IMA Seminar Series 2013/2014

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07/10/2013, 13:30-14:30pm, Room C01

Jon Garibaldi: Recent Developments in IMA

Jon will open this year's seminar series by presenting the recent developments within the group, and giving an overview of plans for the forthcoming year.

14/10/2013, 13:30-14:30pm, Room C01

Jamie Twycross: Principled Selection of Stochastic Simulation Algorithms

Stochastic simulation algorithms (SSAs) allow biologists to perform accurate simulations of chemical systems at low species concentrations. As the complexity of models increases, this computationally expensive algorithm can become intractable. Numerous improvements to SSAs have been introduced but they each tend to only apply to a certain class of model. In my talk I will give an overview of a paper in preparation. In the paper we investigate whether it is possible to determine which algorithms are suited to a particular class of model, and if this can be ascertained a priori to simulation. To answer this question we have developed an SSA performance benchmarking suite. The suite provides reference implementations of the main classes of SSAs. We also provide a set of models, classified using a number of metrics. We compare the computational efficiency of each implementation on these test cases to determine which SSAs perform best on different classes of biological reaction networks.

21/10/2013, 13:30-14:30pm, Room C01

Alex Ladas: Building Behavioural Profiles of Debtors

This presentation will be about my recent work on clustering a socio-economic dataset in order to discover groups of debtors with similar characteristics that will serve as Behavioural Profiles of Debtors. As in any real world dataset, inconsistencies within the data required a series of data transformations before the clustering process. The contribution of these transformations was assessed by using an alternative validation measure to the existing ones and by a detailed inspection of the patterns revealed by the clusters. The results reveal a number of significant patterns and thus verified the importance of the transformations, the correct use of the evaluation method and thus a way to successfully mine a socio-economic dataset was highlighted.

Patrick Moratori: Towards a ground truth dataset for affect detection from physiological information

This talk describes part of our recent work where we aim to create a ground-truth dataset for affective computing to facilitate in particular the application and development of computational intelligence and other automated reasoning techniques. Following a multi-disciplinary approach, we highlight the need for but also the challenge of creating such a dataset that provides validated mappings of physiological data to a series of affective states ("happy", "neutral" and "sad" in our case). We proceed to discuss the experimental approach and setup employed in this paper where a recall task is combined with a series of groups of pre-rated images which are employed as affective stimuli shown to participants while their physiological data is captured. The physiological data sources captured include galvanic
skin responses (GSR) and heart rate (HR). Preliminary analysis of the results indicates that the statistically the resulting data does not allow the differentiation between the different stimuli/emotions shown/experienced. We provide an initial interpretation of these findings, including a reflection on the complexity of designing "laboratory-style" experiments while still capturing an emotional response from participants.

28/10/2013, 13:30-14:30pm, Room C01

Graziella Figueredo: On-Lattice Agent-based Simulation of Populations of Cells within the Open-Source Chaste Framework

Over the years, agent-based models have been developed that combine cell division and reinforced random walks of cells on a regular lattice, reaction-diffusion equations for nutrients and growth factors; and ordinary differential equations (ODEs) for the subcellular networks regulating the cell cycle. When linked to a vascular layer, this multiple scale model framework has been applied to tumour growth and therapy. Here we report on the creation of an agent-based multiscale environment amalgamating the characteristics of these models within a Virtual Physiological Human (VPH) Exemplar Project. This project enables re-use, integration, expansion and sharing of the model and relevant data. The agent-based and reaction-diffusion parts of the multiscale model have been implemented and are available for download as part of the latest public release of Chaste (“Cancer, Heart and Soft Tissue Environment”), (http://www.cs.ox.ac.uk/chaste/), part of the VPH Toolkit (http://toolkit.vph-noe.eu/). The environment functionalities are verified against the original models, in addition to extra validation of all aspects of the code. In this work, we present the details of the implementation of the agent-based environment, including the system description, the conceptual model, the development of the simulation model and the processes of verification and validation of the simulation results. We explore the potential use of the environment by presenting exemplar applications of the “what if” scenarios that can easily be studied in the environment. These examples relate to tumour growth, cellular competition for resources and tumour responses to hypoxia (low oxygen levels). We conclude our work by summarising the future steps for the expansion of the current system.

