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MANCHESTER

Proceedings of the CSE 2016 Annual PGR Symposium (CSE-PGSym 16)

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Proceedings of the CSE 2016 Annual PGR Symposium

CSE-PGSym 16

Preface

Welcome to the Proceedings of the CSE-PGSym 16. These proceedings contain the abstracts of the papers presented at the CSE 2016 Annual Postgraduate Research Symposium, which was held in Chapman Building (Peel Park Campus), 27th April 2016. The symposium was organised by the School of Computing, Science and Engineering to provide a forum for the PGR community in the School to share their research work, engage with their peers and staff and stimulate new ideas.

Research in the School takes place within the Salford Innovation Research Centre (SIRC) which comprises six specialised research groups, including Acoustics, Autonomous Systems & Robotics, Engineering, Informatics, Materials & Physics and Spray & Petroleum. Research at the School continues to be innovative, vibrant and multi-disciplinary and this Symposium is designed to give a flavour of the achievements of the PGR researchers in the School. As developing a vibrant research environment and culture is one of the School's strategic goals, the Symposium forms one of the School's efforts to promote the research culture. This is in addition to other initiatives and investments within the School such as the development of dedicated research labs, the provision of specialised research equipment and the development of an Industrial Collaboration Zone, which includes an investment in a multi-purpose PGR space.

The programme contains 25 presentations in various research topics, within six research areas. The presentations are divided into six sessions, and each session includes 4 – 5 presentations within a specific theme. We are delighted that this year a couple of students from our MSc Taught programme are participating in the Symposium, which is seen as vital to research continuity.

Finally, we would like to thank all those who contributed to the planning and organisation of this event. Special thanks go to the staff in the Research Office at the University of Salford for their help. In particular, we extend our thanks to Ms Tracy Ireland for helping with organising the venue and printing the proceedings and Mrs Catriona Nardone for helping with managing the paper submissions. Lastly, we would like to thank all the presenters for contributing to the success of this event.

Dr Adil Al-Yasiri (Chair)

Dr Francis Li (Co-Chair)

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Session 1 Computer Science and Informatics Chair: Prof Farid Meziane

An Elliptical Cost-Sensitive Decision Tree Algorithm Using Optimization Methods (ECSDT)

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Abstract

Cost-sensitive multi-class classification problems, in which the task of assessing the impact of the costs associated with different misclassification errors, continues to be one of the major challenging areas for data mining and machine learning.

The literature reviews in this area show that many of the current cost-sensitive algorithms aim to solve binary classification problems, where an example from the dataset will be classified into only one of two available classes, in addition, most of them focus on inducing linear decision trees that adopt axis-parallel regions to split the classes. The literature shows that linear decision trees are not adequate for non-linearly separable classes, and can lead to large decision trees that difficult to visualize.

Inducing nonlinear multi-class cost-sensitive decision trees is still in its early stages and further research may result in improvements over the current state of the art. Hence, a major question towards solving this problem is:

How can non-linear regions be identified for multi-class problems so as to maximize the accuracy of classification, minimize costs, and result in a better visualization?

My Ph.D. aims to develop a new cost-sensitive algorithm that induces non-linear (elliptical) decision trees using evolutionary optimization methods such as particle swarm optimization (PSO) and Genetic Algorithms (GA) to further improve classification accuracy, minimize total cost involved in the classification, and enhancing the way of visualizing decision trees.

My participation in CSE-PGSym 16 will include explanations of the idea of the new algorithm, as well as presenting some preliminary results obtained for the initial implementation of the new algorithm.

Using Distributed Agile Patterns for Developing Offshore Projects

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Abstract

Companies have been using agile methods to develop software for more than a decade. Meanwhile, as offshore software development is becoming mainstream, companies are becoming more interested in using agile practices for such projects. While offshore development has several advantages such as reduced development costs, proximity to markets and access to talent, it has introduced new challenges in the applicability of agile practices as teams are distributed. One main challenge is to establish trust between the onshore and offshore team members as the team is normally distributed over different time zones. Other challenges include socio-cultural differences between team members, communication and coordination between the team and knowledge transfer. In order to overcome these challenges companies have been adapting and modifying agile practices.

However, there has not been an attempt to collect common practices repeatedly used to solve recurring problems in offshore development. In this research we have studied over 200 cases from the literature and interviewed practicing professionals engaged in distributed teams. As a result we have observed a number of solutions for agile issues in software development settings, which we have classified as Distributed Agile Patterns. This paper presents the challenges of offshore development and how they affect the applicability of agile practices. We have identified and presented 15 patterns which we have classified into 4 categories. To verify and validate our pattern catalogue we conducted reflection workshops in which we invited professionals to give feedback on our catalogue. Based on their feedback we then finalized our patterns.

