

## IMA Seminar Series 2010/2011

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**14/06/2011, 12.00-2pm, Room C60**

### IMA Research Group Poster Day

***Anh Cat Le Ngo***

Predicting Where People Look - Computational Visual Saliency

***Yujie Mei, Salvador Garcia, Bozhi Liu and Guoping Qiu***

From Pixel to Perception - Beautiful Appearance

***Jan Feyereisl, Yihui Liu, and Jenna Reys***

Detecting Adverse Drug Reactions in a UK General Practice Electronic Health-Care Database

***Ian Dent***

Do you use Electricity? Do you use more than similar people?

***Hala Helmi***

Examine TSVM Algorithm Classification Accuracy with Feature Selection in Comparison with GLAD Algorithm

***Lei Yu, Tao Zhang, Peer-Olaf Siebers, and Uwe Aickelin***

Modelling Electrical Car Diffusion: An Agent-Based Approach

***Daphne Lai***

A Comparison of Distance-based Semi-supervised Fuzzy c-Means Clustering Algorithms

***Christopher Roadknight and Uwe Aickelin***

Microsimulation of the Port of Dover

***Julie Greensmith***

Making Affective Effective

**07/06/2011, 12.00-2pm, Room C60**

***Simon Miller: Modelling Real-World Complex Systems - Representing Uncertainty***

Abstract: The modelling of real-world complex systems is an area of ongoing interest for the research community. Real-world systems present a variety of challenges, not least of which is the problem of uncertainty inherent in their operation. In this seminar I'll describe fuzzy sets and how they can be used to model uncertainty, and give a brief overview of a fuzzy model I created during in my PhD for inventory management within a supply chain.

**31/05/2011, 12.00-2pm, Room C60**

***Robert Oates: ARMAX for System Identification***

When building simulations or control systems, a common challenge is to estimate the values of model parameters that cannot be directly observed. This seminar will present Gauss' formulation of the linear least squares estimator (LSE) for systems modelling. A worked example of the LSE will be developed in R during the seminar. From this foundation we will explore the use of LSE for generating models of time-varying systems using the ARMAX methodology. Finally, we will conclude by looking at variants of ARMAX from the fields of economics and control, that overcome common pitfalls of the methodology.

***Hao Fu: Semantic Image Segmentation***

The aim of semantic segmentation is to assign each pixel contained in the image a semantic label. Most state-of-art methods chose pixel or superpixel as their processing primitives. However, as the information contained in a pixel or a superpixel is not discriminative enough, the outputs of these algorithms are usually not object consistent. In this talk, I will first highlight the importance of choosing object-like regions as the processing primitives and then I will introduce a method to produce those object-like regions. Experiment on a publically available image understanding database confirms the effectiveness of our method.

**24/05/2011, 12.00-2pm, Room C60**

***Milena Radenkovic: Framework for Utility Driven Congestion Control in Delay Tolerant Opportunistic Networks***

Detecting and dealing with congestion in delay tolerant opportunistic networks is an important and challenging problem. In this paper we describe CAFREP, a unified congestion control framework for routing in such networks that adapts both data sending rates and data forwarding policies through a novel reactive fully distributed approach. CAFREP enables congestion control by detecting and reacting to congested nodes and congested parts of the network by using implicit hybrid contact and resources congestion heuristic. CAFREP exploits localized relative utility based approach to offload the traffic from more to less congested parts of the network, and replicate at adaptively lower rate in parts of the network with higher congestion. We extensively evaluate CAFREP against a number of state of the art adaptive and non-adaptive DTN routing protocols across a number of different metrics over three real trace driven experiments with different mobility and connectivity patterns such as Infocom 2006, Rollernet and Dieselnets CRAWDAAD data sets. We show that CAFREP performs well in three different connectivity datasets and continuously outperforms four other protocols in terms of maintaining higher node availability and success ratio while keeping lower delays, lower packet loss rates and lower number of forwarded packets for increasing congestion levels.

***Yujie Mei: High Dynamic Range Imaging and Display***

We are living in a world with high contrast scenery. The high dynamic range of the high contrast scenery presents challenges to reproduce them on conventional low dynamic range display devices. In this seminar, I will introduce the techniques used to capture and display high dynamic range images.

