges through Awareness, Development, and Education)**

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Keywords: Horizon 2020, INCONET, South Asia, Societal challenges

The European Union recognise a need to strengthen internationalisation through strategic policy action to tackle societal challenges. According to the European Commission report (2012), global societal challenges are important drivers for research and innovation and the EU needs to strengthen its dialogues with international partners to build critical mass for tackling these challenges. The project CASCADE in this context aims to provide the foundation for a future INCONET programme targeting South Asian Countries, which will promote bi-regional coordination of science and technology cooperation with the financial support from the EU's Seventh Framework Programme. It has the participation of seven South Asian countries: Afghanistan, Bangladesh, Bhutan, Maldives, Nepal, Pakistan and Sri Lanka. CASCADE also coincides with the launch of Horizon 2020, EU's new programme for research and innovation which helps to address major societal concerns shared by all Europeans; such as health and well-being, food security, climate change, sustainable transport, renewable energy, security, and inclusive societies. The objectives of CASCADE, as an eighteen month supporting action, are to: compile a regional position paper that identifies the key societal challenges and research priorities in South Asia; map and develop an inventory of national and regional stakeholders related to societal challenges; and, raise awareness on research and innovation priorities for fostering cooperation and towards building mutual understanding on how to address common societal challenges. It targets to compile a policy brief with recommendations to the European Commission on how to promote bi-lateral cooperation with Southern Asia with a view to tackling key societal challenges of mutual interest based on the regional position paper and the stakeholder maps developed in the project.

# Coupled waveguide arrays: oblique incidence and propagation of solitons

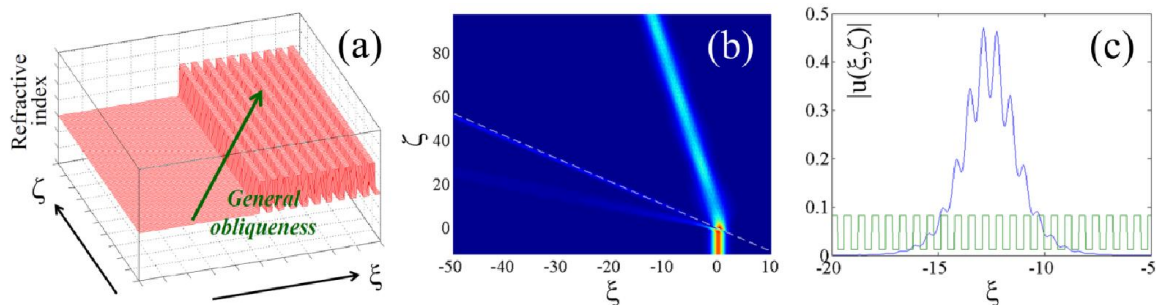
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Keywords: coupled waveguides, periodic systems, photonic crystals, spatial solitons

The propagation of optical beams in patterned nonlinear dielectric media is a fundamental class of problem in modern photonics research [1,2]. Moreover, off-axis effects such as the oblique injection of spatial solitons from a uniform medium into a periodic system (such as an array of coupled waveguides or a photonic crystal) are key configurations that deserve careful theoretical attention as they are crucial to a broad range of future device applications [see Fig. 1(a)]. Here, we propose a model capable of describing arbitrary-angle (nonparaxial) evolution of scalar optical beams in periodic systems. By retaining a more complete governing equation that is naturally of the inhomogeneous Helmholtz class [3,4], we are able to describe configurations where the incident soliton beam may be inclined at any angle *in the laboratory frame* with respect to the periodic system. Numerical analysis involving these geometrical considerations [see Figs. 1(b) and 1(c)] reveal that oblique propagation across a patterned optical structure can involve elements of both coupled-waveguide and photonic-crystal physics. Paraxial theory, rooted in the traditional nonlinear-Schrödinger formalism (with its slowly-varying envelopes and small-angle assumptions), obscures such a physical connection [1,2].



**Figure 1.** (a) Side-coupling of a spatial soliton into a waveguide array with a periodically-patterned linear refractive index (the nonlinear response is assumed to be uniform throughout the system). (b) Strong coupling of a soliton into the array for a quasi-paraxial angle of  $10^\circ$  in the laboratory frame (dashed white line denotes the boundary). (c) Output field (blue line) in the waveguide array (refractive index modulation is denoted schematically by the green line).

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## Observing the everyday: Testing the technology

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Keywords: Domestic energy consumption, wireless sensor networks, RFID, wearable technology

The purpose of this research is to find a technical solution for identifying UK domestic energy consuming behaviour using wireless sensor networks. In order to capture the typical energy consuming behaviour of people in their own homes it is necessary to develop a method of unobtrusive observation. The system that has been developed uses a small RFID tag to be worn by individuals and the RFID reader is connected to and controlled by a Raspberry Pi computer acting as a base station and data logger. To record energy consumption data a wireless ZigBee appliance-level monitoring network is also used.

Twenty separate tests have been carried out of the prototype in three buildings resulting in over 3,000 signal strength readings. At each location the sampling points were taken from a ½ metre grid and the results have been analysed to determine the effects of the environment, changes in the horizontal and vertical orientation of the module and the ability to infer location to room level.

The testing locations included the Salford Energy House, Maxwell Hall, and a 3 bedroomed semi-detached house in Greater Manchester.

Using ½ m grids to map signal strength allows in many cases the location of the individual stationary tag to be inferred to room-level. This empirical method is challenging to roll out to other buildings with different characteristics.

In addition to being used for energy monitoring purposes this system could be adapted for many other applications, such as health and dementia care.

# Coal-CCGT Transition in the UK Electricity Sector

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Keywords: Multi-level perspective, transition pathway, electricity sector

This presentation uses the multi-level perspective (MLP) of socio-technical transitions to analyse the transition from coal fired power plants to the combined cycle gas turbine (CCGT) plants in the UK's electricity generation system. The MLP is a framework of three analytical and heuristic levels for system innovations namely; the socio-technical landscape accounting for exogenous developments, socio-technical regime accounting for system stability and technological niches consisting of slots for the emergence of new innovations. It is the interactions among these levels that give rise to transitions. Different kinds of interactions among multiple levels will result to different transition pathways. When a transition is a result of a combination of the actions of a moderate landscape pressure and moderately developed niche innovations with negligible effect on regime structure, the pathway will be transformation. When a transition is a result of a combination of the actions of a high landscape pressure and moderately developed multiple niche innovations with high effect on regime structure, the pathway will be reconfiguration. When high a landscape pressure and a fully developed technology with high regime effect are involved, the pathway will be substitution. When an unbearable landscape pressure and numerous and similar technologies with high regime effect are involved, the pathway will be de-alignment/re-alignment. The result showed that the transition involved interactions among all the three levels on the MLP with radical regime effect. It also showed that the huge pressure from the landscape level which coincided with the fully matured CCGT technology at around the early 1990s marked the beginning of the transition. These transition characteristics showed that the coal-CCGT transition followed a 'substitution pathway'. The MLP also indicated that the CCGT did not occur as a discrete entity, but rather co-evolved with the relevant social and institutional components such as policy and regulation, culture, markets, user practice, infrastructure network, which is a typical characteristic of socio-technical transitions.

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# An Accurate Dispersion Corrected Studies of Structural and Vibrational Properties of Graphite

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Keywords: DFT, Generalized Gradient Approximation, Long range interactions, Dispersion corrected, Low frequency, Graphite

We present an accurate dispersion corrected studies of structural and vibrational properties of graphite using the dispersion corrected density functional theory (DFT-D). The dispersion corrected TS scheme ([Tkatchenko and Scheffler, 2009](#)) has been implemented with generalized gradient approximation (GGA) for the exchange and correlation functional in the formalism of Perdew, Burke and Ernzerhof (PBE) ([Pedrew et al., 1996](#)) in order to include the long range interactions. The structural and vibrational properties of the graphite system improve after adding the Van der Waals interactions ([McNellis et al., 2009](#)). The calculated low frequency dispersion corrected modes of vibration have an excellent comparison with available experimental ([Mohr et al., 2007](#)) inelastic x-ray scattering and coherent inelastic neutron scattering results.

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# Flat fan Spray Cavitation Bubbles in Oil Wells

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Cavitation bubbles generation has been a contributory factor in the enhancement of erosion during scale cleaning, however, increasing well depth has been found to decrease the cavitation bubbles lifetime. Findings from this research indicate cavitation bubble length not exceeding 3mm at ambient pressure and then decreases to 1mm at 3bar air pressure. The research investigate the effect of increasing well depth on the lifecycle of a cavitation bubbles produced from the Flat-fan nozzle utilised for descaling oil wells. High pressure flow at 10MPa through the nozzle achieve a sufficient pressure drop approaching the saturated vapour pressure of the water, decreasing solubility of air in water[2], and hence producing air-filled bubbles, further drops in pressure causes boiling of water even at room temperature producing water vapour filled bubbles. The abrupt bubble's collapse is known to cause damage called cavitation erosion [3]. Findings from research will contribute the utilization of the appropriate stand-off distance to effective descale oil wells.

Keywords: cavitation, bubble, erosion

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# Nonparaxial spatial soliton refraction: Snell's law & the dual power-law nonlinearity

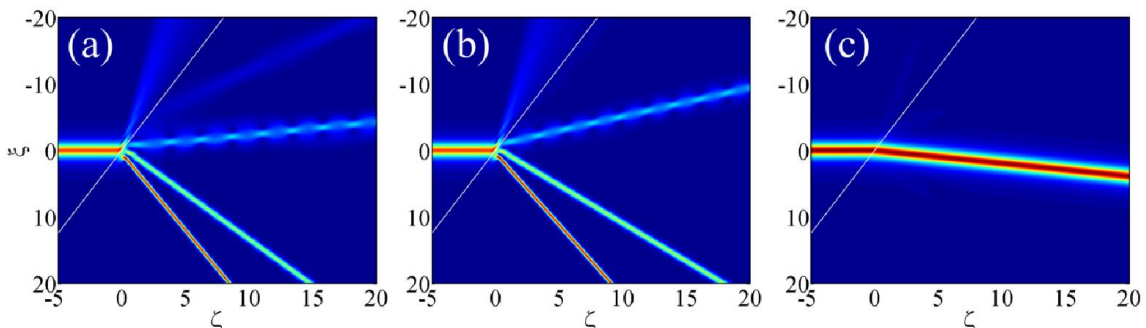
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Keywords: dual power-law nonlinearity, optical interfaces, Snell's law, soliton refraction

In this presentation, we give a detailed overview of spatial soliton refraction at the planar interface between dissimilar materials whose nonlinear refractive index is allowed to have a dual power-law dependence on the optical field amplitude [1,2]. The governing equation is of the inhomogeneous Helmholtz class, and analysis is facilitated through the exact bright soliton solutions of the corresponding homogeneous problem [3]. By respecting phase continuity conditions at the boundary, a universal Snell's law may be derived for describing the refractive properties of soliton beams. This compact new equation contains a single multiplicative factor that captures nonlinearity, discontinuities in material properties, and finite beam waists. Extensive computations have provided strong supporting evidence for the validity of our approach across a multi-dimensional parameter space. Theoretical predictions of critical angles are generally in good agreement with simulations. We have also uncovered some interesting new phenomena such as 'snaking', an effect that seems to be connected to the power-law class of interface problem [4]. Another prevalent phenomenon is soliton splitting [frequently occurring for algebraic solitons at nonlinear interfaces – see Figs. 1(a) and 1(b)], while hyperbolic solitons can refract more 'cleanly' [see Fig. 1(c)].



**Figure 1.** Spatial soliton refraction at interfaces (marked by the white line) with a dual power-law nonlinearity and for an incidence angle of  $\theta_{inc} = 10^\circ$  in the laboratory frame. Splitting of algebraic solitons in the presence of (a) small [ $\Delta \equiv 1 - (n_{02}/n_{01})^2 = 0.001$ ] and (b) larger ( $\Delta = 0.01$ ) linear index mismatches. (c) 'Cleaner' refraction of a hyperbolic soliton at a linear interface ( $\Delta = -0.005$ ).

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# Optical interfaces with self-defocusing Kerr materials: dark surface waves

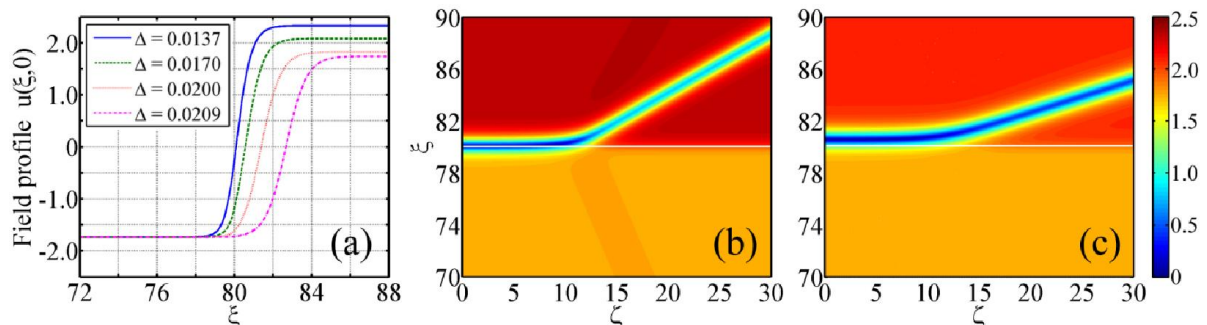
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Keywords: dark solitons, nonlinear interfaces, self-defocusing materials, surface waves

The propagation of surface waves along the planar interface between two dielectric media with different refractive properties is a fundamental problem in nonlinear optics. Over recent decades, bright [1] and dark [2] solutions have been considered for dissimilar focusing and defocusing Kerr materials, respectively, and attention has also been paid to surface waves for adjoining focusing/defocusing media [3]. Analyses have tended to omit supporting computer simulations, or include numerical results obtained by assuming the paraxial approximation (e.g., from integrating a Schrödinger-type equation). Recently, we presented a detailed study of bright surface waves at dissimilar focusing Kerr (and, more generally, power-law) materials; we also reported on the first simulations that tested surface wave stability predictions through direct numerical integration of the underlying nonlinear Helmholtz equation [4]. Here, we extend those considerations to dark surface waves. Exact analytical tanh-type solutions have been derived [see Fig. 1(a)], and parameter regimes in which these solutions exist have been identified. Like their bright counterparts [1,4], dark surface waves break up into two solution families. Our research is currently addressing the stability aspects of these new nonlinear waves through simulations [see Figs. 1(b) and 1(c)].