Keywords
Offshore software development, Agile software development, Distributed development, Patterns, global software engineering

Estimating the QoE value in SaaS Cloud Computing

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Abstract

Quite recently, considerable attention has been paid to measure QoE in SaaS cloud computing, which is important to measure user satisfaction and to make sure that the service is consistent with the levels specified in the service level agreement (SLA), the SLA is important to manage the relationship between the client and the provider. This research presents a framework for estimating QoE value in SaaS cloud computing depending on the measured SLA parameters values. The estimation process is being managed by MonSLAR which is a middleware used for monitoring QoE in SaaS[1]. This study considers measuring QoE as a function for both SLA parameters and the network's QoS value[2]. Studying the effects of changing the SLA parameters values is important to cloud providers as well as consumers for ensuring that the delivered services meet the user needs.

Fuzzy logic is used as an approach for estimating the value of QoE in SaaS cloud computing depending on the measured values of the SLA parameters. Fuzzy logic is suitable to describe human's perception, due to the characteristics of QoE of being vague, having different subjective values and the difficulty of deciding the user satisfaction depending on the SLA parameters' values. The fuzzy system accepts the measured values of the SLA parameters as inputs; it then generates the Fuzzy rules according to the priorities of each SLA parameter decided in the SLA. This research presents a work in progress to monitor QoE in SaaS cloud computing taking into consideration the measured SLA parameters.

Keywords
SLA, QoE, SaaS.

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Four Steps To Get Ready For Cloud: A Roadmap For SMEs To Cloud Migration

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Abstract

Small and Medium size Enterprises (SME) are considered as the backbone of many developing and developed economies of the world; they are the driving force of any major economy across the globe. Through Cloud Computing, SMEs outsource their entire information technology (IT) processes, allowing them to concentrate more on their core business to enhance their productivity and innovation in offering services to customers. It allows businesses to cut down heavy costs incurred over IT infrastructure without losing focus on customer needs. However, to a certain extent adopting cloud computing has struggled to grow among SMEs due to reluctance and concerns expressed by them. Throughout the course of this study several interviews were conducted and the literature was reviewed to understand how cloud providers offer services, and what challenges SMEs are facing. The collected data was then analyzed using the content analysis approach which concluded in identifying four major concerns to be hindering SMEs adoption of cloud services. From the interviews common practices followed by cloud vendors and what concerns SMEs have were identified as a basis for proposing a cloud framework, which is the main aim of this research for bridging gaps between cloud vendors and SMEs. A stepwise guide is formulated in regards to the four most predominant challenges identified which are hindering the adoption of cloud computing among SMEs.

Keywords
Cloud Computing, Cloud migration, Cloud adoption, SMEs.

Session 2 Physical Science and Engineering – 1 Chair: Prof David Howard

Design of a High Altitude Long Endurance Flying-wing Solar-Powered Unmanned Air Vehicle

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Abstract

The low-Reynolds number environment of high-altitude flight places severe demands on the aerodynamic design, stability and control of a high altitude, long endurance unmanned air vehicle (HALE UAV). The aerodynamic efficiency of a flying-wing configuration makes it an attractive design option for such an application and this is investigated in the present work. The proposed configuration has a high-aspect ratio, swept-wing planform; the wing sweep being necessary to provide an adequate moment arm for outboard longitudinal and lateral control surfaces.

A pre-conceptual design methodology aircraft has been developed for solar powered, high altitude UAV to size the aircraft components such as the fuel cell, solar panel, propulsion system and other inboard elements. Another development for the conceptual design stage is a design optimization framework, which has been written under a MATLAB environment, combining aerodynamic, structural and stability analysis.

Low-order analysis tools are employed to facilitate efficient computations, which is important when there are multiple optimization loops for the various engineering analyses. In particular, a vortex-lattice method is used to compute the wing planform aerodynamics, coupled to a two-dimensional panel method to derive aerofoil sectional characteristics. Integral boundary-layer methods are coupled to the panel method in order to predict flow separation boundaries during the design iterations.

A newly developed composite structure model is adapted for application to flying-wing configurations to predict the wing weight and the stiffness. A linear finite-beam element approach is used for structural analysis of the wing-box.

The main contributions of this research include; developing a new conceptual design methodology, developing a low order aerodynamic model which can give good accuracy, developing a new composite structure model, and combining all these individual tools to build an optimization tool which has been used to design a new flying wing UAV called 'SUMER' operating in southern Iraq for long endurance surveillance missions.