04/11/2013, 13:30-14:30pm, Room C01

Orod Razeghi: Understanding Visual Content with Human in the Loop

We study a very challenging automatic visual image recognition task - diagnosing skin diseases based on visual images of the lesions. Worldwide, it is believed that there are between 1000 to 2000 skin conditions of which 20% are difficult to diagnose. An intelligent diagnosing system not only helps patients with no or little access to health services, but also benefits typical general practitioners who have received minimal dermatology training. We introduce a challenging dataset containing 2309 images from 44 different skin conditions. As most state-of-the-art visual recognition techniques fail to perform on this dataset, we have developed a human in the loop approach that arrives at a higher recognition rate by combining visual features and human provided high-level information. In this approach, users provide answers to a set of predefined questions, which are then modelled together with the visual features of the image to suggest an answer.

11/11/2013, 13:30-14:30pm, Room C01

Noah Russell: What's on the SLAB? - Building a Simple Living Artificial Brain

The Neurophotons Lab is a multidisciplinary research group at the University of Nottingham with the goal of understanding fundamental aspects of information processing in the brain.

In order to understand how information is encoded and processed by a network of neurons it is thought to be necessary to be able to monitor and control all action potential activity within the network for an extended period of time. Furthermore, the interaction between an organism and its environment is also essential for a meaningful description of information processing within the network. The continual
flow of information from the network to the environment and back again allows the organism to explore, learn, and form a synergy with its environment.

Unfortunately, even in extremely simple organisms, it is not possible to monitor all the action potential activity, let alone the environmental signals, due to limitations in available technology. In order to overcome the complexities of real organisms the Neurophotonics Lab is developing a simple experimental system in which a small network of cultured neurons continuously exchanges information with a virtual environment implemented on a real-time computer; analogous to how a real organism interacts with its environment.

It is postulated that the resulting system, a Simple Living Artificial Brain (SLAB), contains the minimal, but essential, components required by a cognitive organism, while being technically feasible, experimentally accessible, mathematically formalisable and physiologically relevant to cognition at an elemental level.

This talk will cover the progress that has been made in developing the basic technology required to realise this ambitious goal.

18/11/2013, 13:30-14:30pm, Room C01

Bozhi Liu: Image Understanding: Colour Constancy

Colour Constancy is the ability to perceive colours of objects, invariant to the colour of the light source. This ability is generally accredited to the Human Visual System, although the exact details remain uncertain. Human visual system has this ability but camera does not. Then, when illuminant changed, the observed colour of the same object will not be exactly the same. How to fix this problem is the goal of Computational Colour Constancy. In this talk I will give a introduction about my work in this area.

Josie McCulloch: Image Measuring the Directional Distance Between Fuzzy Set

The measure of distance between two fuzzy sets is a fundamental tool within fuzzy set theory. However, current distance measures within the literature do not account for the direction of change between fuzzy sets; a useful concept in a variety of applications, such as Computing With Words. We highlight this utility and introduce a distance measure which takes the direction between sets into account. We provide details of its application for normal and non-normal, as well as convex and non-convex fuzzy sets, and demonstrate the new distance measure using real data from the MovieLens dataset and establish the benefits of measuring the direction between fuzzy sets.

25/11/2013, 13:30-14:30pm, Room C01

Ben Passow: Computational Intelligence in Integrated Traffic Management and Air Quality Control

The term Intelligence in Intelligent Transport Systems (ITS) mainly refers to innovation in methodologies and the creation of additional services rather than for computational intelligence related algorithms and systems. This talk will highlight some of these gaps in applied intelligent methods with a focus on one specific case: iTRAQ.

iTRAQ - Integrated Traffic Management and Air Quality using Space Services is a European Space Agency funded project led by a consortium of UK industry, academic and local authority partners. The consortium developed and validated a dynamic system for optimising the use of the road network balanced with the need to sustain high standards of air quality. iTRAQ uses a number of inputs that enable it to sense the current situation in near-real-time and provide accurate forecasts using Artificial Neural Networks. The system then uses CI optimisation techniques together with the predictions to provide enhanced traffic and air quality management strategies.
Peer-Olaf Siebers: Using UML for Graphically Describing ABMs in OR

The two simulation methods (most commonly) used in Operations Research (OR) have both a specific purpose. System Dynamics Simulation (SD) looks at aggregate levels of change and is mainly used for strategic decision support while Discrete Event Simulation (DES) considers individual entities but focusses at the process flow and is mainly used at tactical or operational level. There is currently a gap when the situation requires considering the behaviour of individual entities (with memory and autonomous/proactive behaviour) and their interaction with other entities and the environment. The shift in industry from manufacturing to service makes the ability to model human behaviour in human centric systems even more important. The OR community has looked at the Social Sciences where human behaviour simulation studies (using an agent-based approach) are well established. It seems like Agent-Based Simulation (ABS) has a great potential in filling the gap but using ABS models to solve OR problems has not yet gained much attention in the OR community.