**Figure 1.** (a) Dark surface wave solutions at an interface (located at  $\xi = 80$ ) with  $\Delta \equiv 1 - (n_{02}/n_{01})^2$  ( $n_{0j}$  is the linear refractive index in medium  $j = 1, 2$ ). Unstable surface-wave (amplitude) propagation obtained from numerical integration of the nonlinear Helmholtz equation [4]: the input fields in simulations (b) and (c) correspond to the blue and green curves in pane (a), respectively.

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# Spatiotemporal vector solitons in Kerr systems: black-type solutions & stability

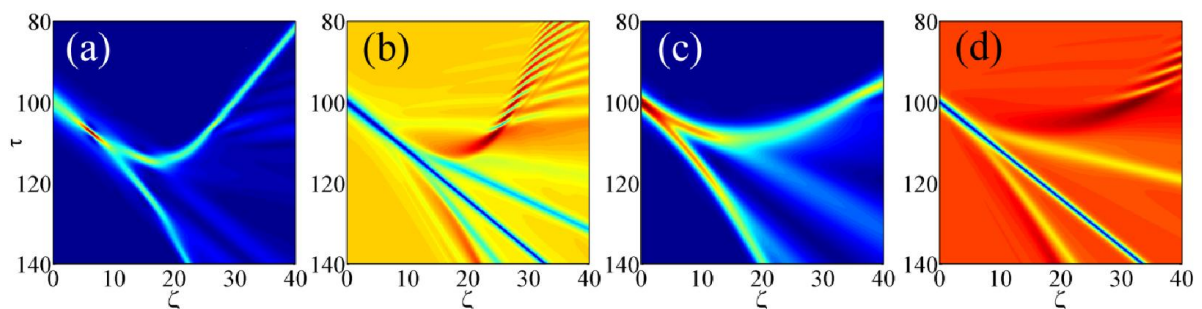
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Keywords: coupled waves, Kerr effect, spatiotemporal dispersion, vector solitons

We further develop our novel spatiotemporal generalization of Menyuk's classic equations [1] describing the propagation of two coupled waves in a nonlinear dispersive optical system with a Kerr type of dielectric response. A two-component generalization of the scalar wave equation, introduced by Christian *et al.* [2], is considered. Analysis of this new class of fully second-order nonlinear vector wave equation is facilitated through deployment of coordinate transformations in the space-time plane, and without recourse to the slowly-varying envelope approximation. Having previously solved the modulational instability problem for vector continuous waves, attention is now turned to two families of dark-type solutions. We have derived exact bright-dark and dark-dark spatiotemporal vector solitons, which are more complicated phase-topological relatives of the bright-bright family. Asymptotic analysis reveals that the conventional solutions which have been known for many years [3–5] are, naturally, a subset of the more general spatiotemporal solitons; one may arrive at those solutions through a Galilean boost from the laboratory to a reference frame moving at the average group velocity. Preliminary simulations have started to investigate the stability of vector pulses with local shape perturbations (see Fig. 1).



**Figure 1.** Preliminary simulations of black-bright vector solitons (bright and dark components are in the anomalous and normal group-velocity dispersion regimes, respectively). Bright [(a)] and dark [(b)] components when the initial pulse width is *broadened* (by 20%) relative to the pulse width predicted by the exact solution, then *narrowed* (by 20%) [(c) and (d), respectively].

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# The spatiotemporal Ginzburg-Landau equation: dissipative dark solitons

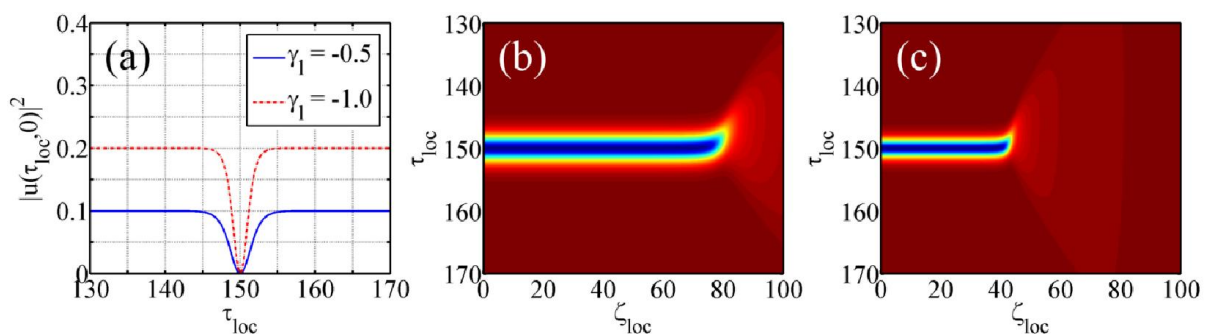
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Keywords: dissipative solitons, Ginzburg-Landau, Kerr effect, spatiotemporal dispersion

The complex Ginzburg-Landau (GL) equation traditionally describes universal wave-envelope propagation in systems that exhibit competition between dispersion and dissipation [1,2]. In optics [3], the balance between dispersive effects (group-velocity dispersion and self-phase modulation), linear gain and nonlinear loss can, in principle, lead to the formation of a stationary wavepacket – a *dissipative soliton* – typically described in the local time frame. We propose a novel generalization of the cubically-nonlinear GL equation to accommodate spatiotemporal dispersion [3]. Exact analytical dark solitons of our new model have been derived, with analysis demonstrating the asymptotic recovery of classic GL solutions [2] in a simultaneous multiple limit. Dissipative dark solitons (both traditional and spatiotemporal) reside on a finite-amplitude uniform plateau [see Fig. 1(a)] that is modulationally unstable in the presence of a linear-gain term in the governing equation; even the zero-amplitude solution is susceptible to a blow-up effect. While the exact dark GL solitons are unstable [see Figs. 1(b) and 1(c)], a potential route toward stabilization may be possible by coupling the nonlinear excitation to a non-dispersing linear wave [5] in the spatiotemporal regime.



**Figure 1.** (a) Normalized exact GL dark soliton solutions (in the local time frame) with a fixed nonlinear-loss coefficient and for two values of the linear gain coefficient,  $\gamma_l$ . Panes (b) and (c) are results from simulations that clearly demonstrate the inherent instability of these solution families ( $\gamma_l = -0.5$  and  $-1.0$ , respectively) over a finite propagation length. While remaining approximately stationary over short distances, the instability emerges more rapidly in the presence of stronger linear gain.

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# Spatiotemporal bright solitons: solutions & stability for step nonlinearities

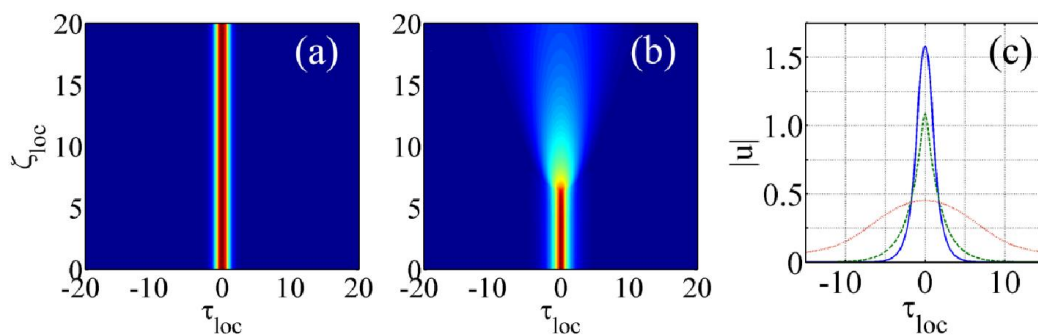
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Keywords: spatiotemporal solitons, stability, step nonlinearity, wave equations

Since proposing a new model of spatiotemporal pulse propagation based on a Helmholtz-type governing equation [1], several different classes of nonlinearity have been extensively investigated in the context of bright and dark soliton solution existence and stability: from the classic Kerr response, through the cubic-quintic system (including its dual power-law generalization) and culminating in a generic model for a saturable refractive index. Here, we introduce a pair of simple step nonlinearities, as considered by Enns, Rangnekar, and Kaplan [2] over a quarter-century ago. Frame-of-reference analyses and coordinate / velocity transformation laws appear throughout the spatiotemporal modelling approach. Two new families of exact analytical bright solitons have been derived, and those solutions found to possess bistability properties [3]. A multi-parameter asymptotic analysis has demonstrated that the conventional step-model solitons are, mathematically, a subset of the more general spatiotemporal solutions. Computer simulations using a difference-differential type of algorithm [4] have begun to explore the stability properties of our new solitons against perturbations to the local pulse shape (see Fig. 1).



**Figure 1.** Propagation of (a) a stable and (b) an unstable exact soliton with a simple sharp-step nonlinearity in the local time frame. Stability is predicted with the aid of the Vakhitov-Kolokolov integral criterion [2,5]. (c) Solution profiles. The input and output pulse shapes are identical for the stable solution in pane (a) (blue line), while they are clearly different for the unstable solution in pane (b) [dashed green line: input; dot-dashed red line: output].

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# Spontaneous patterns in a Fabry-Pérot cavity: multi-Turing spectra & fractality

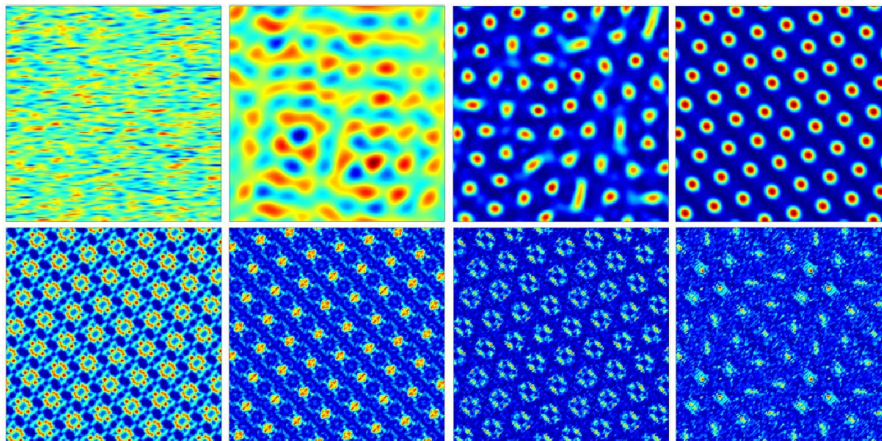
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Keywords: complexity, Fabry-Pérot cavity, optical feedback, spontaneous patterns

The nonlinear Fabry-Pérot (FP) cavity is a generalization of the classic diffusive Kerr slice with a single feedback mirror [1]. Such apparent simplicity is deceptive. Historically, analysis of the FP geometry has proved to be a non-trivial problem [2]: it is the epitome of a complex system capturing the interplay between diffraction, counter-propagating waves, transverse diffusion of carriers, and a host of cavity effects. Our previous investigations found that Ikeda-type instabilities [3] are rife when transverse effects such as diffraction and diffusion are neglected. Here we present the results from a linear analysis of the spatially uniform solution to the FP model, predicting its susceptibility to spontaneous spatial pattern-forming instabilities. The threshold spectrum for Turing patterns turns out to have the multiple-minimum signature proposed as necessary for generating spontaneous spatial fractals [4]. Comprehensive simulations have predicted the emergence of a static hexagon pattern from a perturbed plane-wave solution and that, under the right spatial filtering conditions [4], a multi-scale pattern that tends towards fractality can start to grow (see Fig. 1).



**Figure 1.** Spontaneous pattern formation in the nonlinear FP cavity, with time evolution going from left to right. Top row: emergence of a static (Turing) hexagon pattern. Bottom row: transformation of the hexagon pattern toward a fractal.