***Lei Yu: Modelling Electrical Car Diffusion: An Agent Based Approach***

Replacing traditional fossil fuel vehicles with innovative zero-emission vehicles for the transport sector in cities is one of the major tactics to achieve the UK government's 2020 target of cutting emission.

In the seminar I will be talking about my current research which looks at the impact of governmental interventions on the diffusion of electric vehicles in cities. To gain insight into the evolution of such complex systems we can use agent-based modelling and simulation. I will present a case study related to the introduction of a new car park charging scheme here at the University of Nottingham where we use agent based modelling and simulation to test the impact of different car parking rates and other incentives for promoting electric vehicle diffusion.

**18/05/2011, 12.00-2pm, Room C60**

***Uwe Aickelin: IMA - Achievements and Vision***

Abstract: My talk will be related to a recent Platform application we have made to EPSRC. As part of my talk I will summarise what IMA does and has achieved in the past. A particular question is what makes our work different from that performed elsewhere. I will also talk about long-term research vision. Comments, questions and suggestions will be particularly welcome during this talk.

***Jie Shu: Immunostaining Analysis***

Abstract: The immunostaining techniques can be dated from 1940s. It uses the antibodies against the species. It is a general term of IHC (Immunohistochemistry) to stain the tissue sections. IHC has been explored to be a crucial tool for predictive marker testing to determine the positive and negative patients. The limitations of this technique are highly relied on the experience of hand making of the slide and the eye interpretation of the result. Pathologists have been using the computer assisted method for more than 30 years and have proved it superior to the manually detection of many kinds of markers. The aim of this project is building an auxiliary tool to help the pathologist to do the diagnosis.

**10/05/2011, 12.00-2pm, Room C60**

***Noor Azizah KS Mohamadali: Modelling Student's Perception on Factors Influence Acceptance of Research Related Software using Multi-criteria Decision Analysis Techniques (MCDA) – A case study***

Most decision making problem requires the consideration of several conflicting objectives. The term multiple criteria analysis (MCDA) technique describes various methods developed for aiding decision makers in reaching better decision. Among many, user acceptance of software technology is one of the complex problems which involve various factors and should be evaluated. Evaluation contributes towards understanding those factors that may contribute successful adoption of software technology. MCDA techniques provide means to assign weights between these various evaluation factors. In my previous talk, I have presented proposed framework to help evaluate user acceptance of the technology and also have discussed various MCDA techniques and its applications in real world decision making problems. To advance our study and knowledge, we conducted a case study on student's perception of factor influence their acceptance of research related software with two objectives in mind. First objective is to test if it is possible to model our proposed evaluation framework using MCDA techniques in a context of research related software. Second objectives, is to compare classical AHP technique, Fuzzy AHP technique and normal average weight technique in terms of the weights it provides and subsequently we could assign the ranking between the factors. In this talk, I will present the results of this case study.

***Julie Greensmith: Making Affective Effective***

Af-fect |əˈfekt| (verb): to pretend to have or to feel, from the Middle English “to influence”.

Affective computing is an emerging multidisciplinary field within computer science with the aim of incorporating of emotions into computational systems. The nature of this incorporation can occur via the use of emotion data from users of such systems. Equally it can represent the display of emotions by computational systems to enhance the experience of the user through the generation of an emotive dialogue.

There are a number of challenges in working with affective systems centered on using emotions. Emotions are dynamic, they change over time depending on the internal and external milieu of the individual. Emotions are personal, with individuals portraying different emotions in a number of different physiological and social ways. Emotions are subjective, as it is difficult to find a universal taxonomy or strict definition for any individual emotion. Specific identifiable patterns or physiological signatures of emotion simply do not exist between individuals.

This makes it an interesting problem in terms of the application of computational intelligence techniques. However, little research exists in the area of the application of intelligent classification techniques to the ascertainment of emotions from physiological data. In this talk I will discuss the wearable biosensor technology used to collect physiological data and propose an approach for the modelling and classification of this data using ensemble based computational intelligence techniques. This includes a summary of our previous and current applications areas of adaptive entertainment systems and stress monitoring of motorbike passengers.