Keywords
Flying wing, HALE UAV, solar powered aircraft, composite structure

Evaluation of the Potential Impacts of Climate Change Coupled with Drought on the Temporal Hydrologic Alterations in Transboundary River Basins

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Abstract

Climate change and drought phenomena impact linked with anthropogenic pressure have become a growing concern for water resources managers and decision makers, in particular, in arid and semi-arid regions, where water resources management is challenging. The proposed research aims at expanding a set of practical adaptation strategies for integrated water management in transboundary river watersheds, subject to future climate variability. As a representative case study, the Lower Zab River basin has been selected. The basin is located in northern Iraq and it is divided between Iraq and Iran. A comprehensive but simple methodology for forecasting the annual river flow alteration based on drought indices and hydrological alteration indicators has been proposed. This has been achieved by (1) the evaluation of the impact of drought severity and climate variability during the human intervention period to isolate the influence of climatic abnormality and measure the hydrologic deviations as a result of streamflow regulation configurations; (2) A simple methodology for predicting hydrological drought in relatively small watersheds based on meteorological variables during the early months of the water year. The suggested method is based on linear regression relationships linking the reconnaissance drought index (RDI) based on 3, 6, and 12 months and the streamflow drought index (SDI). The outcome is critical for cases where an early investigation of meteorological drought is available. The findings will benefit water resources managers, engineers and decision-makers responsible for mitigating climate change impacts.

Keywords

Climate variability, Decision-making, Hydrological alteration indicator, Reconnaissance drought index, River drought index, Water resources administration

Spatiotemporal vector solitons in $\chi^{(3)}$ optical systems:

Computational stability analyses through perturbed initial-value problems

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Abstract

Vector soliton pulses are pivotal for a modern understanding of multi-component wave phenomena in nonlinear systems. Menyuk's classic optical model, proposed nearly three decades ago [1], describes electromagnetic wavepackets with slowly-varying envelopes confined to two orthogonal polarizations of a dielectric waveguide. These wavepackets, which may become stationary states under some quite general physical conditions, are localized in time and propagate along the waveguide axis according to a pair of coupled nonlinear Schrödinger-type equations. The traditional mathematical framework for vector pulses has a convenient interpretation in terms of Galilean relativity. Over the last few years, however, our Group has been developing spatiotemporal (i.e., relativistic- and pseudorelativistic-type) formulations of equivalent pulse propagation problems [2,3] where the near-universal assumption of slowly-varying envelopes is omitted and a greater generality preserved in the governing equations.

In this paper, we will present some key results from sets of simulations that investigate the stability of spatiotemporal vector solitons. The computational method deployed is a multi-component generalization of the scalar difference-differential algorithm typically used for simulating Helmholtz-type problems involving nonlinear beams [4]. Attention will focus predominantly on regimes where the $\chi^{(3)}$ susceptibility of the host medium is of the focusing type. An account will be given of spatiotemporal bright-bright solitons (including a physical interpretation of their existence conditions), for which it will be demonstrated that Menyuk's well-known solutions [1] are a subset. We will also summarize recent findings from a numerical perturbative analysis that considers the role of bright-bright solitons as attractors in the system's internal dynamics [5].

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Dissipative solitons of a complex Ginzburg-Landau equation: space-time symmetry and simulations for cubic-quintic nonlinearity

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Abstract

Ginzburg-Landau (GL) models play a fundamental role as complex-amplitude equations in the arena of universal wave phenomena, describing the interplay between dispersion, diffraction, nonlinearity, gain, and loss [1]. In nonlinear optics, for example, they support exact analytical soliton-like solutions when group-velocity dispersion is balanced by self-phase modulation, and dissipation processes (e.g., from two-photon absorption and gain dispersion) are compensated by gain (e.g., from doping the host medium with fluorescent ions) [2]. In the case of purely-cubic nonlinearity, uniformly-distributed linear growth tends to introduce instability in the zero-amplitude state such that finite-amplitude solutions are rendered unstable in the long term [3,4]. The inclusion of a quintic nonlinearity is one route toward supressing unphysical wave collapse [5].

We will report on recent results for a generalization of the classic cubic-quintic GL model [5]. A mathematical formalism based on the spirit of special relativity is proposed [6], whereby the space and time coordinates (measured in the laboratory frame) appear with equal status in the governing equation. Gain dispersion is omitted from our preliminary analysis – while desirable from a physical standpoint, its inclusion tends to frustrate the derivation of exact bright solutions in the context of fully-second-order space-time symmetry. When considering slowly-varying envelopes, and after Galilean-boosting to the local-time frame, one can show that (zero gain dispersion) soliton families derived by Soto-Crespo *et al.* [5] are subsets of our more general solutions. The space-time-symmetric dissipative solitons are subsequently deployed in computational initial-value problems to seek solitary wave-type attractors in the system's fully-developed nonlinear dynamics.

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Realizing an 'Acoustic Black Hole' based Muffler

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Abstract

Acoustic Black Holes (ABH) have been a topic of intensive research in the last decade. These structures are based on the principle of impedance matching and, in principle, can achieve a total absorption of incident sound. Until now, a majority of ABH have been considered for shear waves or Rayleigh - Lamb waves travelling over surfaces such as plates, bars, wedges beams and more recently, for closed termination tubular structures.

In the present study, an ABH principle has been applied to design an open expansion chamber. The muffling section, embodying the open expansion chamber, comprises of a narrow tube of axisymmetric waveguide with a constant (or weakly varying) cross section. To achieve impedance matching, the plane wave radiation incident through the inlet end of this muffler is subjected to a protruding flair of varying wall admittance.