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# Beyond paraxial models of nonlinear ring cavities: from Schrödinger to Helmholtz

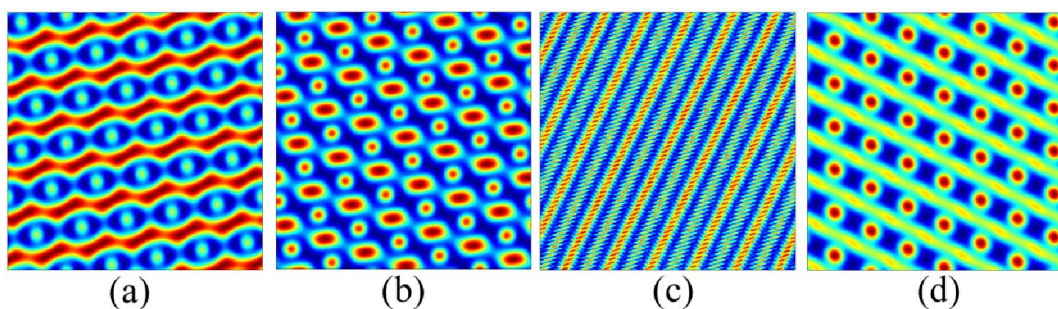
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Keywords: Helmholtz diffraction, optical patterns, ring cavity, spontaneous fractals

Schrödinger-type equations have dominated the theory of optical pattern formation in nonlinear ring cavities since the seminal works of McLaughlin *et al.* [1] and Ouarzeddini *et al.* [2]. These classic models assume paraxial propagation when describing the interplay between the self-lensing and diffraction of circulating light waves, accompanied by a longitudinal boundary condition that lumps cavity feedback (periodic pumping, mirror losses, and mistuning) into a single operation. The system tends to possess a multi-Turing threshold spectrum [3] for spontaneous spatial instabilities, with typical patterns to emerge from perturbed plane-wave stationary states including hexagons, honeycombs, squares, and stripes (see Fig. 1). Recently, we have taken a fresh approach to the historic ‘lumped’ model by analyzing a more general Helmholtz-type (nonparaxial) equation for the intracavity field [4], retaining a fuller mathematical generality in the linear part of the wave operator. The physical advantage of our approach is that it accommodates a full description of (scalar) diffraction since the paraxial approximation is avoided. Our new model can be expected to describe more accurately not just *single-scale patterns* (such as those shown in Fig. 1), but also *fractal patterns* (with structure on scales approaching the optical wavelength) [3].



**Figure 1.** Typical transverse spontaneous static patterns generated in a Kerr-type ring cavity as modelled by the bulk nonlinear-Schrödinger equation with a lumped cavity boundary condition. Here, intensity losses at the coupling mirror are set to: (a)  $r_1^2 = 0.5$  and (b)  $r_1^2 = 0.6$ . Emergent patterns exhibit an interplay between spots (which form a hexagonal array) and stripes. Panes (c) and (d) show emergent patterns when  $r_1^2 = 0.8$ , but from two different sets of noisy initial conditions.

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# Spontaneous patterns in absorptive ring cavities: from thin-slice to slab systems

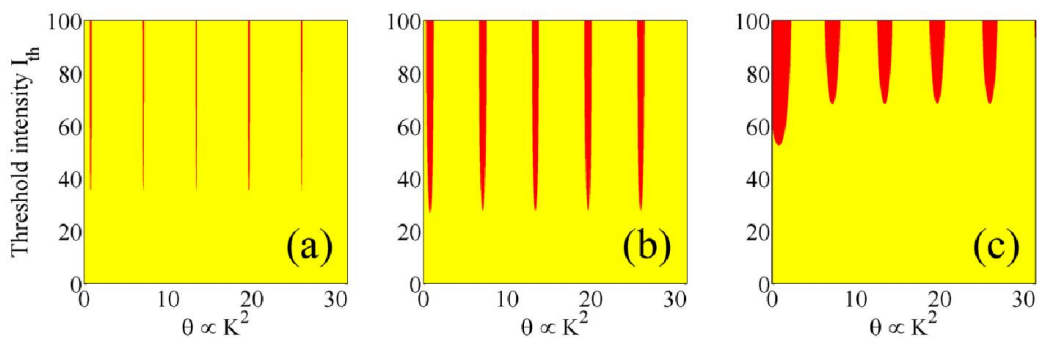
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Keywords: nonlinear materials, ring cavity, saturable absorber, spontaneous patterns

Spontaneous optical pattern formation in ring cavities containing saturable absorbers has been increasingly studied over the past two decades, with models often based on the two-level Maxwell-Bloch equations [1]. Linear stability analysis of the full system (assuming weak absorption) tends to be fraught with complexity, and leads ultimately to a threshold instability spectrum for static patterns that possesses multiple comparable minima [2] – a *multi-Turing spectrum* that we have proposed as a universal signature for predicting any wave-based system’s innate capacity to generate spontaneous spatial fractals [3]. Taking the mean-field limit somewhat reduces the overall complexity of the problem [4] but the multi-Turing spectrum tends to vanish, leaving only a single instability minimum which provides no obvious mechanism by which fractal patterns may emerge. Here, we further develop simplified descriptions of saturable absorbers (i.e., with adiabatic elimination of the material variables) based on a Maxwell-Bloch model without relying on mean-field considerations [5]. In particular, we have extended the spirit of our earlier diffusive thin slice-based analyses to absorptive ring cavities with a finite light-medium interaction length. Preliminary results have uncovered a multi-Turing spectrum for the simplified bulk system (see Fig. 1).



**Figure 1.** Multi-Turing threshold instability spectrum for a simplified saturable-absorber ring cavity. The multiple-minimum structure is potentially indicative of fractal pattern formation [3,5]. Here, absorption is (a) weak, (b) moderate, (c) strong.

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# The discrete nonlinear Schrödinger equation: new contexts & stability analyses

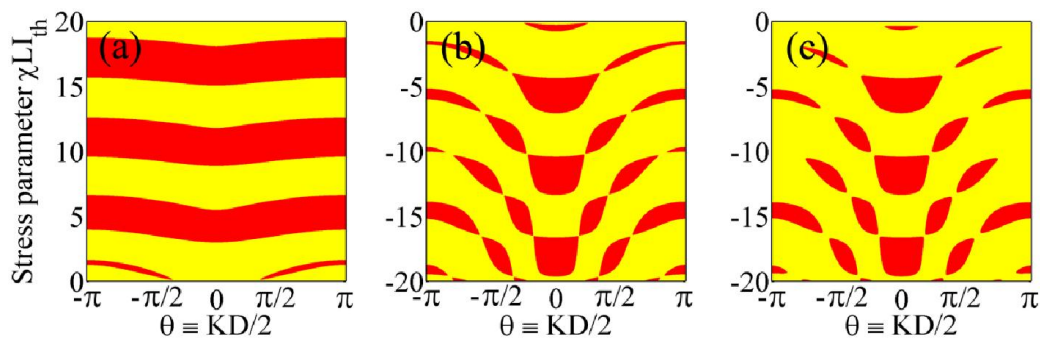
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Keywords: discrete NLS, linear stability analysis, ring cavity, waveguide arrays

The discrete nonlinear Schrödinger (dNLS) equation has come to play a fundamental role in photonics since its introduction by Christodoulides and Joseph some 25 years ago [1]. They proposed the dNLS model as a means of describing the longitudinal evolution of individual complex amplitudes of an averaged optical field travelling down an infinite array of waveguide channels with nearest-neighbour linear coupling and cubic self-interaction nonlinearity. Several authors have subsequently used a mean-field approach (similar in spirit to that developed by Lugiato and Lefever [2]) for modelling light confined to waveguide arrays that have been arranged in ring and Fabry-Pérot cavity geometries. Analyses have tended to consider discrete cavity solitons [3,4]. While such models are straightforward to handle (e.g., the formal boundary condition is merged into the governing equation), they suffer from some physical drawbacks. Here, we consider the full dNLS model [1] when subjected to the ring-resonator feedback loop more traditionally encountered in classic cavity systems [5] (where the mean-field limit has been deliberately avoided). Novel results include the derivation of the discrete plane wave solution, and a linear analysis to test the susceptibility of that uniform state to spontaneous pattern-forming instabilities (see Fig. 1).



**Figure 1.** Multi-Turing instability spectra for the dNLS model with a ring cavity boundary condition for (a) focusing ( $\chi L = +1$ ) and (b) defocusing ( $\chi L = -1$ ) nonlinearity with common cavity parameters. (c) Defocusing case with increased mirror losses.

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# Spatial instabilities in coupled nonlinear microcavities: beyond mean-field theory

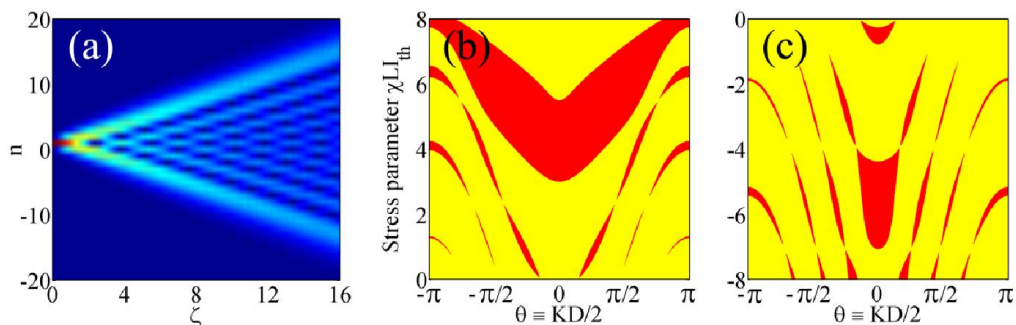
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Keywords: discrete diffraction, discrete NLS, ring cavity, waveguide arrays

The discrete nonlinear Schrödinger (dNLS) equation [1] provides an intuitive building-block model for describing the way in which light waves propagate through periodic optical structures. Its canonical form involves linear coupling to adjacent channels (essentially a one-dimensional Laplacian accommodating discrete diffraction), providing a mechanism for systematic energy transfer throughout the array [see Fig. 1(a)]. Nonlinearity is typically taken to be of the local Kerr type. While the dNLS and some of its generalizations have been intensively studied for many years [2], here we propose a new avenue of research: using the canonical equation, supplemented by a ‘lumped’ periodic ring resonator boundary condition [3], to predict the emergence of spontaneous spatial patterns in coupled nonlinear microcavities. This class of problem appears to have been considered only within the context of the mean-field (MF) approximation [3,4]. Our approach goes beyond the MF limit. Stationary states of the cavity have been identified, and linear analysis deployed to quantify the threshold condition for spatial pattern formation. Results suggest the dNLS cavity has a multiple-minimum characteristic in its Turing instability spectrum [see Figs. 1(b) and 1(c)].



**Figure 1.** (a) Evolution in the cavityless model in the absence of nonlinearity, where light injected into one channel undergoes discrete diffraction into adjacent waveguides. Panes (b) & (c) show multi-Turing threshold spectra for the cavity.

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# Diffraction fractal waves: new paradigms in complexity science

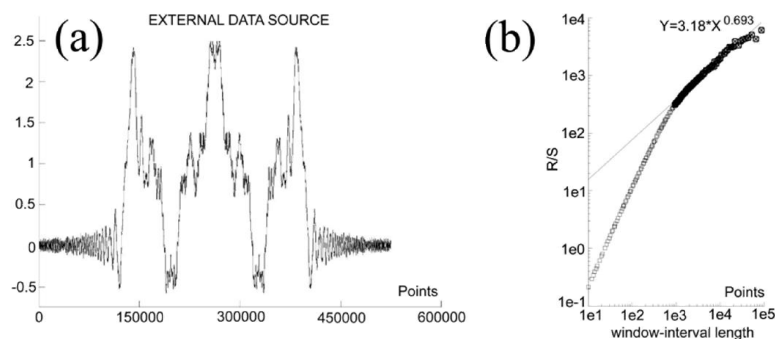
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Keywords: Babinet's principle, complexity, edge waves, fractal light, Fresnel diffraction

Berry's seminal work [1] established that simple waves scattering from a complex object (e.g., a transparent infinite mask with a random fractal phase modulation) may acquire fractal characteristics in their statistics. Remarkably, the complementary regime – where *fractal waves* scatter from a *simple object* – has received almost no attention in the literature. Here, we report on recent advances in the modelling of how fractal waves behave when they interact with hard-edged one-dimensional obstructions [2], such as single-infinite-edge and single-slit amplitude masks (see Fig. 1). The novelty of our approach lies in accommodating an illuminating wave that possesses a very broad spatial bandwidth. Exact mathematical descriptions of near- and far-field diffraction patterns have been obtained using a prescription based on Young's edge waves [3]. The diffraction-of-fractals concept extends well beyond the simple optical systems we have so far analysed. We propose that it is *truly universal*, transcending physical contexts, and we fully expect the idea to play a key role in understanding fractal waveforms in wider classes of system in complexity science. For example, early results have profound implications in the field of fractal antenna engineering [4] and for optimizing sensitivity in experiments to measure surface roughness [5].



**Figure 1.** (a) Fresnel diffraction pattern from a single infinite slit illuminated by a symmetric fractal wave with dimension  $D_{in} = 1.37$ . (b) Rescaled-range dimension calculation (using specialist BENOIT fractal analysis software) gives  $D \approx 1.30 < D_{in}$ .