**22/03/2011, 12.00-2pm, Room C60**

### **Theme: Energy Challenges for Complexity Science**

*Richard Snape and Mark Rylatt (DeMonfort University, Institute of Energy and Sustainable Development): Behaviour and Learning in an Agent Based Model of the Smart Grid*

The term Smart Grid describes an electricity network that can intelligently integrate the behaviour and actions of all users connected to it in order to efficiently deliver sustainable, economic and secure electricity supplies. By this definition, the Smart Grid will require all users of the network to process and respond to information about the electricity market that was previously the preserve of large corporate players. The nature of this response is far from trivial and will depend on the behaviour of both consumers and their installed technology as the electricity market is brought into the home and workplace. In turn, that behaviour is subject to complex phenomena such as attitude, habit, social influence and learning. With such a radical change envisaged, where all users employ a dynamic consumption strategy either directly or through an intelligent automated device, a powerful modelling approach which can describe the behaviour and learning of actors and resulting emergent system behaviour is necessary.

This seminar presentation introduces an Agent Based Modelling (ABM) approach, discusses the applicability of the approach to the Smart Grid and in particular focuses on alternative representations of agent behaviour and learning within the model and how that might change the observed scenarios in model simulation runs.

For more information about the project see <http://www.iesd.dmu.ac.uk/~cascade>

*Nick McCullen (University of Leeds, Department of Mathematics): Modelling the Diffusion of Energy Technology on Social Networks*

How can complexity science contribute to policy on energy at the city level?

Complexity science is the systematic study of multiple interacting individuals. In complex systems the interactions are an important factor in the observed system level "emergent" behaviour. The tools of complexity science include mathematical and computational modelling and simulation. These include

network models, where the individuals are represented by nodes connected by links showing the interactions, and dynamical systems, where the time evolution of variables is governed by equations or discrete rules.

Interventions by local authorities may try to influence the uptake of energy-efficient technologies by households to ensure a rapid transition to a low-carbon economy. Here the consumers are modelled as nodes on a network, the structure of which represents the social contacts between individuals. The spread of technology is a diffusive process, mediated by the passing of information between the consumers. Individuals base their decisions on factors such as cost and benefit to themselves and are influenced by their personal contacts and society as a whole. Simulation of variations of such models can be used to understand which factors are important for the success of a technology, and what measures could be implemented to influence those factors.

For more information about the project see <http://ima.ac.uk/energy/>

**15/03/2011, 12.00-2pm, Room C60**

***Hazlina Hamdan: An Investigation of the Effect of Input Representation in ANFIS Modelling of Breast Cancer Survival***

Fuzzy inference systems have been applied in recent years in various medical fields due to their ability to obtain good results featuring white-box models. Adaptive Neuro-Fuzzy Inference System (ANFIS), which combines adaptive neural network capabilities with the fuzzy logic qualitative approach, has been previously used in modelling survival of breast cancer patients based on patient groups derived from the Nottingham Prognostic Index (NPI), as presented in previous seminar. In this seminar, I will talk about our extend work to examine whether the ANFIS model can be trained to better match the data with the NPI variable represented as a real number, rather than a categorical group. Two input models have been developed and trained with different structures of ANFIS. The performance of these models, in the capability to predict the survival rate in survival of patients following operative surgery for breast cancer, is examined.

***Stephanie Foan: Computational Modelling of Immunosenescence***

In a previous presentation it has been discussed that marked health improvement over the last century has resulted in an aging population. A decline in various components of the immune system with age is thought to contribute to more infection, cancer and autoimmunity, and caring for more people experiencing these diseases of older age is an important economical and social issue.

This project combines simulation and current laboratory work. This presentation will first summarise my masters research during which a predictive model of natural killer cell function was developed. I will then introduce my work re-implementing and validating a model of the dynamics of T regulatory cells throughout the lifetime.

***Andrew Grundy: Congestion Aware Forwarding in Delay Tolerant Networks***

In this presentation I will introduce Delay Tolerant Networks (DTNs), focusing on the issues surrounding the absence of the inherent Internet assumption of contemporaneous end-to-end connectivity. I will discuss the different types of DTN forwarding algorithms and the problem with the common assumptions present in their evaluation. I will give examples of deployment scenarios, showing how the diversity in mobility effects the patterns of connectivity and therefore the need to evaluate algorithms within more than one environment. I will outline our published contributions regarding congestion control and finish the presentation with insight into my current work.