Our hypothesis is that one of the stumbling blocks is the notation. In OR simulation we are used to employ a graphical notation to conceptualise and define our simulation models. In SD we use “stock and flow diagrams” to model how stocks change depending on the rate that defines the flow between two stocks and in DES we use “flow charts” to model the flow of entities through the system. In Social Science however a theory driven equation based modelling approach is commonly used. What is missing is a graphical notation that allows building ABS models in a similar way to SD and DES models.

To make ABS more attractive to the OR community we take ideas from software engineering and use UML state machine diagrams to define the structure of our agents and (if necessary) class and sequence diagrams to describe different types of agents and their interactions. Opposite to the standard theory driven approach in Social Simulation we focus on the structural development of the agent and the interactions between agents before we consider any detailed behavioural aspects defined by behavioural theory (and use equations to define these).

In this tutorial I will give an introduction to the ideas of ABS and put it in context to other simulation paradigms used in OR. I will then introduce a graphical notation (UML state machine diagrams) which seems to be well suited for the design of ABS models. In a “joint effort” (as this is a tutorial) we will then develop a simple state machine diagram together. If time allows I will briefly introduce two case studies where we have used UML state machine diagrams for developing our models. At the end of the tutorial you should all have a good understanding of the principles of ABS and be ready to get your hands dirty and start building your own ABS models using UML.

Jabran Aladi: Type-1 or Interval Type-2 Fuzzy Logic Systems - On the Relationship of the Amount of Uncertainty and FOU Size

A recurring theme in research employing type-2 fuzzy sets is the question of how much uncertainty in a given context warrants the application of type-2 fuzzy sets and systems over their type-1 counterparts. In this talk we will provide insight into this challenging question through an investigation into the ability of both types of Fuzzy Logic Systems (FLSs) to capture and model different levels of uncertainty/noise through varying the size of the Footprint Of Uncertainty (FOU) of the underlying fuzzy sets from type-1 fuzzy sets to very “wide” interval type-2 fuzzy sets. By applying our methodology in the well-controlled context of chaotic time-series prediction, we show how, as uncertainty/noise increases, type-2 FLSs with fuzzy sets with FOUs of increasing size become more and more viable. While this work is focused on a specific application, we believe it provides crucial insight into the challenging question of the viability of interval type-2 over type-1 FLSs.
Jacob Chapman: Coupling Multi-Agent Stochastic Simulation of Occupants with Building Simulation

One of the principle causes for deviations between predicted and simulated performance of buildings relates to the stochastic nature of their occupants: their presence, activities whilst present, activity-dependent behaviours and the consequent implications for their perceived comfort. A growing research community is active in the development and validation of stochastic models addressing these issues; and considerable progress has been made. But one key outstanding challenge relates to the integration of these emerging prototype models with building simulation in a coherent and generalizable way; meaning that emerging models can be integrated with a range of building simulation software.

One promising approach is to integrate stochastic occupancy models within a multi agent simulation (MAS) platform, which communicates directly with building simulation software. This paper describes one such example.

Models of occupants’ presence (Page, Robinson, Morel, & Scartezzini, 2008) activities (Jaboob et al, 2013), metabolic heat gains and use of windows (Haldi & Robinson, 2009) and shading devices (Haldi & Robinson, 2010a) have been integrated within a bespoke MAS framework that parses agents’ characteristics to the EnergyPlus simulation program, which in turn parses environmental parameters to our MAS platform, to impact on future behaviours.

We describe this new framework (from population generation, through parameter assignment to simulation (pre and runtime)), demonstrate its utility through a range of case study buildings (both residential and non-residential) and discuss modelling capabilities that will be integrated into the future. These latter include further behavioural models, adaptive comfort models as well as means for simulating different archetypal behaviours and interactions (agency) amongst members of the simulated population.