A theoretical basis has been established to realize the acoustic wave propagation through such a muffler structure based on an earlier study conducted by Mironov and Pislyakov Acoust. Phys. (2002). Numerical analysis has been carried out to visualize the ABH effect in Frequency Domain, using COMSOL Multiphysics, a commercial Finite Element based software.

The study presents a parametric comparison for possible geometric variations to target low frequency domains of application, including automotive and aviation sound attenuation requirements as also building vents and ducts.

Keywords

Acoustic Black Hole, total absorption, open expansion chamber, varying wall admittance, sound attenuation

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Automatic detection of retinal optic disc by using watershed

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Abstract

The Optic Disc, sometimes referred to as optic nerve head, is one of the significant parts in the retina. It is usually the brightest partition in a retinal image. The optic-head is the place from where all the vessels emerge and to where the brain connects. It has a circular or an elliptical shape, and it is considered as a blind spot in which data is not captured. Furthermore, it is a crucial location in which to investigate several ophthalmological diseases, such as Glaucoma.

The computer analysis of retinal images involves several operations; one of them is optic disc segmentation.

This study investigates computer vision and artificial intelligence techniques to analyse retinal images, to automatically detect optic discs in the human retina. Such findings will be used in further retina studies, which will be used to help ophthalmologists in their diagnosis.

The process of this segmentation will be achieved in six stages: pre-processing, vessel location detection, vessel segmentation, vessel extraction, watershed marker creation, and optic disc segmentation by watershed.

Keywords
Image Segmentation, Optic Disc Segmentation, Optic Disc Detection, Vessel Detection, Retinal Images Analysis

Modelling Electricity Distribution Networks with Geospatial Big Data

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Abstract

Big Data refers to technologies involving data that is too diverse, fast changing and very big for conventional technologies, skills, and infrastructure to address efficiently. Geospatial big data refers to spatial data sets exceeding capacity of traditional computing systems. Geospatial data has always been big data; the size of such data is growing rapidly every year. Along with this exponential increase of geospatial big data, the capability of high performance computing is being required more greatly than ever, for modelling and simulation of geospatially enabled contents. The increasing volume and varying format of collected geospatial big data presents challenges in storing, managing, processing, analysing, visualising and verifying the quality of data.

Recently Geospatial big data is becoming popular in the utilities industry as it is plays a significant role in the operational capacity of the various energy distribution networks. Electricity Distribution Network Operators (DNOs) especially often collect and process vast amounts of geospatial data in order to support the day-to-day operation of their networks, but they do not use the collected data efficiently. The main objective of this study is to find a systematic approach to overcoming the operational issues currently faced by DNOs using geospatial big data and advanced geospatial big data mining techniques.

The study aims to identify how geospatial big data has been used in existing electricity distribution networks. I also intend to investigate the current challenges of applying the latest and most advanced geospatial big data mining techniques to electricity distribution network modelling. The ultimate goal is to find how geospatial big data can be used to model future electricity distribution networks and provide recommendations to improve the operational effectiveness.

New geospatial data mining techniques and algorithms, theoretical analysis and experimental results on synthetic data sets and real world datasets will be presented, analysed and discussed in this research.

Keywords
Big data, Geospatial big data, Spatial Data Mining, Electricity Distribution Network

Global Identity Management in the Internet of Things

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Abstract

The Internet of Things (IoT) is a novel paradigm that is becoming popular in wireless telecommunications. The IoT objective is the integration and unification of all communication systems around us. The systems can be afforded control and access to other systems in order to provide ubiquitous communication and computing with the purpose of defining a new generation of services.

Managing identities in such distributed environments face many barriers. The entities have different identity attributes being stored and managed by different Identity Management systems (IdM) in each system they interact with. The IdM system aims to limit offering a service to users based on a static trust relationship between the service provider (SP) and the identity provider (IdP). These IdMs are not always interoperable with each other. This is because they often use various types of identity information and different authentication and accesses control policies. Therefore, these diverse identity attributes may not truly represent the user across-domains, which is key to the IoT objective. Moreover, the literature shows that the user has relationships with multiple objects that can also be used to identify that user. These relationships are changeable or may even vanish, hence it is important to consider them when identifying the effective actor of the IoT-enabled object, which has requested accessing a service across-domain.

To overcome this barrier, new identity information (identifier) to represent that actor-object relationship is proposed. Moreover, a new identity verification method is proposed to be used by SPs to identify the actor of a nomadic object across-domain in the IoT environment. This method requires developing two new IPv6 extension headers to facilitate the exchange processes of the identity information between IdM parties across domains.