**08/03/2011, 12.00-2pm, Room C60**

***Zhiming Cai (Senior Nuclear Safety Consultant, AMEC Nuclear UK Limited): The Application of System Dynamics in the Modeling of Natural Resources Industries - A Case in a Study of Global Helium Resources***

This presentation aims to introduce the application of System Dynamics (SD) in the simulation of natural resources industries such as natural gas, oil and helium industries. A study of global helium resources using SD methodology will be used as a case study. A comparison of SD and other methodologies such as econometrics in terms of the modelling process, problem definition, model formulation, model analysis, model validity and sensitivity analysis will be presented as well.

Bio: Dr Zhiming Cai is currently working as senior safety consultant for AMEC Nuclear UK Limited in Knutsford, Cheshire. He graduated from Judge Business School, Cambridge University. The subject of his PhD study is "A Study of Global Helium Resources" using System Dynamics research methodology. The research result is published in the Journal of Resources Policy [link]. Zhiming had been a lecturer for over six years in Nuclear Engineering and Safety in China.

**01/03/2011, 12.00-2pm, Room C60**

***Simon Miller: Modelling Real-World Complex Systems - Representing Uncertainty***

The modelling of real-world complex systems is an area of ongoing interest for the research community. Real-world systems present a variety of challenges, not least of which is the problem of uncertainty inherent in their operation. In this seminar I'll describe fuzzy sets and how they can be used to model uncertainty, and give a brief overview of a fuzzy model I created during in my PhD for inventory management within a supply chain.

**22/02/2011, 12.00-2pm, Room C60**

***Christian Wagner: Ambient Intelligent Environments, Transparency and Fuzzy Logic***

Ambient Intelligent Environment applications combine the challenge of developing systems for real world deployment with the requirement to particularly focus on the needs of the human user at the centre of the system(s). I will talk about the EU FP7 project ATRACO (Adaptive and Trusted Ambient Ecologies) which over three years has focussed on the development of user-centred, "activity sphere" based intelligent functionality while at the same time investigating the social impact and considerations resulting from the use of "intelligence" in the home. Specifically, I will focus on the use of fuzzy logic, including general type-2 fuzzy logic, to develop adaptive strategies to address the constant changes in device characteristics and user behaviours prevalent in Ambient Intelligent Environments while remaining transparent to the human user.

**15/02/2011, 12.00-2pm, Room C60**

***Jianyong Sun: Robust Bayesian Clustering for Datasets with Repeated Measures***

Experimental scientific data sets usually contain repeated measures. The repeated measures for the same object are correlated, and this correlation must be carefully dealt with in scientific analysis. In this paper, we propose a robust Bayesian clustering algorithm for data sets with repeated measures. The method aims not only to accurately cluster the data points taking the repeated measures into consideration, but also to find the outliers which possibly require further study. Experimental studies have shown that the developed algorithm compares favourably against a Gibbs sampling algorithm, while maintaining computational simplicity. We demonstrate the benefits of including the repeated measures in the model, in terms of improved outlier detection rates in varying conditions of

measurement uncertainty. Finally, we apply the approach to clustering biological transcriptomic dataset, which measures the response of Arabidopsis roots to the plant hormone auxin, and find that the robust clustering algorithm successfully identifies genes that respond to the hormone, and there is strong agreement with the genes found independently in another similar transcriptomics experiment.

**08/02/2011, 12.00-2pm, Room C60**

***Hala Helmi: Predicting Based on TSVM (Tranductive Support vector machine)***

The Tranductive is strongly related concept to semi supervised learning, where semi supervised learning is halfway between supervised and unsupervised, in such situation any data set will be divided into two fractions: for the labelled data the points for which labels . On the other hand, the second fractions: the points where the labels are unknown. The ides of the transduction learning method is to utilize the information of the labelled points (training set) together with that of the unlabeled points to predict unlabelled data.

The transductive support vector machine (TSVM) is the transductive inference of the support vector machine. The TSVM use the information carried by the unlabeled data set to obtain better classification performance than the regular support vector machine (SVM) where it use the labelled data only. TSVM is usually suitable in the case when the distribution of the training samples differs from that of the test samples, as well as it gives more accurate results when the training data set is small comparing with test set.