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# Diffraction of laser light at snowflake apertures: line integrals & edge waves

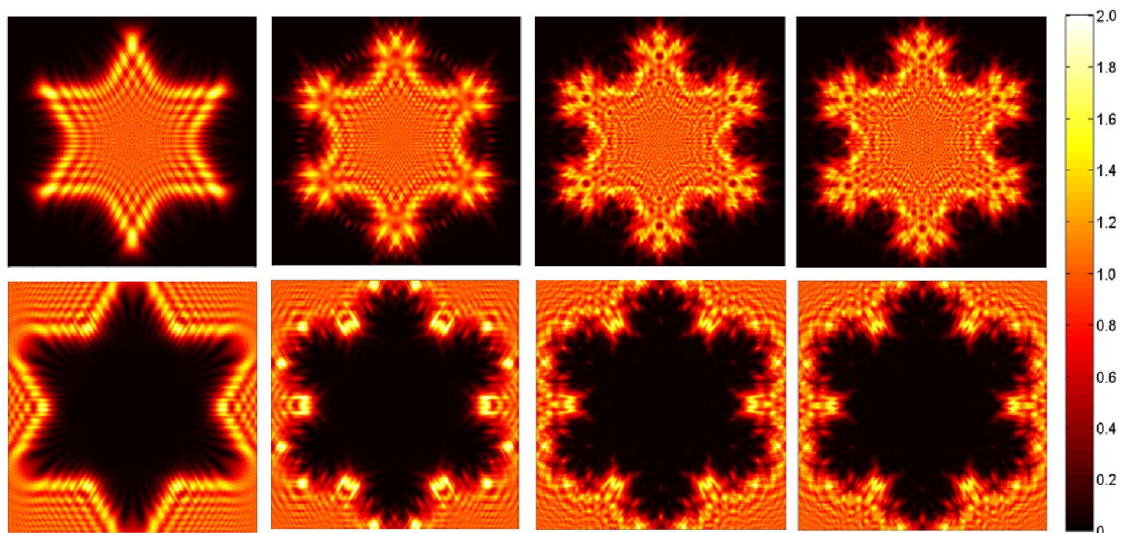
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Keywords: Babinet's principle, diffraction, edge waves, fractals, von Koch snowflake

The diffraction pattern produced by a plane wave illuminating an aperture in an opaque screen is well-described by the Fresnel integral [1]. Of particular interest in our research are apertures whose shape tends toward the classic von Koch fractal snowflake. Optical diffraction from snowflakes has been studied fairly extensively in the Fraunhofer (far-field) region [2], while in the Fresnel (near-field) region there appears to be only a limited number of experimental studies [3]. Here we present what appears to be, to the best of our knowledge, the first exact mathematical description of Fresnel patterns produced by the von Koch snowflake. Our approach is based on a line-integral formulation, where the conventional integral over the closed area of the aperture is transformed into a circulation around its edge; previously, we have applied this method to quantify diffraction at polygonal apertures [4]. The line-integral representation is both elegant and powerful, and it allows complex field patterns (see Fig. 1) to be interpreted in the context of Young's edge waves.



**Figure 1.** Top row: Computations of diffraction patterns from a set of snowflake apertures with 12, 48, 192, and 768 edges, respectively (Fresnel number of 50). Bottom row: diffraction patterns from the complementary stop apertures.

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# On a new class of fractal laser: from kaleidoscope to snowflake cavities

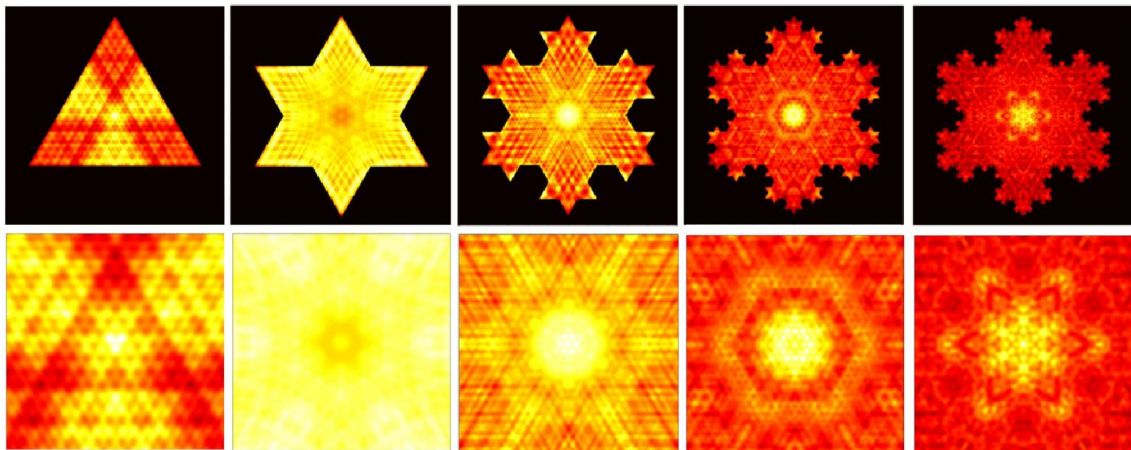
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Keywords: fractal lasers, unstable resonator, transverse eigenmodes, von Koch snowflake

We propose the *snowflake laser* as a new class of unstable cavity with fractal transverse geometry. Unlike its kaleidoscope-laser counterpart [1] (whose aperturing element has the shape of a regular polygon), the snowflake laser has a feedback mirror whose shape tends toward the von Koch snowflake (an iterated function system involving self-similar sequences of equilateral triangles). Our modelling of the empty-cavity eigenmodes is semi-analytical, combining a two-dimensional generalization of Southwell's virtual source method [2] with exact mathematical descriptions of constituent (Fresnel) edge-wave patterns from a set of snowflake apertures. This approach was first developed for kaleidoscopic geometries [3], unfolding the linear resonator into a sequence of virtual apertures of increasing size. Key considerations include extensive computations of mode patterns (see Fig. 1), eigenvalue spectra, and convergence phenomena (changes in system characteristics as the snowflake enters pre-fractal stages of iteration). We have also taken the first steps toward computing the dimension of these new mode families using specialist fractal analysis software [4].



**Figure 1.** Two-dimensional virtual source computations of the lowest-loss snowflake laser modes. Top row: entire mode pattern for first five iterations of the von Koch snowflake initiator-generator algorithm (here, the aperture sits within a circle of unit radius). Bottom row: magnification of the central region of the corresponding mode pattern.

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# Dispersion & detuning in ultrabroadband light generation: the Raman ring cavity

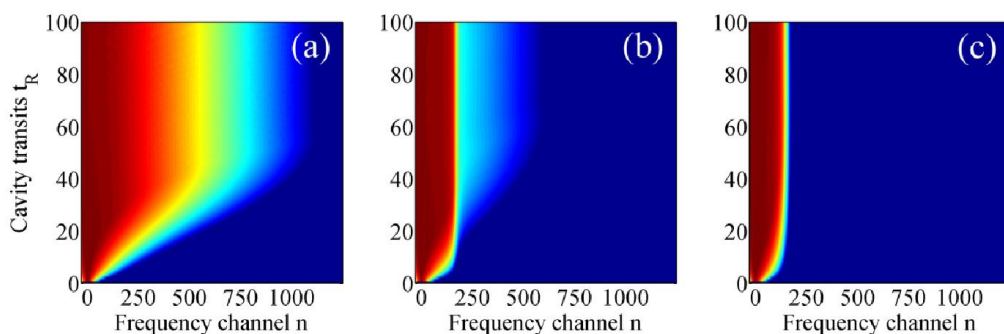
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Keywords: broadband light, detuning, dispersion, Raman scattering, ring cavity

Ultrabroad-band multi-frequency Raman generation (UMRG) is a (laser-driven) resonant-symmetric two-colour pumping method for producing polychromatic light beams that may have a temporal bandwidth of the same order as the pump frequency, and contain scores of discrete spectral lines of comparable energy [1]. Here, we consider a simple model to describe bandwidth evolution when the gain medium is confined to a ring cavity configuration [2]. The circulating field is subjected to periodic pumping, losses, and interferomic mistuning via a longitudinal boundary condition. Particular attention has been paid to the role played by the frequency response of the coupling mirror, where the finite reflectivity bandwidth will inevitably determine the optimum operating conditions for any Raman ring cavity device. Our investigations have been predominantly numerical, with the continuous-wave UMRG equations [3] integrated using a suite of custom MATLAB codes. Long cavities tend to exhibit strong fluctuations in their output characteristics, which is manifest in rapid changes to instantaneous bandwidth. However, the system can be remarkably stable for short cavities and spontaneous self-synchronization phenomena may emerge even with moderate levels of background dispersion [4] (see Fig. 1).



**Figure 1.** Simulation of continuous-wave ultrabroadband multi-frequency Raman light generation in a short ring cavity filled with hydrogen gas. Plots show logarithmic intensity evolution when the level of background dispersion (modelled by a Lorentz formula [4]) is (a) zero ( $\gamma_1 = 0$ ), (b) small ( $\gamma_1 = 10^{-3}$ ), and (c) moderate ( $\gamma_1 = 10^{-2}$ ).

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# **IMPACT AREA (4): Sustainable and Built Environment**

# Understanding Knowledge Boundaries in the Construction Industry: A Critical Reflection

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Keywords: Construction industry, Knowledge boundary

This paper seeks to evaluate the level of understanding of key project of stakeholders in knowledge boundaries in the construction industry by: Identifying the different types of knowledge boundaries that exist in the implementation of a project, and establishing key challenges that confront key stakeholders in the construction sector with respect to knowledge boundaries. Understanding knowledge boundary and knowledge integration are key success factors for organisation to be competitive and innovative. Many Innovations arguably occur occurs at boundaries. In order to be, and remain, competitive organisations need to be innovative and create value by improving communication and interaction between experts who are involved in knowledge communities. One of the aims of organisational boundaries is to obtain a balance between external instability, autonomy and internal order. In other words, the more effective knowledge is managed across boundaries, arguably the more competitive an organisation could be. However, the effect of knowledge on organisational boundaries has not been explicitly explored. To achieve this, knowledge should be accurately integrated with the aim of addressing future needs of organisation. Through archive data, analysis thematic and content analysis of knowledge boundaries, this paper seeks to identify different types of knowledge boundaries that exist and key challenges that confront stakeholders in implementation of a construction project. From a critical review of the literature, the three different types of knowledge boundaries that affect the implementation of project are; semantic, syntactic and pragmatic boundaries. Managing knowledge across these boundaries should lead to novelty and accurately implementing a project. Bridging these boundaries facilitate the process of sharing knowledge which, in turn, will enable stakeholders to have a better understanding of key challenges in the implementation of a project. Literature identifies cost and time as the key challenges that confront stakeholders in the effective implementation of construction projects. The paper offers appropriate recommendations for the benefit of academia, policy and practice.

# Monitoring Security of Tenure in Iraqi Cities: People, Land and Policies; Al-Nassiriya city as an interpretative case study

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Keywords: Monitoring, Security of Tenure, Land, Al-Nassiriya city.

*The study aim is to examine the background and current status of urban Land Registration and Property Rights in Iraq by making future guide for (MST) adequacies that will encourage local Iraqi Urban Land Sectors (ULS) development. The study aim can be achieved by the followed objectives:*

- I. To build a theoretical knowledge and understanding of the Land tenure and Property Rights management as a key to understand the crisis in Iraq.
- II. To study the real local situation of implementation (processes, practices and strategies) of urban asset management and the effect on attainment of best Land tenure and Property Rights in Iraq.
- III. To build the critical success factors (CSFs) for establishing the success of Iraqi local urban land tenure management in terms of Best (MST) managements.
- IV. To identify real indicators influencing the recent process of Land tenure and Property Rights in Iraq within triangle ;( People, Land and Policies).
- V. To develop conceptual framework of Iraqi Land tenure and Property Rights with which Iraqi local (ULS) can re-manage their property resources.
- VI. Providing an adequacy -based management for systematic solutions that could be considered as a future guide for Monitoring Security of Tenure in Iraq in the implementation stage of local (LTM) framework.

The study contributes towards the growing body of knowledge on adequacy in Urban Land Sectors (ULS) of Iraq for implementing urban (MLT) strategies. The results will be most suited to addressing the subjective conception of Iraqi (MST) and also help policy makers to formulate approaches to overcome the competency gap in (MLT) strategies.

## References:

Land tenure management strategies held by Iraqi Government, consulting research organisations and municipality governing bodies and UN-Habitat reports (2003-2013).

# Modelling Driver-Vehicle's Characteristics for Motorway Roadwork

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Keywords: roadwork, micro-simulation, driver-vehicle unit, traffic management.

A new microscopic simulation model is being developed to analyse traffic behaviour and to determine traffic capacity at motorway roadwork sections (see Figure 1). Several computer software packages such as VISSIM and Paramics have been developed to represent traffic behaviour and interaction between individual vehicles on local arterial and regional freeway networks. One of the main reported limitations of the above micro-simulation packages is that they are not capable of accurately representing certain important interactions between vehicles, such as the courtesy behaviour of drivers travelling on UK motorways. Therefore, in this study, the courtesy behaviour which consists of the cooperative slowing down and the yielding behaviours (i.e. shifting lanes to allow drivers to merge) will be represented in the new developed model since these behaviours are predominant on UK roads.

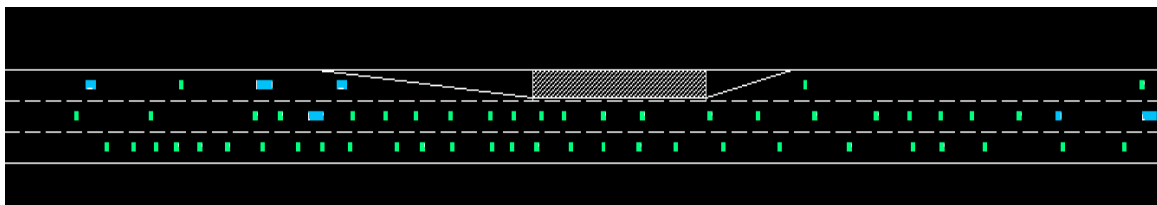


Figure 1: Typical screenshot from the new developed simulation model

The approach of micro-simulation involves modelling the motion of each individual unit (i.e. vehicle and driver) in the traffic stream. Therefore, field data taken from UK motorways has been used to gain information on drivers' desired speed as well as vehicles' types and lengths. Other information relating to acceleration and deceleration rates, perception reaction times and drivers' aggressiveness were taken from the literature. The new micro-simulation model consists of four sub-models. These are car-following, lane-changing, gap acceptance and lane closure rules. At this stage, driver-vehicle unit characteristics and the car-following sub-model have been modelled using Compaq Visual FORTRAN (6.5) programming language. The calibration and validation processes based on observations from motorway roadwork sites will follow.