Keywords
Internet of Things, identity management system, identifier, entity

Gap Analysis of Middleware for Internet of Things

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Abstract

The Internet of Things model brings the possibility to connect billions of objects (Things) to the internet, allowing its interaction and the sharing of data. IoT predicts the development of our environment towards a new smart one, such as smart homes, smart cities, and revolutionised medical support. Even though Internet of Things middleware solutions are under wide research and investigation, many aspects regarding the capacities of these solutions (to meet the arising challenges from the development of IoT technologies) have not been addressed. A well-defined and scalable architecture is required to make the IoT model closer to reality.

Several challenges stand between the mere idea of IoT and the efficient deployment of its applications in our life. In this research paper we evaluate a sample of the current platforms, on the basis of their capability to meet the expectations of IoT. We provide a gap analysis with respect to (1) the support of heterogeneous hardware, (2) the support of application developers, (3) the platforms' extensibility for the formation of smart environments, (4) data management and authentication issues, and finally (5) the platforms' architectural style.

The aim of this research is to improve the current solutions and their integration to the future smart environments. We conclude with a set of requirements and recommendations to fill these gaps for the development of IoT platforms.

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The Development of Soundscape Simulator to Analyses the Soundscape Perception Based on Expectation of Sound Objects

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Abstract

Many studies have categorized sound objects that correlate with positive and negative impressions in a soundscape. Although the categorizations have shown clear results, the relationship between the overall perception of soundscapes and the sound objects remain unclear. The purpose of soundscape simulator development is to understand the relationship based on sound objects expectation. A soundscape simulator is a system to compose a soundscape by controlling the parameters of sound objects (both background sounds and event sounds) in the laboratory, allowing the participants to compose a soundscape according to their expectation.

The soundscape simulator was developed using the concept of background-event sound objects, the structured perspective in soundscape composition, and object oriented concept. The simulator was developed using a combination of PureData, DAW software, and Ambisonic VST plugin. A two-dimensional ambisonic system with eight speakers was used to reproduce the simulated soundscape. The simulator has been applied to analyse the interaction between sound objects and human perception, based on the dimension of relaxation, dynamic and communication. Furthermore, the approach using the soundscape simulator has succeeded in explaining the relationship between sound objects and the perception of soundscapes.

Keywords

Soundscape Simulator, Sound Objects, Soundscape Perception

Methods to mitigate reverberant effects on Speaker Recognition

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Abstract

Speaker recognition systems built in the laboratory with clean speech recordings can provide very high accuracies when tested under clean conditions. However, the robustness of speaker recognition systems is crucial for real-world applications such as security and forensics, which typically contain both additive noise and room reverberation. Moreover, most of the research has used speech samples from the non-control room, while the speech sample used in this work was recorded in the anechoic chamber. This paper presents a method for mitigating the impact of reverberation upon speaker verification. In particular, three reverberation mitigation techniques were studied: one that used MFCC and GFCC features and their combination, ones that used training the system with multi utterances for each speaker from the different condition in order to evaluate the verification system and finally, applied liftering technique embedded with MFCC to mitigate the amount of reverberation on speech signals. Validation tests were carried out with clean speech and the speech contaminated by the reverberation of varying degrees. Error equal rate and Statistical relationships between recognition accuracy and reverberation times have therefore been established and testing results discussed.

Keywords
GMM-UBM, ISM, MFCC, GFCC, MSR toolbox, Liftering

The Extraction of Semantic information from Arbitrary Audio Soundtracks Recording

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Abstract

Soundtracks of related media records are information rich, from which much substance related metadata can be extracted. However, automated semantic audio information mining has apparently become a tangible solution to the problem of the big data challenge. A systematic review shows there is an increasing demand for automated classification, identification and information mining of audio content.

The existing individual algorithms and most of the published research on the recognition and analysis of speech, music or event sounds, have been mostly restricted to specific conditions. Such studies, however, have failed to address the real world soundtracks problems which can be a combination of classes illustrated above.

No previous study has been general enough to address a universal system that is extracting the maximum rate of information for further text mining. Mainstream algorithms typically work with a single class of sound, e.g. speech, music or event sounds and logical classification methods are exclusive (detect one class at a time) which leads to missing out useful information when the overlap takes place between two or three classes.

A universal open architecture for audio content and scene analysis has been proposed and carried out in the current work. To mitigate information losses in overlapped content, a non-exclusive segmentationapproach was adopted.

A set of decision trees have been learning on carefully tailored feature spaces and used to generate a timetable slot.The experimental results show that the developed system, when compared with well-established audio content analyzers, can detect and extract information from many more speech and music segments. The full presentation will discuss the methods, detail the results and illustrate how the system works.

Keywords
Features extraction, Audio classification, indexing, metadata generation

A comparative Study of Speech Enhancement Approaches for Speaker Recognition in Realistic Noisy Conditions

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Abstract

Automatic speaker recognition systems have matured significantly in the last two decades and are widely used in various areas, especially security and forensics. Consequently, the performance of these systems is crucial for real-world applications. Automatic speaker recognition can achieve a high level of accuracy in matched enrollment and recognition conditions. However, performance decreases rapidly in channel-mismatched scenarios, where the speech signals used in enrolment and recognition phases differ due to variations in speech transmission channels. Non-Stationary environmental noises and their variations are high up in list of causes of the mismatch.