***Sameh Zakhary: Reliability of Communication in Challenged Environments***

Our published work is concerned with fully distributed reputation-based mechanisms that improve security in MANETS. We propose to use two different centrality measures for evaluation of the individual trust claims and resolving the aggregated ones. We design and build our prototype over AODV and test it in NS-2 in the presence of variable active blackhole attacks in highly mobile and sparse networks.

***Ian Dent: Ian Dent - An Introduction***

Background on Ian Dent and an introduction to the Desimax project and Ian's provisional research area which will cover analysis of domestic electricity data and the derivation of useful 'stereotypical' electricity usage daily profiles. The project aim is to use the research to affect domestic behaviour (save electricity) and supply side behaviour (generate electricity more efficiently)

***Jenna Reys: Detecting adverse events in a general practice database***

We aim to produce an efficient data-mining technique to identify adverse events in a general practice database (GP). Existing adverse event detecting techniques have been developed for a specific type of medical database known as spontaneous reporting systems (SRS). This is due to the availability of these types of databases but they have many limitations. I will summarise both the advantages and disadvantages of detecting events using the SRS and the GP databases and will then briefly discuss the technique we are currently testing on the GP database.

***Daphne Lai: Distance-based Semi-Supervised Fuzzy c-Means Algorithms***

There are many issues to be considered in the design of distance-based fuzzy semi-supervised (FSS) algorithms. To identify these issues, we compare experimental results of four such algorithms on common datasets. We describe the properties of these algorithms, highlighting their key differences. In

our work, several experimental conditions are set. Firstly, two forms of initialization of unlabelled patterns are used; 1/c and 0. Secondly, the algorithms are run with different amount of labelled patterns in the datasets, ranging from 2% to 40%. While some algorithms outperform others in some datasets, no algorithm outperforms the others in all the datasets. Also, small modifications in similar objective functions can improve clustering. Most of the algorithms perform slightly better with zero initialization of unlabelled patterns. One interesting observation is that the increase in labelled patterns does not always improve clustering. From these results, we conclude that the number and scale of dimensions in the data set, initial partition matrix, distance metrics and objective functions, together, affect clustering results. In addition, not all initially labelled patterns are good candidates for supervision.

### ***Wanlu Wang: A Novel Method for Volume Rendering***

Primary Goal: Investigate current approaches to volume rendering. Compare and analyse these approaches and find a novel method to solve/improve current issues (e.g. image quality, speed).

### ***Stephanie Foan: Computational Modelling of Immunosenescence***

In just the last hundred years, developed countries have seen marked medical advancement promoting longer life, but it is widely accepted that this extension on life is not all good quality in terms of health. There are obvious economical and social issues associated with an aging population and there is emphasis at governmental and academic levels to understand the problem. Research into diseases associated with age has shown immune-related aspects. It is evident that an aging immune system contributes to increased incidence of infection, cancer, autoimmunity as well as less intuitive diseases such as Alzheimer's. Understanding the contribution of an aging immune system to these pathologies is crucial to developing appropriate therapies.

This PhD project represents a collaboration between IMA and the School of Molecular Medical Sciences, Division of Oncology. Essentially we are interested in the iterative process of using simulation with our laboratory findings to systematically generate hypotheses. We are also interested in making predictions about the quality of an aged immune system from limited measurements on single blood samples.

**01/02/2011, 12.00-2pm, Room C60**

### ***Yihui Liu: Finding the Prognosis Biomarkers in Survival Analysis Based on Wavelet Feature Extraction***

Prognosis biomarkers in survival analysis take an important role in medical diagnosis and treatment. How to select the significant biomarkers from hundreds of protein markers is key step in survival analysis. we propose a method to detect the prognosis biomarkers in survival analysis using wavelet analysis, genetic algorithm, and Bayes classifier. Kaplan-Meier curve and Cox regression model are used to evaluate the performance of selected biomarkers.