# Building Information modelling (BIM) benefits Evaluation Framework

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Keywords: BIM, Benefits, Maturity, Client Organisation

Despite the BIM great value, The UK construction industry in general is experiencing slow BIM implementation. According to the smart market report (2011) just 23% of contractors already adopted it and just 7% of them are using BIM as a process on 30% or more of their construction projects. Kennett (2010) also stated that the BIM uptake across the UK industry still very weak.

There are many factors that may affect the process of BIM implementation in the UK industry. According to a survey held by Smart market report in 2011, clients can play a vital role in the process of implementation where client demands could be a big motivation for industry to start implement BIM (Smart Market 2011). Furthermore, BIM implementation was prevented from being wider accepted across the construction industry stakeholder by client fears and lack of full understanding of the BIM benefits as well as the requirement that need it to gather these benefits (Succar, 2010). The main reasons behind the client's behaviour is that the BIM benefits are not clearly defined to clients compared to others construction industry stakeholder, (Smart market Report 2012).

In the previous literature, BIM benefits were explained without any reference to their relationship to the project stages and the maturity level of the client organisation. Hence, there are no clear guidelines for client to follow to maximise the benefit from implementing BIM and answering the client question "how benefits will materialise and over what period" (Love et al., 2013).

This research aims to develop a BIM benefit evaluation framework for client organisations. This framework will focus on the relationship between the BIM implementation maturity level of the organization and the benefits that clients get out of BIM implementation.

# **Transforming Public Organisations' Performance in the Developing World to Attract FDI by Integrating Strategic Planning & PMO**

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The main challenges facing the Public Sector organisations in the developing world in developing environment enabled for Foreign Direct Investment (FDI) include non-transparency, bureaucracy and corruption which influence the organisations initiatives for attracting FDI. The literature does not seem to cover solutions which are capable to overcome these problems at the short or even the medium term. However, the literature greatly emphasise the role of using excellence models, such as EFQM, Baldrige and PROBE, to improve the performance of organisations, which in turn will help to streamline their problems and develop capacity to continuously improve themselves. In doing so, it is important to assess the organisations' overall level of practices and their impact on performance and compare it to those of world-class organisations and identify the gaps. Having identified the gaps, the traditional solution is to adopt an organisational performance improvement technique for conducting a step-change-improvement to the identified gaps.

However, this approach is a lengthy one and the implementation of which can jeopardise any improvement due to the lack of quick wins. Thus, an alternative approach is required to provide a quick solution for the identified organisational weaknesses in which it can help public organisations to overcome their performance weaknesses. By utilising the same factors that underpin the business excellence models a solution could be derived to introduce an attractive environment for FDI in a reasonable period of time.

In this context, the literature has suggested that both strategic planning and project management office (PMO) to be the main factors that positively affect the implementation of organisations' plans for attracting FDI. The literature has not looked at these solutions collectively in a way that could overcome FDI problems in an accelerating way and, thus, this will be the aim of this research project.

# Waste Management on Complex Construction Sites

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Key Words: Management, Complex Construction Sites

Effective waste management in the UK construction industry could significantly impact on environmental sustainability. In light of this, strategies are currently developed to encourage construction experts to use a set of regulations and legislation to control the effectiveness of the impact by minimising the consumption of materials resources and energy. A construction waste management plan aims to improve materials resource efficiency by implementing reuse, recovery and recycling as well as to minimize issues such as illegal dumping by properly documenting waste removal processes (DEFRA, 2009).

This research aims to develop a strategic framework to manage construction waste on complex construction sites. In view of this, the existing strategies for waste management are critically reviewed to explore the positive and negative challenges of previous and existing frameworks in construction, as well as to identify the key players who are affecting the waste management processes on site. Based on this, a framework would be developed, and validated, using expert experiences in complex construction sites.

The methodology adapted is the mixed methods approach. The epistemological stance of this research leans more towards interpretivism, while the ontological stance leans towards constructivism. The axiological stance is one of “value laden”. The approach is both qualitative and quantitative.

Many UK based construction organisations produce guidelines and templates for contractors to manage their construction waste but in a complex construction site such as stadia, hotels, large buildings, and hospitals, due to usage of a huge quantity of different materials and large built-up areas, as well as involvement of multi stakeholders, management of waste become more critical, so, developing a waste management strategy will help to prevent waste generation, and thus in parallel, will reduce the environmental effects. In such a framework all factors should be captured and a process should be generated to control each factor. In this case, all stages of waste hierarchy should be considered.

## **Reformation of the Curricula on Built Environment in the Eastern Neighbouring Area (CENEAST)**

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Keywords: CENEAST, sustainable built environment policy, higher education curricula, Eastern Neighbouring Area

It has been observed that the energetically and ecologically sustainable, affordable and healthy built environment policy was not considered essential by the Russian, Ukrainian and Byelorussian universities. Such policy has also not been incorporated in the curricula of building and civil engineering higher education programmes. Due to insufficient demand for the energetically and ecologically sustainable, affordable and healthy built environment in these countries, graduates lack the multidisciplinary character of knowledge in built environment, including technical, technological, organisational, management, social, environmental, economic, cultural, psychological, political and other aspects. Insufficient communication between universities and labour market and lack of compliance to Bologna practises have also been observed in the region. The European Union funded CENEAST research project address the aforementioned issues and aims at upgrading the built environment curricula in the universities of Belarus, Russia and Ukraine according to Bologna practices in order to increase their capacity to continually modernise, enhance the quality and relevance of education of the building and civil engineering students to the labour market needs and to ensure international cooperation. The project consist of 14 European Union and Eastern neighbouring institutions led by Vilnius Gediminas Technical University, Lithuania. The project consortium will develop modules for 9 BSc/specialists, 11 MSc and 2 PhD programmes adding up to 22 modules in total, including frameworks and teaching materials. All modules will be developed jointly and each partner will contribute towards module development within their areas of expertise. The developed modules will be incorporated into excising curricular of BSc/specialists, MSc and PhD programmes for building and civil engineering students in universities of Belarus, Russia and Ukraine.

# Motivation of Quantity Surveyors towards Job Improvement

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Keywords: Motivation, Quantity Surveyor, Job Performance

The research aims to develop a model and a set of guidance on the motivation of Quantity Surveyors (Qs) in the Malaysian construction industry for improved organisational performance. The philosophical stand for the epistemology is leaning more towards interpretivist while the ontological and axiological stands are leaning more towards constructivist and value free respectively. The research attempts to use a mix-methods research approach, by implementing the combination of archival document, surveys and interviews to obtain data. Overall, questionnaire surveys will be distributed to all population of Qs working in the construction industry in Malaysia. To complement these findings, 30 semi-structured interviews will be carried out with individual Qs registered with the BQSM. The web-based questionnaire will be analysed statistically using the SPSS software package version 19.0. The interviews will be analysed using content analysis using NVivo10 software.

Tentative findings of the research show that the motivation factors of quantity surveyors are 'opportunity to grow in career in the organisation', 'nature of job or task given', 'provisions of rewards in term of material and physical', 'relationship with management and colleagues', and 'fairness in organisational practices'. Also, employees in the public sector are intrinsically motivated whereas employees of the private sector are keen of the economic rewards. The data collected will be used to develop a model and its practices and a set of guidance in the area of motivational practices for quantity surveyors in Malaysia for the benefit of individual quantity surveyors, construction organisations, professional bodies, and academicians.

# STORYTELING AS AN EFFECTIVE KNOWLEDGE SHARING TECHNIQUE IN CONSTRUCTION PROJECTS

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Keywords: Construction Projects, Knowledge barriers, Knowledge sharing, Storytelling

Construction project processes offers inter-organisational setting where different organisations contribute with certain kinds of knowledge. The process is driven by a shared interest in completing a common and specific task, which offers opportunities for sharing knowledge and learning across organisational and professional boundaries. Sharing of knowledge within the construction industry is thus a challenge dependent on informal and personal contacts. In construction projects, certain knowledge barriers alter the effective sharing and communication of knowledge amongst project teams which could in-turn impact on the overall deliverables. Storytelling has been seen as a technique with adequate potentials in sharing and communicating knowledge in complex environments part of which the construction project environment belongs. This paper seeks to explore the nature and power of storytelling as an effective Knowledge sharing technique (KST) in overcoming knowledge sharing barriers (KSB) within construction projects. Since these paper is based on a critical review of literature, the findings from the review of literature would be content analysed. A content analysis of about 25 different articles on storytelling and knowledge sharing barriers would be conducted. Based on these reviews, the emerging nature of storytelling as a medium for tacit knowledge transfer emerges to make recommendations or suggestions on its potential ability in overcoming knowledge barriers which seeks to add value to academia, practice and industry. Having established the possibility of overcoming knowledge barriers in construction projects using storytelling, the next phase explores how this affects decision making in construction projects.

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# **What are the challenges in building Local Governments' road maintenance capacity?**

## **A case study on the post-tsunami road reconstruction in Aceh, Indonesia**

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Keywords: Local Governments, Capacity Building, Road Maintenance, Post-disaster,

In major disasters, such as tsunami, road infrastructure sector frequently suffers one of the most damages and losses. In the Boxing Day tsunami in 2004, more than 2700km of roads destroyed, and more than 3600km of roads were repaired and rebuilt. Since the local governments are held responsible for the maintenance of most of the reconstructed assets, there are concerns whether the roads can be maintained, particularly when the maintenance capacity of the local governments have been renowned to be limited. Therefore, capacity building is considered as an important aspect in post-disaster road reconstruction, in order to obtain the maximum value of the investment made in the reconstruction.

As part of an ongoing PhD research, the objective of this poster has been set to identify the challenges in the implementation of the capacity building programs in the road sector. Three districts in Aceh were selected as the case studies; Aceh Besar, Aceh Jaya, and Aceh Barat Daya.

The primary data was collected using semi-structured interviews with 28 respondents from the national, provincial and district level; representing the governments, donor agencies, and private sectors. The respondents were selected using a mix of purposive and snowballing sampling methods. The interviews were conducted in face-to-face approach. The data was analysed using Content Analysis technique, with the aid of nVivo version 10.

The analysis of data shows that the challenges are rooted to four main problems; low political interest, poor budget allocation for capacity building programs, poorly designed capacity building programs, and the personnel issues. By identifying the capacity building challenges, it is expected that future post-disaster road reconstruction may put into account these issues, and eventually help ensure that the optimum value is achieved from the investment made in the reconstruction of road infrastructure.

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# **Empowering local governments in making cities resilient to disasters**

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Keywords: disaster resilience; built environment; empowerment; local government; cities; Sri Lanka

The world is experiencing rapid urban growth with a consequential increase in urban poverty. The excessive unplanned urban growth leads to various physical, social and economic vulnerabilities. Consequently, the impacts of disasters are highly detrimental when they occur in urban environments. It is therefore important to safeguard the urban cities by increasing the city's resilience to disasters. A large number of stakeholders are required to get involved in the process of making cities resilient and the local governments have to play an essential role as they are the main governing body in every city. Even though there is a growing concern among researchers and practitioners regarding the required lead role of local government in making cities resilient, several incidents have been reported on the inadequate contribution of local governments in implementing disaster risk reduction initiatives. In this context, this research aims to explore and propose mechanisms to empower the local governments to make cities resilient to disasters within the context of the built environment. The research adopts case studies as its research strategy and investigates three cities in Sri Lanka which are potentially vulnerable to disasters. The empirical data reveals that local governments face a number of challenges in contributing to making a disaster resilient built environment within cities. In addressing these challenges the research proposes a set of recommendations to empower the local governments. Empowerment of local governments is proposed by developing the organisational capacities and reforming the governance related to way in which local governments are established.

## **Collaborative Action towards Disaster Resilience Education (CADRE)**

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Keywords: disaster resilience; education; professional doctorate; collaboration

CADRE is a three year ERASMUS multilateral project which aims to address current and emerging labour market demands in the construction industry to increase societal resilience to disasters. CADRE will make a contribution to both theory and practice in the development of societal resilience to disasters through the development of curricular and modules to update the knowledge and skills that employees have obtained in the past. It will broaden and deepen the employees' understanding of the disciplines in which they are studying, upgrade their skills, promote inter-disciplinary working, and provide them with appropriate transferable skills. CADRE will enhance not only academic knowledge, but also the concerns, capabilities and expectations of the relevant industries and communities. In turn, this will create the necessary intra Industry, Community and University (ICU) feedback and feed-forward mechanisms to enable effective lifelong learning. CADRE will achieve this aim by establishing a framework for ICU integration to address societal concerns; developing and testing an innovative professional doctoral programme that integrates professional and academic knowledge in the construction industry to develop societal resilience to disasters; and exploiting ICT to enable cross-border cooperation in the sharing and delivery of educational resources. A constructive & developmental research approach has been selected as the overarching research methodology. This approach will begin with a detailed market needs analysis, capturing inter-disciplinary needs across a range of stakeholders and countries. Alongside this, an ICU framework will be developed to identify how integration can take place and how the effectiveness of such integration can be measured. Based on these inputs, the development of the academic content of the joint professional doctorate programme and the associated processes will begin.

# **Collaborative reformation of curricula on resilience management with intelligent systems in open source and augmented reality (RESINT)**

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Keywords: resilient management; curricular; intelligent systems; higher education institutes

RESINT is a two year ERASMUS multilateral project which promote cooperation and innovation among European higher education institutes, governments, associations and business partners to increase society's resilience to disasters. The project proposes a collaborative approach for resilience management in overcoming the existing inadequacy of university courses, curricula and syllabuses. RESINT therefore aims at reforming curricula in resilience management with the collaboration of non-academic partners. Accordingly it will contribute towards resilience management teaching and learning by developing open source new methodologies and didactical tools with augmented reality and intelligent computer learning systems. The innovative teaching methods with the cooperation of business partners and associations will enhance the entrepreneurial skills and attitudes of teachers and students and will facilitate students and staff mobility between academia and business. RESINT will achieve its aim by seven clearly defined work packages which includes effective management of project activities (WP1); development of new curricula and syllabuses in resilience management (WP2); development of the innovative virtual interuniversity network for resilience management educational cooperation (WP3); development of open Source in intelligent systems and augmented reality (WP4); effective dissemination of project results (WP5); assurance of quality (WP6) and designing and developing mechanisms of ensuring sustainability of OER platforms developed as part of the project (WP7). The project will bring new tools for networking, teaching and disseminating which will empower students and other target groups with a series of competences in resilience management.