20/01/2014, 13:30-14:30pm, Room C01

James Gilbert: Generating artificial complex networks with community structure and realistic topology

The detection of a hidden community structure within complex networks is of interest to a variety of fields, despite this, the field still lacks appropriate, configurable models capable of simulating modular networks found in varying domains. Existing approaches, such as stochastic block models and benchmark graphs, generally use fixed degree distribution configurations as model parameters. Here we take a different approach using a simple static generation model by exploiting circular geometry combined with wrapped Gaussian functions. We show that this model can easily fit both scale-free preferential attachment models and real world degree distributions in a highly flexible manner. Extending this model, we allow for the generation of overlapping and non-overlapping graphs showing a clear link between a predefined community density and high clustering coefficients. This approach should help researchers simulate random, artificial networks with domain specific properties as well as adding an additional form of benchmark graph for community detection algorithms.

Julie Greensmith: From Inspiration to Application: Artificial Immune Systems

This tutorial based talk is designed to inform IMAers of the research in artificial immune systems (AIS) over the last two decades. AIS is a particular type of technique in Natural Computing where inspiration is taken from the human immune systems to build complex problem solvers. They are applied to a range of interesting problems including security, optimisation and self-healing systems. As the immune system has many behaviours, there are equally as many different types of AIS. This talk will give an overview of techniques in AIS to date, discuss the impact of improvements in computational modelling, and to describe my own current research into a particular AIS known as the Dendritic Cell Algorithm.
Aslam Ahmed: Scaling and Variance in System Dynamics and Agent Based Modelling in the Context of the Spread of Infectious Disease

Compared to System Dynamic Models (SD), Agent Based Models (ABM) are able to capture natural variation in the output space without modifying the input parameters. The variation in the output for ABM can be a useful indicator of the boundaries and form of the output space. However, with large population sizes, compared to simulations using SD models, simulations using ABM run much slower and in some cases the performance means that the simulation is no longer feasible.

In our study the SIR model is implemented using SD and ABM and at different population sizes. Incremental changes are made to the different input parameters to determine the effect of the changes on the output space of the simulation for both SD and ABM. During each change, a test is applied to the output curve of the simulation against the original experimental data to map the space of the parameters which is in agreement or disagreement with the original experimental data. In addition, population sizes are varied at three different scales to determine the effect of population sizes on performance and variance.

The study shows how the variation of the output space for SD compares with that of ABM and discusses how the issue of simulation performance with ABM can be overcome by scaling the simulation using population counts at three different orders of magnitude.

Fang Zhou: Network Abstraction

The talk will focus on the Methods for Network Abstraction. The work is motivated by the growth of networks in many areas of life. Consider networks of thousands of genes, millions of people, or billions of web pages. They are too large to be directly analyzed by users. The aim of network abstraction is to summarize a large network as a smaller one but keep the essential information. An abstracted network can then help users to see the overall topology of a large network, or to understand the connections of distant nodes. In this talk, I will introduce the research area of network abstraction, and present methods to solve some instances of the problem.

Bio: Dr. Fang Zhou currently is a research fellow in Division of Computer Science at The University of Nottingham Ningbo China. She got her Ph.D. degree in Computer Science in 2012 from University of Helsinki, Finland. Her research interests include data mining, large-scale graph analysis, with applications in bioinformatics and multimedia.

Amir Pourabdollah: Experimenting Non-Singleton Type-I and Type-II Fuzzy Logic Systems using Juzzy Extension

Using the non-singleton fuzzification is a possibility for adding extra uncertainty dimensions to the fuzzy logic systems (FLSs), particularly when the FLS’s inputs are uncertain. This method of fuzzification can be applied to both type-I and type-II FLSs, moreover, the non-singleton fuzzification can itself be of type-I or type-II. This results the existence of three extra FLS configurations in addition to the singleton type-I and type-II systems. However, those three configurations are not very much discussed and experimented in the literature.

Juzzy is an open-source Java library for fuzzy logic research supporting type-I, interval and general type-II systems. We have recently extended it in order to support non-singleton fuzzification. This extension allows experimenting the extra FLS configurations, yet opening a gate for future researches on input uncertainties in FLSs. Using a basic well-known “restaurant tipping” example, it will be demonstrated how the non-singleton fuzzification may change the way you may tip a waiter in your next restaurant visit!
Diman Hassan: Comparison of Distance Metrics for Hierarchical Data in Medical Databases