**07/12/2010, 12.15pm-2pm, Room C60**

### ***Guoping Qiu: Social Image Quality - Image Quality Assessment by the Mass for the Mass***

High dynamic range (HDR) photography is an emerging technology that has the potential to dramatically enhance the visual quality and realism of digital photos. One of the key technical challenges of HDR photography is displaying HDR photos on conventional devices through tone mapping or dynamic range compression. Although many different tone mapping techniques have been developed in recent years, evaluating tone mapping operators prove to be extremely difficult. Web2.0, social media and crowd-sourcing are emerging Internet technologies which can be harnessed to harvest

the brain power of the mass to solve difficult problems in science, engineering and business. Paired comparison is used in the scientific study of preferences and attitudes and has been shown to be capable of obtaining an interval-scale ordering of items along a psychometric dimension such as preference or importance. In this paper, we exploit these technologies for evaluating HDR tone mapping algorithms. We have developed a Web2.0 style system that enables Internet users from anywhere to evaluate tone mapped HDR photos at any time. We adopt a simple paired comparison protocol. Internet users are presented a pair of tone mapped images and are simply asked to select the one that they think is better or click a “no difference” button. These user inputs are collected in the web server and analyzed by a rank aggregation algorithm which ranks the tone mapped photos according to the votes they received. We present experimental results which demonstrate that the emerging Internet technologies can be exploited as a new paradigm for evaluating HDR tone mapping algorithms. The advantages of this approach include the potential of collecting large user inputs under a variety of viewing environments rather than limited user participation under controlled laboratory environments thus enabling more robust and reliable quality assessment. We also present data analysis to correlate user generated qualitative indices with quantitative image statistics which may provide useful guidance for developing better tone mapping operators for creating superior visual experience for the consumers.

**30/11/2010, 12.15pm-2pm, Room C60**

***Chris Roadknight: Simulating the Port of Dover***

Simulating the traffic flow of heavily used but secure environments such as seaports and airports is of increasing importance. Errors made when simulating these environments can have long standing economic, social and environmental implications.

This talk discusses issues and problems that may arise when designing a simulation strategy. Data for the Port is presented, methods for lightweight vehicle assessment that can be used to verify and validate simulations are also discussed along with an example of how a simulation can be extended. Finally, conclusions are drawn about how microsimulations can be moved forward as a robust planning tool for the 21st century.

**23/11/2010, 12.15pm-2pm, Room C60**

***Daniele Soria: Breast Cancer Classification: From Consensus Clustering to Fuzzy Logic***

In this talk I will present my past and current research work. Firstly, I will introduce a novel framework to elucidate core classes in multi-dimensional biomedical data which was developed during my PhD. It mainly focuses on the consensus between different clustering techniques to find the most representative groups within a dataset. The validation of the framework over breast cancer data led to the discovery of new cancer subtypes. However, it was not possible to assign every patient to a specific group. To overcome this issue and to refine the classification, fuzzy logic and fuzzy rules have been used in the development of a new algorithm. The latest results will be presented and discussed.

***Mazlina Abdul Majid: Human Behaviour Modelling Practice: A Comparison of Traditional Discrete Event and Combined Discrete Event and Agent-Based Simulation***

This study presents a comparison between two simulation methods, namely Discrete Event Simulation (DES) and Agent Based Simulation (ABS). In our literature review we identified a gap in comparing the applicability of these methods to modelling human centric service systems. Hence, we have focused our research on reactive and proactive models of human behaviour in service systems. The aim of the study is to establish a human behaviour modelling practice for modelling human reactive and proactive behaviour in service systems using DES and ABS. To achieve this we investigate both the similarities and differences between model results performance and the similarities and differences in model difficulty performance. The comparison of the simulation methods is achieved by using a case study

approach. We have conducted three case studies: fitting room services, international support services and airline check-in services. To conduct our case studies we have created two sets of simulation models- DES and combined DES/ABS. With these models we have carried out two sets of experiments: Set A is concerned with modelling results performance, while set B is related to model difficulty performance. We have then conducted statistical analysis on the results of these experiments. Evidence from the experiments reveals that DES is the most effective approach when modelling a combination of reactive and simple proactive behaviour, while combined DES/ABS is the most effective approach when modelling a mix of reactive and complex proactive behaviour. Another finding from the experiments is that it is only worth representing complex proactive behaviour if it occurs frequently in the real system (considering the relation between modelling effort and impact).

The contribution made by this study to the body of knowledge is a human behaviour modelling practice for modelling service systems which has been built from evidence collected from the case studies. This best practice will assist modellers who are new to the field of service systems modelling to make an informed decision on the method they should use for their own modelling, based on the level of proactiveness inherent in the real system and on the levels of difficulties they should expect for each method.