# Capacity Building for Flood Disaster Mitigation in the UK

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Keywords: mitigation, flood, protection, prevention, preparedness, disaster, risk, hazard

In recent times, the United Kingdom had witnessed flood disasters, from the overflowing of the banks of the River Thames to the submerging of residential and commercial neighbourhoods in Devon, Dorset, Somerset, Lancashire, Worcestershire, and at various other locations, too numerous to mention. The magnitude of the flood completely overwhelmed existing flood defences and made a mockery of well-known and packaged agendas meant to “prevent, protect and prepare” against such adverse occurrences. The European Union’s (EU) Flood Directive 2007 is robust in its aim and mandate to member states, for which the UK is a member, in specifying that “adequate and coordinated measures” be taken to reduce flood risk. The UK Environmental Agency, solely responsible for action against these natural disasters had been caught napping and widely blamed for failings in pre-empting these sad incidents. Thousands of properties were devastated and vital infrastructures, such as roads, bridges and rail tracks were damaged, as a result. Thousands of people were made homeless and some had to seek temporary shelter and refuge. The consequences on businesses were untold and large compensation were to be paid out by insurance companies.

This research is set to look into various mitigating measures meant to overcome the lapses and inadequacies of the present system and to encourage a better informed approach in dealing with future occurrences. The research effort will draw from existing documentation and legislation put in place to enhance corporate response, to avert repeating the cycle of flood disaster in the UK.

# **Assessing gender vulnerability within post-earthquake reconstruction: case study from Indonesia**

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Keywords: gender, vulnerability, post-earthquake reconstruction, Indonesia

Understanding types of gender vulnerability and its determinants within disaster management context is useful to protect women and men from greater destabilization, to achieve better process of disaster management, to enhance sustainability of reconstruction and to build community resilience. Using mixed method combining qualitative and quantitative data analysis, this study reveals various dimensions of gender vulnerability within post-earthquake reconstruction at Yogyakarta province. This study found that the physical dimension (i.e. women with disabilities, pregnant women, elderly women), four types of social dimension (i.e. homeless women, violence against women, widow with many dependants, women heading household), and two types of economic dimension (i.e. women with debt burden and women with lack of productive assets) are the most prominent dimension. Existing patriarchal culture and weak of gendered institution are the root causes of gender vulnerability. This study suggests assessing gender vulnerability within post-disaster reconstruction helps key stakeholders to identify dimensions and determinants of gender vulnerability that should be tackled to ensure gender equality within post-disaster reconstruction.

# **Tsunami Evacuation Planning, A Case Study of Padang, Indonesia**

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Keywords: Tsunami, Evacuation, Planning, Preparedness

Padang is the third biggest city in Sumatra with a population of about 800,000. It is the capital city of the West Sumatra Province of Indonesia. It is situated directly on the coast of the Indian Ocean and is exposed to potential tsunamis in the future.

The potential tsunami hazard in Padang city has been studied by the International research community. Among them are (Borrero, Sieh, Chlieh, & Synolakis, 2006), (Taubenböck et al., 2009) and (McCloskey et al., 2008). They all have the same opinion that Padang is the region that is the most likely to be devastated by any huge tsunami that may occur in the near future.

Research conducted by (Singh et al., 2010) estimated that the arrival of a tsunami in Padang city could be about 20-32 minutes after the massive earthquake generates the tsunami. Padang city is situated on very flat liquefiable ground. To reach an altitude of 5m from the coast, one has to walk more than 3 km. The population of the city is dense with 844.316 inhabitants (BPS, 2011), therefore it would be very difficult to evacuate about 400,000 (50%) people in a short time to a tsunami safe zone. There would not be enough time for people to reach a safe place or higher. Transportation facilities are far from sufficient and crowded vehicles with people who are panicking at the time would cause traffic jams.

The local government has constructed various efforts to develop local early warning systems and disaster management. These activities include preparing legislation, preparing evacuation infrastructure, building shelters, preparing resources for government officials, and in the community, and other support activities that must be done to anticipate the tsunami hazard. Therefore, this study will carry out an evaluation of the Tsunami Evacuation Planning process in Padang city. The evaluation is conducted by formulating a disaster preparedness measure for government and community.

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# Assessing the Critical Cost Factors in Low Cost Housing Provision

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Low cost housing have seemingly become commonplace across the globe, particularly in developing economies such as Nigeria. Usually, this strategy is targeted at providing affordable shelter for a majority of the population who cannot otherwise afford same at the prevailing market rates. In Nigeria, such strategies have been targeted at low and middle income earners. Notwithstanding several policy reforms on low cost housing provision over the past two decades, housing demand by this class of beneficiaries has not been met by public and private sector developers alike. In areas where this strategy is being implemented at all, there have always been serious concerns over affordability as houses are provided at high costs. Such concerns have engendered poor cost recovery and programme abandonment in most cases. This study which constitutes an integral part of an ongoing research on costing the provision of low cost housing in Nigeria from a sustainable perspective seeks to examine and identify the various critical cost factors within the structure of housing provision which impact on the unit and overall cost of low cost houses. Following a critical review of extant literature relating to costs and structure of low cost housing in developing countries obtained from peer reviewed journals, books and housing policy documents, four critical cost factors were identified. These factors include costs associated with; land, transaction, construction, and developers profit. Therefore, it is expected that the finding of this particular study will contribute towards an enhanced understanding of the degree of influence wielded by these factors, enabling the successful development of an appropriate framework for a balanced costing approach for low-cost housing provision in Nigeria.

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# Soundscape Composition of Manchester City Centre Area

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Keywords: Soundscape composition, city centre, soundscape simulator, object oriented approach

Soundscape has become important aspect of a space. Urban planners or architects should consider all factors, including soundscape, for designing space (Jennings & Cain, 2013). It is important to provide tools for them to test soundscape design (Adams, Davies, Bruce, & Building, 2009). The development of reproduction system has made it possible to provide tools for testing soundscape.

The developments of reproduction system make soundscape reproduction in a room possible to be done. Many researches have been done to analyze the quality of reproduction system. 2D ambisonic playback system can reproduce the soundscape as they were in real outdoor condition (Guastavino, Katz, Polack, & Levitin, 2005). The reproduction system can give similar perception with field condition (Davies, Bruce, & Murphy, 2014). With this reproduction system and Digital Audio Workstation (DAW), soundscape simulator has been developed (Bruce, Davies, & Adams, 2009). Soundscape composition using soundscape simulator could be solution for testing soundscape design.

On this research, we try to compose the soundscape of Manchester city centre with object oriented approach. The reason why we choose city centre: it is important element of modern city (Kang & Zhang, 2010), it has a lot of variety and necessity to design (Davies, Adams, Bruce, Carlyle, & Cusack, 2009), and it is the main attraction of a city (Nathan & Urwin, 2005). There will be three stages in this research: Baseline, the perception analysis of soundscape reproduction system; Composition, the making of soundscape composition using soundscape simulator with object oriented approach; and Comparison, the interpretation between soundscape composition result and soundscape recording.

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# Transportation Evacuation Strategies based on Vehicular Disaster Management System

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Keywords – Intelligent Disaster Management System; Intelligent Transportation System; Cloud Computing; Vehicular Ad hoc Network and Evacuation Strategies.

The importance of emergency response systems cannot be overemphasized today due to the many manmade and natural disasters throughout the world such as the Philippines storm, Typhoon Haiyan 2013 and September 2001 attacks. We have witnessed unprecedented advancements in information and communication technologies over the last few decades and the role of ICT technologies in Intelligent Transportation Systems is to grow tremendously. Vehicular Ad hoc Networks (VANETs), and sensor networks are enabling transformational capabilities for transportation. Our ability to monitor and manage transportation system in real-time and at high granularity has grown tremendously due to sensor and vehicular network that generate huge amount of extremely useful data.

Our research is concerned with developing emergency response system with a focus on transportation system which exploits ICT (Information and Communication Technologies) developments. In this paper, we leverage Vehicular Ad hoc Network and Cloud Computing technologies to propose an intelligent disaster management system. The system architecture is described as well as the traffic models used to provide transport intelligence are explained. We develop a tool to investigate the effectiveness of our system in improving different evacuation strategies implementation. We demonstrated the system impact through modelling the impact of a disaster on a real city transport environment based on traditional approaches and comparing it with the case where our disaster management system was in place. We report great benefits derived from the adoption of our proposed system in terms of improved and balanced traffic flow and smooth evacuation. Also, an increase in the possibility of saving lives and properties has been noticed.

# IMPORTANCE OF ORGANIZATIONAL READINESS FOR TQM IMPLEMENTATION IN THE NIGERIAN CONSTRUCTION INDUSTRY

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Keywords: TQM, organizational Readiness, continuous improvement, Nigerian construction industry.

It is indeed people that constitute organisations; it is they who definitely are the actual source of, and vehicle for, change. They are the ones who understand how to either to embrace or refrain from change. The Nigerian construction industry continues to occupy an important position in the nation's economy even though it contributes less than the manufacturing or other service industries. In the Nigerian construction industry, organizational culture has been considered as one of the impediments to TQM implementation. Culture in any business may be defined as the beliefs that pervade the Organization about how business should be conducted, and how employees should behave and should be treated. The inability to change organizational culture was identified as an impediment to TQM implementation within the Nigerian construction sector. The entire TQM concept is an approach to enhancing the efficiency and overall flexibility of business as a whole, fulfilling customer requirements both external and internal to the organization which can lead to reduction in resource wastage, Strengthening brand image, Reductions in defects and costs, Cost benefits which can be obtained through control of financial performance. It is fundamentally a way of organizing and connecting the whole organization, each and every unit, the entire person at every level. Change readiness is not automated and it simply cannot be assumed. Therefore in this paper, conceptually define the important of organizational readiness for change as well as develop a theory of its determinants and outcomes with our target in the Nigerian construction sector and other organization that may benefit from the TQM idea. This paper is composed from an interpretivist perspective recognized to be examining the perceptions of the human actors which will be conducted in the Nigerian Construction industry on organizational readiness for TQM implementation. To achieve this, a semi-structured interview will be conducted with the local contractors, foreign firms and expert interviews within the Nigerian construction industry. It is envisaged that the results from the interviews will reveal some important lessons for the Nigerian construction organizations in improving quality management practices for proper TQM implementation.

# Improving Resilience to Supply Chain Disruptions in Construction

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Keywords: Supply Chain Management, Disruptions, Resilience, Risk Management, Construction

With the government's goal to transform Malaysia into a prosperous, competitive and resilient by the year 2020 through "Malaysia Vision 2020", the construction industry has become the focal point for development. However, despite good plans on the development of public projects by government departments, the Malaysian Auditor General Report 2013 has identified several weaknesses and disruptions in the implementation of the construction projects that had caused the project objectives to not be fully achieved. Strategic effort such as Supply Chain Management adopts a system perspective that suggests the whole system to be responsible for project performance. Hence, instead of focusing on individual errors, the entire supply chain system needs to be considered in assessing their level of resilience to disruptions.

Improving the resilience of the supply chain towards disruptions demands an in-depth understanding of the management of supply chain disruptions. The purpose of this paper is to review the literature to discuss the current practices and research trends in managing supply chain disruptions. The study finds that majority of the literature on managing supply chain disruptions comes from the manufacturing sector, and little attention has been paid to the disruptions faced by construction supply chain. By looking at the supply chain disruptions as a process rather than an event, the paper reveals that the literature can be categorised into pre-disruption and post-disruption stage. Most literature in construction is focusing on the risk management process at the pre-disruption stage, by analysing the probability and impact of risk of 'potential disruption' in construction projects, and little works are presented on post-disruption activities on the response of the supply chain following an 'actual disruption'. The paper concludes that it is important to consider both

pre and post disruption stages and the proactive and reactive approach in building supply chain resilience to disruptions.

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# **A Roadmap for European Higher Education in Developing Societal Resilience to Disasters**

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Keywords: Disaster resilience, Higher education, Education policy, Roadmap, ANDROID

Academic Network for Disaster Resilience to Optimise educational Development (ANDROID) is an Erasmus academic network that will raise awareness and promote a common understanding among stakeholders of the importance of disaster resilience education and the essential role of European higher education institutions in improving society's ability to increase disaster resilience. The network is developing a Roadmap for European higher education in developing societal resilience to disasters. The roadmap collates the major findings that arise from the network's surveys in order to set an agenda for educational policy in the field. The survey on European education to map teaching and research programmes in disaster resilience demonstrates the lack of disaster resilience related programmes offered by HEIs across Europe and suggests a clear potential for such programmes. The survey on capacity analysis of European public administrators has given insight into the relative demand for academic qualifications within European public administrations and the degree to which staff knowledge and skills have affected the implementation of disaster resilience initiatives. Thus the roadmap considers society's requirements in terms of skills and scientific advances and the existing capacity of European HEIs to meet these requirements. Finally, the report will consider what needs to happen in education policy to help address some of the greatest challenges and opportunities for education in the 21<sup>st</sup> century in helping society address the threat posed by hazards of natural and human origin.

