MATHSYS ANNUAL RETREAT
2019

Programme and Abstracts

Contents

SCHEDULE

MONDAY 29 APRIL

08.30	Coach departs from campus	*Coach park*
10.30	Arrival at YHA Ilam Hall	
11:45 - 12:00	Welcome	*Main hall*
12:00 - 13:00	Lunch	*Dining room*
13:00 - 14:30	M.Sc. poster session	*Main hall/Classroom*
14:30 - 16:00	Ph.D. presentations	*Main hall/Classroom*
16:00 - 16:15	Coffee break	
16:15 - 18:00	WARPs	
18:30 - 19:30	Dinner	*Dining room*

TUESDAY 30 APRIL

07.30 - 09.00	Breakfast	
09.00 - 10.00	Ph.D. presentations	*Main hall/Classroom*
10:00 - 11.00	**Invited Speaker:** Dr. Eva Navarro-López Manchester University	*Main hall*
11:00 - 11:15	Coffee break	
11:15 - 12.30	WARPs	
12:30 - 13.00	Director's talk	*Main hall*
13:00 - 14:00	Lunch	*Dining room*
14:00 - 18:30	Free time	
18:30 - 19:30	Dinner	*Dining room*

WEDNESDAY 1 MAY

07.30 - 09.00	Breakfast	*Dining room*
09.00 - 10.00	**Post-Ph.D. Advice Talk**: Dr. Janis Klaise	*Main hall*
09.30 - 10.00	Students-Staff Liaison committee meeting	*Classroom*
10:00 - 11.00	**Invited Speaker:** Dr. Andrea Soltoggio Loughborough University	*Main hall*
11:00 - 11:15	Coffee break	
11:15 - 12.00	Photo session and prizes	*Main hall*
12:00 - 13:00	Lunch	*Dining room*
13:00 - 15:00	**Presentation Skills Workshop:** Piero Vitelli	*Main hall*
15:00 - 15:15	Coffee break	
15:15 - 17:00	WARPs	
17.00 - 18.00	**Starting your Ph.D.**: Prof. Colm Connaughton	*Classroom*
17.00 - 18.00	**Peer-Review in Academia**: Dr. Ed Hill	*Main hall*
18:30 - 19:30	Dinner	*Dining room*

THURSDAY 2 MAY

07.30 - 09.00	Breakfast	*Dining room*
10.00	Coach departs from YHA Ilam Hall	

PH.D. STUDENTS TALK SCHEDULE

MONDAY 29 APRIL

	Stream 1 (Main Hall)	Stream 2 (Classroom)	Length
14:30 - 14:40	Benjamin Miller	Alvaro Cabrejas Egea	10 min
14:40 - 14:55	Trystan Lang	Andrew Hilditch	3 min
	Laura Guzmán Rincón	Steve Bennett	3 min
	Emma Southall	Joe Pollard	3 min
14:55 - 15:05	…. Short break ….	…. Short break ….	
15:05 - 15:15	Benjamin Atkins	Annika Heike Stechemesser	10 min
15:15 - 15:25	Tim Pollington	Ayman Boustati	10 min
15:25 - 15:35	…. Short break ….	…. Short break ….	
15:35 - 15:50	Christopher Davis	Kutlwano Bashe	3 min
	Susie Cant	Samuel Forbes	3 min
	Cameron Lack	Charlotte Roman	3 min

TUESDAY 30 APRIL

	Stream 1 (Main Hall)	Stream 2 (Classroom)	Length
9:00 - 9:10	Alexander Holmes	Robert Gowers	10 min
9:10 - 9:20	Emma Davis	Sami Al-Izzi	10 min
9:20 - 9:25	…. Short break ….	…. Short break ….	
9:25 - 9:40	Aditi Shenvi	Michael Luya	3 min
	Roger Hill	Simon Graham	3 min
	Connor White	Son Le	3 min
9:40 - 9:50	Chris Norman	Danielle Varjosalmi	10 min

EXTERNAL SPEAKERS (in order of appearance)

Hybrid Dynamical Systems: The Anti-Disciplinary Approach to Complex Systems

Dr. Eva Navarro-Lopez

Lecturer in Hybrid Systems and Control Engineering

School of Environment, Education and Development, Manchester University

What is a hybrid system? The term itself is confusing and broad, and can be used for any system consisting of elements of a different nature. From the dynamical viewpoint, a hybrid system integrates continuous-type and discrete-event dynamics. This definition can lead to a wide range of interpretations. Each interpretation has different goals and deals with specific types of problems, and reflects the background of the researchers behind it, whether they are computer scientists, control engineers or applied mathematicians. The main goal of the hybrid system framework is to bring together formal methods of computer science, dynamical systems theory and control engineering methodologies to better formulate complex systems: that is, systems that are changeable and unpredictable in behaviour. This gives rise to models, behaviour analysis tools, stability definitions, and control schemes which are novel and challenge existing orthodoxy of control engineers, computer scientists and mathematicians. In this talk, we will explore how all these theories can be combined and applied to a wide range of applications through the DYVERSE framework. DYVERSE represents a fresh perspective within the theory of hybrid systems and complex dynamical systems, and provides new insights into the modelling, analysis and control of systems with discontinuous transitions and complex behaviours.