To address the noise problem, this paper describes how different types of speech enhancement approaches were studied and compared for their robustness as a pre-processing stage for speaker verification. Seven different speech enhancement algorithms were adopted for this task. These algorithms included a spectral subtraction algorithm, statistical based algorithms (e.g. Wiener filtering, Psychoacoustically motivated algorithm), and a subspace algorithm. First, a Wiener filter was investigated as a pre-processing stage for the recognition phase only and for the enrolment and recognition phases together. Then, the effectiveness of other speech enhancement algorithms on the robustness of speaker verification under noisy environment was studied. The experimental results indicate that these speech filtering approaches provide very limited robustness for the performance of speaker recognition, and at times can even have an adverse effect on the recognition system.

Session 5 Data Telecommunications and Networks Chair: Prof Nigel Linge

Reliable Spectrum Sharing Management for Cognitive Radio Networks

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Abstract

Cognitive Radio Network (CRN) is a promising network that aims to improve the utilization of the wireless spectrum by enabling unlicensed (secondary) users to reuse the underutilized bands. CRN utilization of residual spectrum bands of Primary (licensed) Networks (PNs) must avoid harmful interference to the users of PNs and other overlapping CRNs. Numerous Internetwork spectrum sharing frameworks have been proposed in the literature however, spectrum sharing among overlapping CRNs presents significant challenges. This paper comprises two major contributions; firstly, it proposes a novel CRNs management framework, CogMnet, which regulates the operation of centralized CRNs. CogMnet aims to ensure the reliability of CRNs' spectrum sharing by tackling the Primary User Emulation Attack (PUEA) issue and avoiding an overcrowded CRNs scenario. Secondly, it proposes a CRN Admission Control (CRNAC) algorithm capable of determining the maximum number of CRNs allowed in any location. To the best of our knowledge, CogMnet is the first Internetwork framework able to distinguish an attacker CRN that may perform PUEA. Furthermore, CRNAC is the first network admission decision-making algorithm in the CRNs literature. Analytical results are presented to demonstrate the performance of the algorithm. Assigning the number of CRNs is very important to avoid a saturated spectrum situation.

Keywords
CRNs, Internetwork framework, Self-coexistence issues, PUEA, Collision

Improving the Energy Efficiency for a WBSN Based on a Coordinated Duty Cycle and Network Coding

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Abstract

The most important challenges in the design of a Wireless Body Sensor Network (WBSN) are the successful delivery of data and the reduction of energy consumption. In general, a WBAN topology comprises a set of sensor nodes, relay nodes and a sink node. The sensor nodes near the sink deplete their energy quickly due to heavy traffic, which limits the network lifetime. Large amounts of data flow near the sink, so the closer nodes consume more energy than the other nodes, causing a bottleneck zone. The sensor nodes in the bottleneck zone run out of energy very quickly, which is called the energy hole problem in WSNs. Failure of sensor nodes in the bottleneck area leads to wastage of network energy and the reduction of network reliability and bandwidth.

We propose XOR network coding and a coordinated duty cycle to reduce the energy consumption and ensure the successful delivery of data. This research combines a coordinated duty cycle (CDC) and network coding (NC) applying on the relay node to enhance the WBSN lifetime. To improve energy efficiency and the packet delivery ratio, a coordinated duty cycle, which is implemented on the event-centric monitoring application, is   used.

Keywords
Wireless Body Sensor Network, Energy Efficiency, Duty Cycle, Network Coding

A Collaborative Resource Allocation Algorithm for Cellular Network

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Abstract

Cellular Network has gone through tremendous change, motivated by the support for a higher data rate and a greater quality of services demand from the ever evolving climate of computing, where further and far more intelligent applications are deployed and many users have connected daily over the last three decades. The Third Generation Partnership Project adopted the Long Term Evolution (LTE)-Advanced as the Fourth Generation and uses the Orthogonal Frequency Division Multiple Access (OFDMA) as its air interface to enable high speed broadband. Also to support the Internet of Things (IoT), the Mobile and wireless communications Enablers for Twenty-twenty (2020) Information Society (MEITIS) is currently conceptualizing the architecture of the Fifth Generation.

Radio resources in cellular networks are very important, finite and costly for the operators to acquire. To efficiently satisfy the traffic demands of connected devices, it is important for radio resource allocation techniques to keep evolving to allow for new approaches. To this end, different resource allocation algorithms have being deployed and have evolved over time.

In this presentation, a novel algorithm: Collaborative Resource Allocation Algorithm (CRAA) is proposed. This is inspired by lending and welfare from the field of political economy; developed as a Market Game to enable users to collaborate in order to transmit at satisfactory Quality of Service.