This project has been funded with support from the European Commission. This publication [communication] reflects the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

# **The creation of an Infrastructure Delivery System via participatory action research to act as an effective organisational change management tool within the regulated water sector**

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Keywords:

Infrastructure delivery, action research, change & knowledge management, systems

There is considerable focus on the impact of infrastructure investment on enhancing economic performance; and recently, driven by the financial crisis, infrastructure (specifically physical or 'hard') in the UK has come under considerable scrutiny with regard to its effectiveness, efficiency and structure. A large focus has been on the enticing of private investment into infrastructure, which is nowhere more prevalent than in the regulated water sector in England & Wales which provides full private financing and investment for the enhancement of the UK economy; which has its supporters and critics alike. Thus, the efficiency and effectiveness of infrastructure delivery via appropriate procurement methods has become a focus of savings within the context of UK 'Plc' and its infrastructure investment. Literature exists with a focus on the nature and effectiveness of infrastructure provision via asset sales and resultant regulation, as well as with the delivery of infrastructure related assets and capital delivery programmes at the level of construction. This project was subsequently formed to address the delivery of infrastructure in a systemic way with a view to creating an infrastructure delivery system in collaboration with a regulated water company through the use of participatory action research to act as a change management framework and thus improve the delivery of infrastructure and for research to create value, opposed to research about value.



# Identifying The Main Challenges to Human Capital Development For Knowledge Based Economy In Qatar

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For the Gulf Cooperation council (GCC) country of Qatar, labour is crucial for it to sustain and deliver infrastructure needed for it to meet international obligations as well as deliver on the vision 2030 agenda. According to the General Secretariat for Development Planning (GSDP) (2012) the current infrastructure development for Qatar is considered as a means to an end; whereby the main goal of the vision 2030 is to establish a knowledge based economy that is highly competitive at the international level. This would demand, among other things, the paradigm shift away from a hydrocarbon based economy to one that is knowledge based. Currently, there are many organisations involved in the planning and implementation of the infrastructure development for Qatar, however, the Qatari government's strategy has been to use the construction industry as the main vehicle for ensuring that the investment in infrastructure can be realised and that the country can be built on a strong and modern footing in terms of infrastructure and service provision to the people.

Essentially, the government has a wider economic agenda through industrial development, such as the development of the hydrocarbon industry and through tourism such as the hosting of international sporting tournaments such as the FIFA soccer world cup 2022. Realising the economic development through industrial activities as well as tourism would be under threat if the infrastructure development stalls; therefore the human resource planning, , succession planning, and talent management of the labour force – *inter alia* – becomes a crucial factor in the strategic delivery process of Qatari infrastructure needs.

This research, therefore, takes an exploratory approach that depends on reviewing the literature to the identity the main challenges to develop Qatari's capability for infrastructure development to implement QNV2030 agenda.

# **EXAMINING THE RELATIONSHIP THAT EXISTS BETWEEN PROCUREMENT METHODS AND COST MANAGEMENT STRATEGIES USED IN THE NIGERIAN OIL AND GAS SECTOR**

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Nigeria can best be described as one of the several mono-product economies in the world today; especially as it derives a high proportion of its gross revenue from crude oil and crude oil based transactions. Nigeria has continuously relied upon the proceeds from the sector to drive national development. Unfortunately, the citizenry and government of the country lament the spate of project abandonment and divestments of major oil and gas operators from production activities in the industry in recent times; maintaining that such actions lead to reduced productivity and hence reduced contribution to the national economy. Considering the significance of this factor, it is then surprising that there is a seeming paucity of studies which have been carried out to investigate the current modes of cost management being utilised in the industry. Also, there appears to be a lack of studies exploring the impact of the adopted procurement systems on the identified cost management strategies

selecting appropriate procurement systems to achieve effective cost management within the oil and gas industry, this particular study will attempt to identify the various cost management strategies being used in the Nigerian oil and gas industry through an extensive review of the literature and explore the probable relationships between the effectiveness of these strategies and the prevalent procurement systems in the industry. It is expected that the findings of this study will contribute to the development of a conceptual framework upon which the rest of the PhD study would be hinged.

# Evaluating the Value of Urban Food: Real Food Wythenshawe

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Keywords: Urban Agriculture, food poverty, food security

Urban Agriculture (UA) is the production of food in the city context. Agriculture is commonly thought of as a rural practice, conducted in spaces that are kept separate from urban areas and invisible to the city dweller. UA bridges the gap between production and consumption, whilst potentially offering a partial solution to the difficulties that may arise in feeding urban populations.

Food poverty affects urban areas all over the UK, an example of which is Wythenshawe, a district in South Manchester. Wythenshawe, built as a garden city in the 1920s, contains many green spaces, and yet there are few outlets where residents are able to purchase fresh, healthy food. The area suffers from high levels of deprivation and has been referred to as a 'food desert' due to the lack of access that residents have to fresh food. Access problems along with high levels of unemployment, poor health and a lack of knowledge regarding food preparation have inspired the Real Food Wythenshawe project (RFW).

RFW received £1 million from the Big Lottery to pioneer the practice of UA in Wythenshawe. The project aims to initiate a level of behavioural change within the community, whereby residents will redevelop their connection to food and will be more inclined and better equipped to grow, cook and eat fresh, local food.

This PhD aims to evaluate RFW, providing a review of the project's impact. It aims to map access to fresh food across parts of Wythenshawe and to use qualitative techniques to assess dietary habits and perceptions towards food. This research also seeks to establish reasons for food choices in concert with accessibility limitations and to monitor changes in perceptions as a result of participants' involvement with RFW.

# Decision support tool based on ecosystem service variables for retrofitting of sustainable drainage systems including wetlands

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Keywords: Sustainable drainage system, Ecosystem services, Decision support

There is a lack of practical decision support tools useful for a rapid assessment of the potential of ecosystem services when retrofitting of sustainable drainage systems (SuDS) such as wetlands and ponds in urban areas. A wetland is effective at providing storage capacity, diverse wildlife habitat and pollutant removal capacity. The aim was to develop an innovative rapid decision support tool based on novel ecosystem service variables for retrofitting of wetlands and ponds, and other SuDS techniques.

More than 100 sites and corresponding catchment areas that were large enough for the retrofitting of SuDS were identified in Greater Manchester. The key ecosystem service variables of relevance to wetlands were Moderation of Extreme Events and Storm Runoff Treatment. A rapid assessment methodology for retrofitting of SuDS was developed to reduce the currently high level of subjectivity in practice. The suitability of sites for SuDS retrofitting was also assessed based on traditional 'community and environment' variables (promoted by the construction industry) for comparison.

A comparison of the traditional variables and the new ecosystem services variables shows a bias of the old tool towards semi-natural SuDS techniques such as wetlands, ponds, filter strips and swales. In comparison, the new ecosystem services approach favoured infiltration techniques. All sites were suitable for the retrofitting of SuDS when the traditional assessment based on 'community and environment' variables was carried out. In comparison, the ecosystem services approach shows that nearly half of the sites have a relatively low ecosystem services potential, making them of limited use for retrofitting of most semi-natural SuDS techniques.

The findings can be used to prioritise sites for SuDS retrofitting. Wetlands and ponds did not feature highly when only the ecosystem services approach was used. This is because of the relatively high importance of non-regulating services such as supporting, regulating and cultural services.

# **A FRAMEWORK OF CAPTURING AND SHARING TACIT KNOWLEDGE IN CONSTRUCTION SUPPLY CHAINS IN CONTEXT OF LEAN AND AGILE PROCESSES**

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Keywords: Construction Supply Chain, Knowledge Capturing, Knowledge Sharing, Lean & Agile Construction, Lean & Agile Processes

This research seeks to develop a Knowledge Capturing and Sharing framework and a set of guidelines within the context of Lean and Agile principles to improve awareness and understanding in Construction Supply Chains. By reviewing relevant and related literature on the area of Knowledge Management, supply chain management and Lean and Agile, within Construction Supply Chains, its contributions and challenges associated with effective Knowledge Management and identify the critical success factors, measure/ascertain the contributions made to Construction Supply Chains, especially in terms of efficiency and improvements through the application of Knowledge Management in the context of Lean and Agile. The research methodology considers research philosophies (Ontological, Epistemological and Axiological), research approaches (qualitative and quantitative) with reasoning of inductive and deductive. The research strategy adopted is mixed method, based on this multiple analyses were employed. Preliminary results from literature shows that application of Knowledge Management in Lean and Agile brings about efficiency in Construction Supply Chain. There are challenges in the application of Knowledge Management, these include; lack of skills, partnering and collaboration, process integration, trust and commitment, motivation and capabilities amongst others. The critical success factors and challenges associated with effective Knowledge Management include; observational, absorptive, conversational, application, routing, explanation and dissemination capabilities. Improvement in the supply chain efficiency that promotes innovation, managing change and enhance learning and performance through the application of Knowledge Management in the context of Lean and Agile thinking. Based on the results the Knowledge Communication framework has been developed to increase the efficiency of Lean and Agile processes and Construction Supply Chains.

# Impairment of flow regimes in transboundary river basins

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Keywords: Riparian country; shared river basin; artificial alteration; climate change; hydrologic modelling system; water resources management

The increased competition among riparian countries regarding the use of shared water resources has raised the importance of examining the upstream anthropogenic activities twinned with climate alterations on water availability for the downstream state. This paper covers ten river basins of about 18,000 km<sup>2</sup> total drainage area shared between Iran and Iraq, where considerable water exploitations are currently taking place on the Iranian side of the basins and noticeable accelerating growth in water control programmes. Iraq is the lower riparian country of all these rivers, which makes its management of water resources greatly vulnerable to upstream water utilization arrangements, water storage schemes and political interests. Climate change is likely to put further pressure on water resources and aggravate the level of vulnerability. Thirteen meteorological stations within or in close proximity to the examined basins were investigated. The monthly precipitations and the mean air temperature data over different periods were analysed. The Hydrologic Modeling System of the Hydrologic Engineering Center for the U.S. Army Corps of Engineers has been used for runoff simulation. The impairment flow analysis has been carried out through assessing the current and projected water exploitation schemes in the upper riparian country. Moreover, climate alterations have been investigated. The paper is aiming at exploring the anomalies in the natural flow regimes of these basins due to the present and projected upstream anthropogenic pressures. Findings bridge the knowledge gap between upstream artificial flow alterations and downstream water resources management.

# Modeling Flash Flood Early Warning System in Petra, Jordan

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Keywords: Jordan, flash floods, early warning systems

Jordan is one of the key Arab countries of the Middle East region. Much of Jordan is covered by desert (90% of its area); however the north-western area is regarded as part of the Fertile Crescent. The country is statistically the fourth most water scarce country in the world with a per capita share of 145 Cubic meters per year (UNDP, 2011). Petra is located within the southwest central part of Jordan. Currently Petra is governed by **Petra Development and Tourism Region Authority (PDTRA)**. It is classified as an arid area with average rainfall of 178mm per year. Major amount of rain water that arrives to Petra region comes from outside of the region because of it features a sloping topography, and that definitely contributes in producing flash floods and landslides. Climatic hazards pose set of threats to Jordanian economic and human development, particularly the droughts and flash flooding. The observations and studies by the Jordanian meteorological department indicating that precipitation will reduce in Jordan as a result of climate change; this will seriously affect the rain-fed agriculture, water resources and food security sectors in the country. In particular, parts of the country face severe localized flash flooding; e.g. Petra, Aqaba, Ma'an and many other wadies. Flash flooding has historically caused damages to local tourist infrastructure, archaeological sites and urban infrastructures. The vulnerability of the Jordanian society and economy to natural hazards and climate change induced disasters owe to the limited proactive approach to disaster prevention and mitigation, insufficient institutional capacities at the national and local levels, lack of trained human resources, lack of awareness amongst senior officials and communities about disaster preparedness, and unsatisfactory implementation of existing policies. In terms of disaster impact; e.g. flash flooding could cause severe losses to people's livelihoods damage to the tourism related sources of livelihoods; e.g. roads, archaeological sites, excavated towns etc. In today's interconnected world, any news of a disaster in Jordan could scare tourism which provides much needed employment to numbers of Jordanians, and contributes with more than 14% to Jordan GDP. Within this background context, this PhD study aims at: analyzing the spatial surface water balance in the study area; modeling scenarios of the flash floods in the study area with respect to hydrologic loses; approaching approach thresholds of occurrence (rain duration, intensity, and base flow) for the EWS; and designing a responsive early warning system in the study area.

# **Gender Equity and Disaster Resilience Associated with the Third Revolution Digital Technology**

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Keywords: gender equity, disaster resilience, digital technology

Sustainable progress towards development can be achieved by shaping power dynamics within social structure; social norms that cause gender disparities in resources, markets & technologies. Understanding gender roles, relations are important to cater multidisciplinary needs at household as well as community levels. Overall sex ratio in Sri Lanka was 94 males per 100 females indicates that there are more females indicates that there are more females in Sri Lankan population than males. However, sex ratio among children below 18 is reported as 102 which indicates more males among child population while the corresponding figure for 60 or more population is 79 indicating more females among older population With reference to the economic status, from the total population 51.9% population is economically active and within the age of 15 years and above. Nevertheless, there are 75.8% are males and only 30% are females. Therefore it is crucial to consider gender dimension for improving disaster resilience. Developing technologies can reshape cultural traditions. For example, worldwide cell phones have created a different techno-cultural world. Nevertheless, it is wise to be mindful about the potential of new technologies shaping our lives through conversion or eradication of our traditions. Social relations can affect gender equity, community empowerment and disaster resilience. As technology can influence on social relations, traditions can be positively reshaped to achieve gender equity, community empowerment and disaster resilience could also get influenced. Within this context, this PhD research aims to understand whether there is a correlation among gender equity and disaster resilience with the third revolution digital technology? It further attempts to analyse the importance of third revolution digital technology in the context of disaster resilience and impact on gender equity and tries to explore potential and existing mechanisms/approaches at national, sub national and grass root levels that improve disaster resilience with gender sensitivity and using latest digital technologies.