**16/11/2010, 12.15pm-2pm, Room C60**

***Graziela Figueredo: Comparing ABS and SDS for tumour growth and its interactions with effector cells***

The current scenario in the simulation field presents paradigms that allow us to build simulation models for various domains. Some important simulation approaches are System Dynamics Simulation (SDS), Agent-Based Simulation (ABS), Discrete Event Simulation (DES) and Dynamic Systems (DS). New research combines these methods and defines frameworks for the usage of each paradigm. There is already work comparing SDS/DES, DES/ABS as well as their combinations. Nevertheless, there is still few knowledge about the comparison and combination of SDS and ABS. Hence, our research aims for the establishment of a framework for the development of simulations involving the choice between SDS and ABS approaches and their combination for immune system-related problems. ABS is a paradigm used in many levels of abstraction, including those levels covered by SDS. As there is this intersection, some range of simulation problems can be solved by either SDS or ABS. In previous work we have compared the use of ABS and SDS for modelling static agents' behaviour in an immune system ageing problem. By static we mean that there were no movement or interactions between the agents. We concluded that for these types of agents, it is preferable to use SDS instead of ABS. When contrasting the results of both simulation approaches, we could see that SDS is less complex and takes up less computational resources, producing the same results as those obtained by the ABS model. In order to move this research forward, our next research question is: Once we have established that SDS is more suitable for static agents than ABS, if we introduce interactions between these agents will SDS still be the most appropriate paradigm to be used? To answer this question for immune system simulation problems, we use, as case studies, models involving interactions between tumour cells and immune effector cells. These effector cells are responsible for eliminating tumour cells in the organism. Our goal is to determine which scenarios for immune system simulations inside the SDS/ABS intersection would benefit from SDS resources and those that are more suitable for ABS.

***Tao Zhang: Complexity Science, Agent-Based Simulation & Energy Research***

Abstract: Complexity science is a newly emergent scientific area studying complex systems. It is a broad multi-disciplinary subject which blends social sciences and natural sciences. In this seminar, I will briefly introduce the basic theories of complexity science and its main research method agent-based simulation, and then use a case study to demonstrate its application in energy research.

**09/11/2010, 12.15pm-2pm, Room C60**

***Peer-Olaf Siebers: Conceptual Modelling for Simulation - A Tutorial for Beginners***

Conceptual modelling is almost certainly the most important aspects of the simulation modelling process as it impacts all other aspects of a simulation study. At the same time it seems to be one of the least understood. In this tutorial I will shed some light onto the mysteries of conceptual modelling.

**02/11/2010, 12.15pm-2pm, Room C60**

***Jon Garibaldi: Non-Stationary Fuzzy Reasoning in Clinical Decision Support***

Fuzzy sets were introduced by Zadeh in the 1960s, and were subsequently expanded into a complete systematic framework for dealing with uncertainty. As part of the generic fuzzy methodologies, fuzzy inference systems were proposed for the modelling of human reasoning with uncertain data and knowledge. However, standard fuzzy sets and fuzzy reasoning do not model the variability in decision making that is typically exhibited by all human experts in any domain. Variation may occur among the decisions of a panel of human experts (inter-expert variability), as well as in the decisions of an individual expert over time (intra-expert variability).

Dr Garibaldi has introduced the concept of non-stationary fuzzy sets, in which small changes (perturbations) are introduced in the membership functions associated with the linguistic terms of a fuzzy inference system. These small changes mean that each time a fuzzy inference system is run with the same data, a different result is obtained. It is straight-forward to extend this notion to create an ensemble fuzzy inference system featuring non-stationary fuzzy sets. In this talk (aimed at an audience not completely familiar with fuzzy methods), non-stationary fuzzy sets and reasoning will be explained in detail, and its use in several real-world scenarios of decision support in medical contexts will be described. Results will be presented to demonstrate the benefits of non-stationary fuzzy reasoning.