Simulations results show that the CRAA, compared with two popular LTE-Advanced algorithms performs higher than the two algorithms when evaluated using throughput, spectral efficiency, fairness and delay as evaluation metrics; where a 35.97% increase was achieved by simulating five different traffic models (File Transfer Protocol, Hyper Text Transfer Protocol, Video, Voice over IP, and Gaming) as applications run in the network.

Keywords

4G, 5G, Resource Allocation, Collaboration, Algorithm

A Concise Investigation on Cloud-RAN: Benefits and Challenges

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Abstract

In today's digital world the number of mobile users is doubled each year, principally with the start of mobile social networks, smart phones and Internet of Things (IoT). This trend has motivated the operators of mobile networks to find holistic and efficient approaches to deploy and manage dense mobile networks. The cloud radio access network (C-RAN) is considered as one promising technology for future networks. C-RAN is seen as a novel architecture to tackle the problems of the mobile network generations (2G, 3G, and 4G) and also support the future 5G networks. In comparison with the traditional system, the main modification in C-RAN is the transition from distributed to centralised infrastructure for baseband processing as shown in Figure 1. However with the evolution of the centralised configuration of C-RAN brings many challenges such as base station virtualization, Baseband pool interconnection and cost of fronthaul communication link. The objective of this paper is to highlight the advantage and the current challenges of C-RAN. It is worth noting that the first letter 'C' of this architecture has been gained different meaning such as Centralised, Cooperative, Cloud and Clean technology. However, achieving each one of these terms in mobile networks in reality has its benefits and challenges. In this study, we will provide detailed analysis and justification of these benefits and challenges. This paper is concluded with some research topics which require further investigation in C-RAN.

Keywords: D-RAN; C-RAN; Virtual Base Stations; Fronthaul Communication Link.
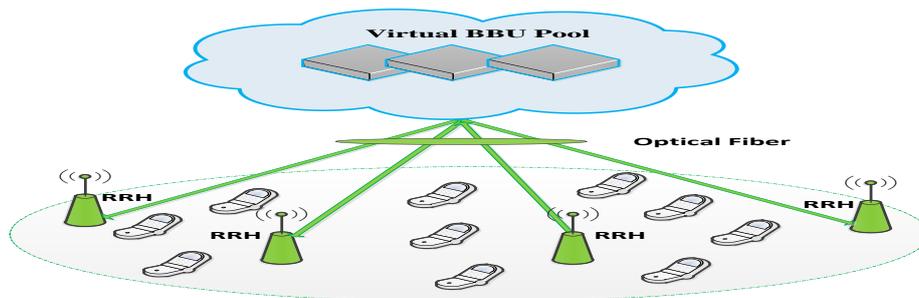

Figure 1: C-RAN Architecture

Telecommunications Infrastructure in Nigeria

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Abstract

After the astonishing growth in adoption of mobile phones, all eyes are on the next phase of the telecommunications story in Africa. Nigeria's transition from zero to over 150 million active users of voice services, representing 80 percent mobile penetration in just over 10 years highlights the potential in frontier markets. Nigeria presently has nearly 10 terabits per second of international bandwidth capacity sitting on the shores of the country via four submarine cable operators – Glo-1, MTN-WASC, MainOne and SAT-3, growth in the data segment is still lagging far behind with less than 30 percent, while broadband penetration is further behind with less than 10 percent of the population compared to that of Voice. One of the major challenges of sufficient broadband availability in Nigeria is believed to be the problem of infrastructure as the existing infrastructure is not capable of meeting the demand for broadband. The problem faced by operators in Nigeria is how this bandwidth capacity can be processed and translated to provide adequate domestic bandwidth for broadband services to the last mile. Today the internet speed in Nigeria is averagely low; you have low download speed, and low upload speed because of the constraints of the bandwidth. In the last millennium, Africa moved from human slavery to economic slavery, the Continent needs to avoid the third wave of slavery - information slavery. This work will simulate the existing infrastructure in Nigeria using Qualnet, and design a better and improved network that can drive the available bandwidth from the undersea cables to the cities, rural areas and last mile for greater broadband access.

Experimental Vertical-Flow Constructed Wetlands Treating Textile Wastewater

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Abstract

Wetlands have long played an important role as a natural purification system. Textile industry processes are among the most environmentally unsustainable practices, because they produce coloured effluents in large quantities, polluting water resources. In this study, two different azo dyes (Acid Blue 113 (AB113) and Basic Red 46 (BR46)) have been fed as part of synthetic wastewater recipes to a laboratory-scale vertical-flow construction wetland set-up, comprising wetlands with gravel media as controls and wetlands planted with *Phragmites australis* (Cav.) Trin. ex Steud. (common reed) for each dye. Two different concentrations (5 mg/l and 200 mg/l) were used for each dye at two different hydraulic retention times (48 h and 96 h). According to initial results for the low concentration of BR46, there is no significant ($p>0.05$) difference between wetlands in terms of dye removal. For chemical oxygen demand (COD) removals of 50%, 59% and 67% for the control and for the wetlands with short and long retention times, respectively, were significant ($p<0.05$). For the high concentration of BR46, the removal percentages for this dye and COD were 94% and 82%, and 89% and 74% for the long and short retention times, respectively. For the low concentration of AB113, the percentage removals for the dye were 71%, 68% and 80% for the control, and the short and long retention times, respectively. The corresponding COD removals were 4%, 7% and 15% in that order. Finally, for the high concentration of AB113, the percentage removals for the dye and COD were 71% and 73%, and 50% and 52% for the 48-h and 96-h retention times, respectively.