# **Out of harm's way; preventive resettlement of at risk informal settlers in highly disaster prone areas**

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Keywords: preventive settlement, risk reduction, informal settlers

Importance of getting the correct replacement goals in place for the next 10 year plan cannot easily be exaggerated as disasters continue to erode gains in poverty reduction in the developing world and place trillions of dollars of assets at risk globally. Past decade has seen a growing impetus to integrate climate change adaptation into disaster risk management planning. Overall there has been progress although muted by ongoing and recent large scale events which remind practitioners of the importance of stepping up in the replacement plan towards actual, tangible gains in risk reduction. Preventive resettlement of communities from extremely hazard prone areas would result in large quantitative gains in global disaster resilience, reduce annual global recovery spending, and prevent disaster events from impacting on hard won development gains. Although states have moved to acknowledge the benefit in spending money on prevention as opposed to recovery, this has not extended beyond traditional methods of risk reduction including structural mitigation, scientific research, and awareness raising activities. Poor global track record of development induced displacement and resettlement has inadvertently impacted on perceptions of resettlement in general, and prevented states from properly considering whether preventive resettlement can achieve global goals for disaster risk reduction. The question is whether we can make strong, worthwhile gains in resilience through the resettlement of highly disaster prone, communities. To answer the question the research will consider the global knowledge on resettlement including why in other areas such as development induced displacement and resettlement, it has not been effective. It will consider case studies in the Philippines to determine whether resilient communities can be created through preventative resettlement. Key themes that will be explored are the influence that corruption, civic engagement, and low capacity government on the success of preventative resettlement.

# **Community Capacity Building for Disaster Risk Reduction: Exposing and Challenging Level of Prioritisation in Kenya**

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Keywords: capacity building, disaster risk reduction, Kenya

Kenya, one of the Horn of Africa countries, frequently experiences a combination of both natural and human-induced hazards ranging from droughts, floods, landslides, tsunamis, storm surges, earthquakes, human and livestock disease outbreaks, lightning, domestic/industrial/ and bush fires, violent inter-communal conflicts, to transport and industrial accidents. Of all the aforementioned, drought and floods are the most significant hazards affecting the country, with drought as the single most important hazard in the country. It also benefits from enormous donor and local government development funding where unfortunately, development gains are repeatedly reversed or wiped out by aforementioned cyclic disaster shocks. And given the above disaster risk landscape coupled with the level of donor investment in the country, Disaster Risk Reduction (DRR) ought to be a priority consideration, supported and mainstreamed by all major relief and development practitioners at all layers necessary for engagement. However to date, there is little known and written about the level of prioritization and subsequent support given to community capacity building for DRR in Kenya. This research sets out to reduce the evidence gap by examining, exposing, and challenging the status of current support given to community capacity building for DRR by key Government of Kenya relief and development partners including institutional donors, UN agencies and INGOs. The exposé will lead to conclusions and recommendations focused on how to close identified gaps: Level of prioritization for 'community capacity building for DRR' among key Government of Kenya relief and development partners identified; Good practice case studies of community capacity building for DRR identified, documented, and enabling factors brought forward for interested parties to learn from; Barriers to prioritizing and supporting such good practice identified; Compelling conclusions drawn and practical recommendations made with a focus on what needs to be done to strengthen community capacity building for DRR.

# **IMPACT AREA (5):**

## **Ecosystems**

# DETECTION OF DEFORMED WING VIRUS IN GLANDS OF *Apis mellifera*

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Keywords: DWV, honeybees, bee pathogens

Deformed wing virus (DWV) is now one of the most widespread honeybee pathogens and in association with the Varroa mite has which killed millions of colonies across the globe. However, DWV has also been shown to be transmitted between adult bees through trophallaxis and to their brood via the provision of brood food. This work aimed to investigate if DWV is present in the brain and the mandibular, hypopharyngeal, and thoracic and cephalic salivary glands of *Apis mellifera* ligustica. Newborn and 30-day-old honeybees were collected from a Varroa infested colony at Sheffield, England, but emerged from cells that where not infested with Varroa. The bees where flash killed and the various tissues and glands dissected and pools of ten samples tested for DWV using real-time PCR, with negative and positive controls. We detected DWV in the bodies of each group of honeybees indicating that these test bees where indeed infected with DWV. We detected DWV in the mandibular and salivary thoracic glands of newborn honeybees, indicating that this virus may have affinity with these glands, since we did not detect DWV in brain, salivary cephalic and hypopharyngeal glands in newborn and 30-day-old honeybees. Therefore, these glands may serve as the natural viral transmission route between bees and from them to the brood via the brood food. This is the first detection of the DWV in mandibular and salivary thoracic glands of bees, while at the same time it was absent from mandibular and salivary thoracic glands in 30-day-old honeybees, indicating that the results are not due to general DWV contamination of the various glands from the body hemolymph.

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## On the origin of selfishness

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Keywords: Aggressive behaviour; Antipredator behaviour; Fish; Group living; Selfishness; Alarm cues.

Selfishness is common a concept in human societies, but it is not commonly applied to animal groups. Group behaviour is product of collaborative behaviour; however, the individuality has only recently been approached in studies of animal personality. Anecdotes of selfish individuals are plentiful in captivity, but are not empirically tested. Theories of indirect selfishness such as the selfish herd hypothesis are widely known; however, cases of direct selfishness are not scientifically reported. How to detect selfishness? Here we propose the behaviour where individuals within a group deliberately hurt their companions, reducing their fitness, to benefit their own survival. Fishes from ostariophysi superorder possess alarm cue cells on skin, which release a substance when damaged (e.g. predation event). This alarm system incites antipredatory behaviours, but on other hand, can attract predators as well. The complexity of this system has intrigued evolutionary biologists, who cannot identify the benefit of a system where the individual who release such cues had no direct benefits. During our experimentation with *Astyanax bimaculatus*, a neotropical freshwater fish, the addition of alarm cues from an skin extract triggered aggressive behaviours. The aggressive behaviours consisted in attacks towards conspecifics, which could result in some missing scales. We concluded that these fishes use aggression to decrease actively the fitness of conspecifics by causing the release of chemical alarm cues. An evolutionary explanation is: the fish that have these “chemical targets” will benefit their own fitness when, in the event of release of alarm cues, aggression towards group members will even out the fitness of the group. This evening out of fitness may provide a new approach to behavioural ecology and sociobiology, and explain the evolutionary basis for selfish human behaviours. Thus, we consider this selfishness as a cost of group living.

# **Social group cohesion and reproductive success: a survey of captive cheetah (*Acinonyx jubatus*) personality**

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Keywords: animal behaviour; animal welfare; captive breeding; cheetah; personality; zoo

Despite an international, co-ordinated captive breeding programme, the captive cheetah population is not self-sustaining. In 2012, only 6.9% of the captive population successfully bred and of 250 facilities holding cheetahs, only 33 had reproductive success. This is detrimental to cheetah conservation efforts and might indicate underlying welfare concerns. The effect of individual differences on the behaviour and welfare of zoo animals has long been recognised by zoo biologists, and people who work with animals often describe their different character traits. Personality can affect individual reproductive success, the success of breeding pairs and the compatibility of social groups. This study investigated the effects of individual differences in cheetah personality on reproductive success, pair compatibility and social group cohesion. Personality ratings were collected for 120 cheetahs at 31 zoos. Keepers were asked to rate their animals on 20 behavioural traits, without conferring, using a calibrated rating questionnaire. Six components of cheetah personality were identified: 'Fearful-insecure'; 'Active'; 'Friendly to keepers'; 'Friendly to conspecifics'; 'Excitable' and 'Fearful of conspecifics'. There were no differences in the personalities of breeders and non-breeders. Preliminary evidence of pair compatibility was uncovered, as successful breeding pairs had more divergent personalities than unsuccessful pairs. In addition, group-housed cheetahs scored significantly higher on the component friendly to conspecifics than singly-housed cheetahs. Information about the personality of an individual could be invaluable to staff at institutions involved in co-ordinated captive breeding programmes. Recommendations for breeding pairs and new social groups could be improved if the personalities of individuals are known. Zoos should endeavour to include personality profiles within standard record keeping practices.

# Comparing spatial and aspatial approaches for mapping the potential generation of urban ecosystem services

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Keywords: Urban ecosystem services, hotspot analysis, trade-offs, synergies

Ecosystem services are the benefits to humans produced by surrounding ecosystems. Interactions between overlapping ecosystem services allows analysis of trade-off and synergy, where services compete for or share natural resources. These patterns can provide further information on carrying capacities, ecosystem resistance and conflicts of supply and demand across a landscape. Studies typically use arbitrary threshold values to define and overlap service hotspots without consideration of wider spatial influences.

This research considers the potential for using Getis-Ord  $G_i^*$  statistic for hotspot analysis to improve the identification of hotspots that are statistically significant. A classified map was used as a basis to develop indicators for five key ecosystem services: carbon storage, climate stress mitigation, water flow mitigation, potential for aesthetic attraction and potential for recreation across Salford, England. Cross-correlations and percentage overlap between ecosystem service pairs were measured as indicators of trade-offs and synergies.

Initial results showed that correlations between services was weak apart from a positive relationship between aesthetics and recreation and negative relationships between water flow mitigation and aesthetics, or recreation. The total area of Salford containing a hotspot was similar using both approaches. However, the aspatial approach presented a higher level of synergy between service pairs. While the spatial approach found no positively significant hotspot areas for water flow mitigation, negative hotspots were identified. Benefits of the spatial approach include the introduction of confidence levels and the removal of the assumption of hotspot size, providing more information on hotspot strength. Derivation of service thresholds would improve the aspatial approach, but this is conceptually challenging for less tangible cultural ecosystem services.



# Life in a polluted environment: an interdisciplinary approach on the effects of contaminants in the brown shrimp, *Crangon crangon*

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Keywords - endocrine disruptors; sexual differentiation; ecotoxicology; reproductive ecology

The brown shrimp, *Crangon crangon* uses estuarine areas, potentially impacted by human pollution, as nursery grounds. Its sexual mode of reproduction is still debated, being described as gonochoristic, obligate protandric (male to female sex changer) or facultative protandric (some but not all individuals change sex). This suggests a degree of sexual plasticity which makes this shrimp an interesting candidate to study the effects of endocrine disruptors (ED) on sexual development: due to its natural plasticity, the brown shrimp might be particularly sensitive to the effect of chemicals that may influence development, growth and pathways of sexual differentiation.

We are sampling several populations across a geographical range, including historically contaminated areas, in order to assess the sexual patterns and the effect of environmental contaminants on the sexual development of this economically important species. We are also implementing ecotoxicological approaches, assessing the accumulation of pollutants in the shrimp's tissue and the resulting cellular damage. Moreover, we are planning to test the use of vitellogenin as an effective ED biomarker.

This interdisciplinary project has three strong components: 1) a practical component – the monitoring of the effects of ED in the brown shrimp at the individual level (sex determination and sex differentiation) and at the population level (sex ratio); 2) an applied component – the characterization of vitellogenin as an effective biomarker in this species and the visualization of cellular and nuclear abnormalities; 3) a theoretical component – the study of the reproductive ecology (still debated) of this species under normal and contaminated conditions.

# Using a Network Approach to Assess the Resilience of an Urban Tree Infrastructure (UTI)

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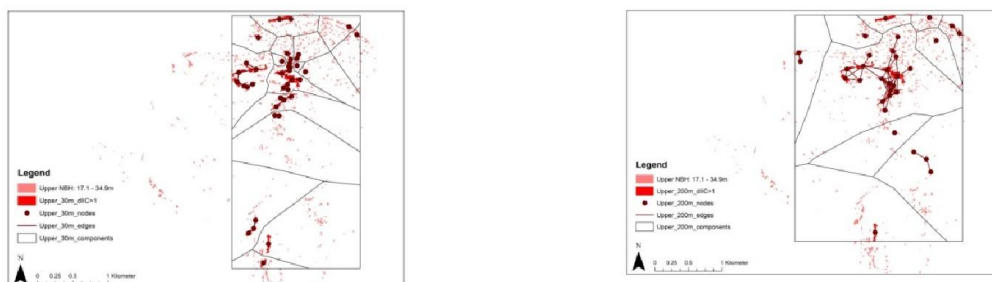
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Keywords: Urban Tree Infrastructure, Network, Graph Theory, Resilience, Passerines

The resilience of ecological systems in cities strongly depends on the connectivity of the urban tree infrastructure (UTI). The movement of urban passerines through the UTI contributes to ecosystem function, resilience and the provision of several ecosystem services. The amount of trees, the variation in tree age and height (structural complexity), and the overall connectivity of the UTI have been shown to positively influence passerine species richness. However, gaps in canopy cover may be perceived as inhospitable by passerines and thus restrict normal daily movements.

A network perspective can provide valuable insights into the resilience of ecological systems such as the UTI. Developed from graph theory, connectivity and centrality are comprehensive variables representing the fundamental structural properties of systems and can be used to assess the resilience of a system when it is presented as a network

By incorporating passerine gap crossing distances into a network analysis of a UTI's upper canopy, we identified (1) differing levels of centrality (importance of canopies to provide connectivity), and (2) that the structure of the network changes with organism perception, thus revealing different insights into the resilience of the system (Fig. 1).



**Figure 1:** Network analysis of an urban tree infrastructure's upper canopy