**26/10/2010, 12.15pm-2pm, Room C60**

***Feng Gu: The Extended Dendritic Cell Algorithm for Large Anomaly Detection Datasets***

As one of the main algorithms in the field of Artificial Immune Systems (AIS), the Dendritic Cell Algorithm (DCA) has been successfully applied to a range of problem domains. One particular type of problem that the DCA is designed to solve is known as anomaly-based intrusion detection. Previous applications showed several intriguing strengths of the algorithm, such as being unsupervised and lightweight, making it a suitable candidate for applications that require high detection speed. However, in the literature issues with the DCA have been described, and some of them stop the algorithm from being applied to a wider range of problems and accepted to a bigger group of users. As a result, this thesis is aimed to address the issues with the current DCA and propose the corresponding solutions, which are validated and verified in either an empirical or a theoretical manner. The main objective of this thesis is to show the possibility of developing an extended system based on the DCA, capable of handling large anomaly detection datasets. Based on the investigations shown in this thesis, we draw the following conclusions: firstly, the DCA can be formally defined and theoretically analysed to show its simplicity and prove its low runtime complexity; secondly, it is possible to improve the applicability of the DCA to online detection and large datasets through segmentation approaches; thirdly, it is possible to automate the data pre-processing phase of the DCA through combining techniques of dimensionality reduction and statistical inference.

***Aslam Ahmed: Multi-paradigm Simulation of TRAPS***

Tumor Necrosis Factor Receptor-Associated Periodic Syndrome (TRAPS) is an autosomal, dominantly inherited disease, characterised by periodic bouts of fever and localised inflammation. The aim of our

research is to extend our understanding of the mechanisms bringing about the onset of TRAPS using Multi-paradigm simulation. This involves using different modelling methods such as the use of differential equations, discrete event models and agent-based models in order to form a more complex and sophisticated model which may be able to capture more closely, emergent properties of the system.

**19/10/2010, 12.15pm-2pm, Room C60**

***Jan Feyereisl: Learning Using Privileged Information: The Power of X\****

The novel paradigm of Learning Using Privileged Information (LUPI) and the associated SVM+ method developed by Vladimir Vapnik provides a number of powerful features over classical learning settings. Firstly, it allows for the use of additional, in this scenario "privileged", knowledge about a problem domain during learning which is not required during testing. Secondly, such knowledge can be rejected, if inappropriate for the learning task, i.e. a solution of at least the same quality as in the classical setting can be achieved. The primary goal of the LUPI paradigm is to significantly increase the rate of convergence of the underlying learning machine. Thus with the novel paradigm the Bayesian solution is approached with a smaller number of samples. A question that remains is how privileged information should be chosen in order to achieve the fastest rate of convergence. In this work we propose a method for efficiently evaluating the possible benefit of different types of privileged information. This is compared to an existing method for generating privileged information. Experiments are conducted on an artificial dataset as well as real-world data from a study of colorectal cancer patients.

***Naisan Benatar: An Investigation into a Mechanism for Selection of Fuzzy Logic Type Based on Noise & Uncertainty***

Fuzzy logic is frequently used as a mechanism for controlling automated processes. Generally fuzzy logic controllers use what is known as type 1 fuzzy logic however there also exists a more computationally expensive variety known as type 2. With processing power becoming cheaper the feasibility of running Type 2 fuzzy logic is improving, however there is no method for deciding when such as system would be beneficial in terms of performance. This presentation outlines the work we are undertaking in order to address this short coming. Currently we are working in the application area of sail boat control which can be subject to large quantities of uncertainty and noise. Our investigation is looking into the possibility of using a measure of this uncertainty in order to develop a method for choosing the most effective type of fuzzy logic.

**05/10/2010, 12.15pm-2pm, Room C60**

***Chris Musselle (Bristol Centre for Complexity Sciences (BCCS) @ University of Bristol): Malware and Artificial Immune Systems***

Malicious software, or malware, has always been a problem for the security of computer systems; however in the last 10 years, the motivation to write such malicious programs has undergone a radical shift from intellectual prank to large scale online fraud. The Co-evolutionary arms race that exists between cyber criminals and security experts means there is an ever growing need to develop new detection and prevention methods for malicious programs.

My PhD investigates the potential for Artificial Immune System inspired approaches to better distinguish between normal and potentially malicious behaviour in a computer system. The main methods investigated for this are the Dendritic Cell Algorithm and the Danger Theory upon which it is based. It is hoped that new methods for malware detection are possible form developing an algorithm inspired by new theories of how the Human Immune System carries out self/non-self discrimination.