Keywords
Acid Blue 113, Basic Red 46, chemical oxygen demand, industrial wastewater, *Phragmites australis*, red bed filter

Activated carbon for acoustic applications

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Abstract

Acoustic absorbers are used to control the build-up of sound energy in a space, reducing noise levels and aiding intelligibility, and/or improving acoustic isolation through inclusion in multi-layer partitions. A longstanding challenge in the design of these devices is the relationship between their thickness and the wavelength of sound at which they are effective; a broadband absorber which also works at low frequencies takes up a lot of space. Activated carbon has unusual acoustic properties that arise because it is a 'multiscale' porous material; it has pores at micro, nano and meso scales. This complex internal structure gives it exceptionally large surface area so sorption processes (absorption and adsorption) become significant. This allows the material to 'breathe in' and 'breathe out' air, so when it is added to an air volume, the volume acts as if it were a larger one. This leads to direct application in loudspeaker cabinets and acoustic resonators. Moreover, the material shows impressive improvements in low frequency (<200Hz) absorption and transmission loss, even when tested in very thin layers (<2cm).

The activated carbon tested to date has mostly been in granular form, but this is problematic to use in practice. This project will investigate other more robust forms, such as activated carbon fibre fabrics and felts, and encapsulation. New mathematical models will be developed to predict the acoustic behaviour of these materials. Impedance tube measurements will be carried out to physically assess their performance and verify the mathematical models.

Keywords
Sound absorption, porous material, sound propagation, sorption, multi-scale, low frequency

Adaptive Control of Functional Electrical Stimulation for Upper Limb Rehabilitation

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Abstract

Functional electrical stimulation (FES) is the use of electrical pulses to produce the contraction of muscles in such a way as to support the performance of functional tasks. Stroke patients may use FES to support the practice of functional tasks. However, current FES systems generally offer only crude control, greatly limiting their usefulness. The Salford team has produced a flexible system, which enables therapists to set up patient and task-specific FES state machine controllers. However, significant therapist input is still required to set up and adapt the controller as the patient's status changes.

This PhD extends the Salford system by combining the state-machine-based control with adaptive control thereby reducing the need for therapist input. The work has begun with the development of a method using segment mounted Magnetic Inertial Measurement Unit sensors (MIMUs) to track upper-limb joint angles. Firstly, a sensor-to-segment calibration procedure is required to align the coordinate frames of each sensor with its anatomical reference frame. Two reference vectors are defined using static alignment (the subject holds a defined static position and the measured gravity vector is used to establish an anatomical reference vector), and dynamic calibration (the subject performs a uni-axial rotation to determine a vector representing the functional axis of rotation). These two are combined to define a rotation matrix, the columns of which are the unit vectors describing the local coordinate system expressed in the sensor coordinate system. Finally, the joint rotation matrix is found using the orientation matrix of the distal segment with respect to its adjacent proximal segment.

Keywords

Modelling driving behaviours at motorway roadworks using micro-simulation

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Abstract

The presence of roadworks on motorway sections creates turbulence in traffic operation as these sections involve physical changes to the road layout with complex traffic management schemes. This paper focuses on the development of a new micro-simulation model for motorway roadwork sections. The aim is to evaluate the effect of such turbulence on operations and to suggest the most suitable scheme to maximise capacity and minimise delay. The reason for building this model from scratch (using the FORTRAN programing language) is the lack of ability of the S-Paramics software model (which is made available to the authors and is used widely in industry) to appropriately model drivers' behaviours at motorway roadwork sections. The new model was developed based on car-following, lane-changing, gap-acceptance, lane closure and narrow lanes rules. These rules were based on real data from UK motorway sites, as well as previous related studies. The real data was used in developing, verifying, calibrating and validating the model. Several new driving behaviours (e.g. courtesy of drivers at lane closure schemes and avoiding passing heavy goods vehicles (HGVs) on narrow lanes scheme) were observed, reported and integrated in the new model. The simulation results revealed that, under high traffic demand associated with high HGVs% (i.e. ≥ 25%), the use of offside lane closure scheme seemed to perform better in terms of capacity and delay than narrow lanes scheme. Also, the model suggests that to maintain site capacity and to reduce delay, stricter speed limits should be imposed.

Keywords

Motorway roadwork sections, traffic management schemes, modelling, driving behaviours, S-Paramics