Distance metrics are broadly used in different research areas and applications such as, bioinformatics, data mining and many other fields. However, there are some metrics used specifically for data with hierarchical structure like, pq-grams and Edit Distance. Other metrics used for non-hierarchical data are the geometric and Hamming metrics. We have implemented these metrics to The Health Improvement Network (THIN) database which has some hierarchical data, by converting it into tree-like structure for the first group of metrics. On the other hand, the data is converted into a frequency table or matrix for the second group of metrics then for all the two groups of metrics, all the distances are found and normalized. Based on this particular dataset, our research question is which of these metrics is useful for THIN data. We compares the metrics, particularly the pq-grams metric on finding the similarity of patients’ data, and investigates the similar patients who have the same close distances as well as the metrics suitability for clustering the whole patients’ population. Our results show that the two groups of metrics performed differently as they represent different structures of data. However, all the metrics could represent some similar data of patients as well as discriminate sufficiently well in clustering the patients’ population using k-means clustering algorithm.

10/02/2014, 13:30-14:30pm, Room C60

Julie Greensmith: Artificial Immune Systems

Jon Garibaldi: IMA Overview

Peer-Olaf Siebers: Intelligent Modelling and Analysis for Risk Assessment

In my presentation I will provide some insight into a case study we recently conducted with the UK Border Agency. The system we looked at is the Calais Ferry Port screening facilities where all lorries that want to get onto the Calais-Dover ferry are screened to find illegal immigrants that try to get into the UK on the back of these lorries. We conducted a cost benefit analysis with the help of discrete event simulation to try and come up with a sustainable cargo screening process that fulfilled the following high level objective: To minimise costs while maximising benefits in regards to service (cope with growing throughput) and security (avoid illegal immigration).

Jamie Twycross: Engineering Complex Systems

17/02/2014, 13:30-14:30pm, Room C60

Bob John: ASAP Overview

Jason Atkin: Some Transport Research in ASAP

Shahriar Asta:

Andrew Parkes:

17/02/2014, 13:30-14:30pm, Room C01

Qian Zhang: Geometric consistent visual phrase matching for partial duplicate image discovery

This talk will introduce a new geometric consistent visual phrase matching technique for boosting the performance of partial duplicate image discovery. Instead of treating each visual word independently, we consider an image or image patch’s visual words and their corresponding spatial positions together (visual phrase). A novel technique that projects the locations of bag of visual words onto the perimeter of a circle centred around their geometric centroid has been developed to efficiently encode the geometric information of the visual phrase of an image or image patch. We show that this new geometric encoding technique can be used with traditional partial duplicate image discovery techniques.
to achieve effective geometric consistent visual phrase matching that is also invariant to scales and rotations.

03/03/2014, 13:30-14:30pm, Room C01

**Simon Miller: Exploring Statistical Attributes Obtained from Fuzzy Agreement Models**

In this talk I will discuss ongoing work that aims to explore the characteristics of Fuzzy Agreement Models. This initial study has involved extracting a series of preliminary attributes from Type-1 Fuzzy Agreement models constructed using interval valued survey data, which we compare with some traditional statistical models applied to the same data.

These comparisons can provide insight into what the models actually capture, and what the process of transforming interval valued data into Fuzzy Agreement Models gives us in terms of information about the agreement.

**Tuong Vu: Agents in different disciplines**

From computer science, Agent Based Modelling has been adapted and used by many different disciplines such as economics, sociology, ecology, or biology. However, there are still many differences in the agent designs between different philosophies. To better understand the diversity, I will contrast the use of agents between Agent-Based Computing and Agent-Based Social Simulation.

10/03/2014, 13:30-14:30pm, Room C01

**Polla Fatah: Measuring micro changes over time in clustering**

This study aims to find out how people’s preferences change over time in public good games by clustering subjects into multiple groups of preference according to their behaviour inside an experimental game. After collecting data based on separate segments of time and clustering each segment individually the difference between any two segments is measured using area under the curve of ROC and external cluster validity measures to extract a scaler criteria that quantifies changes that happen to the items inside same clusters of constitutive time points. So far according to our results external cluster validity performs better (i.e. shows more sensitivity for underlying data change) and data shows that there is an insignificant change in the behaviour specially in the second half of the repetitive sequence of games.

**Anthony Williams: Visual Representations of [Un?]Certainty and its Consequences for the Design of Visualisation Tools**

14/03/2014, 13:30-14:30pm, Room C01

**Daniel Soria: Working with R: data analysis and visualisation.**

In this tutorial I will introduce the R software and quickly explain how to define variables and vectors. I will then show how to compute some descriptive statistics using a standard dataset and how to perform various statistical tests. There will also be a demonstration of how to use different graphics tools and how to apply clustering methods.