From AI to Machine Learning: Examples in Lifelong Learning Machines and Biomedical Research

Dr. Andrea Soltoggio

Lecturer in Artificial Intelligence, Department of Computer Science

Loughborough University & Intelligent Automation Centre

Artificial intelligence is a synonym of new and sometimes surprising claims about thinking machines, but under the hood, solid machine learning and statistics carry out the heavy computational duties. In this talk, I will show how these two opposite views can be combined.

Lifelong learning is a human-inspired concept in which new knowledge is built upon previously acquired knowledge. I will overview the attempt of the next generation of AI to reproduce lifelong learning in machines, in particular in the area of computer vision and reinforcement learning. Such attempts also call for more explainable processes, particularly in the area of biomedical research, which I will overview with an example of detecting chemical compounds from breath samples.

Presentation Skills

Piero Vitelli
Island 41

Island 41 was founded with the purpose of using actors' techniques in everyday settings. Piero Vitelli is a transferable skills trainer, presenter and writer who provides solutions for development needs in the personal, interpersonal and team settings. In this interactive session Piero will focus on preparing and delivering effective presentations.

Post-Ph.D. Advice Talk

Dr. Janis Klaise
Data scientist at Seldon

Janis will be talking about life after finishing his Ph.D. from job searching, interviews, changing jobs and salary negotiations.

Peer-Review in Academia

Dr. Ed Hill
Post-doctoral researcher in the Mathematics Department
Warwick University

Ed will be talking about his publishing experience from authorship, choice of journals and responding to reviewers, to being a reviewer and how to structure a review.

POSTER ABSTRACTS

Moh Huda
Helen Le
Matthew MacPherson
Alexis Mercadal-Ramírez   *Single-Cell Transcriptome Analysis*

RNA sequencing is a technique that reads how many RNA molecules are present in a tissue sample at the time of the analysis. Transcribed genetic sequences are amplified and later counted, producing an array of gene counts per gene for each cell. This data will be studied to define the optimal set of algorithms in order to identify different cell types based on their expression patterns and distribution.

Richard Fox
Callum Jones
Paul Kent   *Modelling the Best Use of Sleeping Sickness*
Chatchuea Kimchaiwong   *Diagnostics under Existing and Emerging*
Peter Strong   *Tools*

The poster will communicate three points:
1. Context: What is sleeping sickness and the current state of the prevalence of the disease.
2. Focusing on some of the diagnostics we'll be using and the important characteristics of a diagnostic test in general for this disease.
3. Algorithms we plan to use for diagnosis and simulations/results if we get that far into the project.

Trent Barnard
Leander Cascorbi
Charlie Pilgrim   *ResearchFish - Exploratory Data Anlaysis,*
Huaying Qiu   *Visualisations and High Dimensional*
Stas Zhydkov   *Correlations*

ResearchFish has provided data relating to over 300,000 research funding awards. Following an exploratory data analysis, we present visualisations of this high dimensional data set, and investigate correlations between features of awards and research outcomes.

Jack Cowlard
Kendal Foster
George Watkins
Yuanyi Zhu   *Space Weather*

Using the data from a network of magnetometers around the world, we investigate major solar events and try to determine whether they can be predicted.

PH.D. STUDENT ABSTRACTS (in alphabetical order)

Sami Al-Izzi
10 minutes

Elasticity and geometry
I will talk about some cool theory and experiments on elastic media! (Maybe with some demos if I have time).

Benjamin Atkins
10 minutes

An introduction to Bayesian inference with STAN
STAN is a state-of-the-art platform for statistical modeling and high-performance statistical computation. I will provide a basic overview on the STAN programming language and how to use it to implement Bayesian inference (e.g. MCMC), including methods of interfacing with Python and R.

Kutlwano Bashe
3 minutes

Modelling Ecologies of Investors and the Impact on Financial System Stability
I will talk about financial networks and financial system stability.

Steve Bennett
3 minutes

Enhanced 4 Stage Transport Modelling
4 Stage Transport models have become the the key tool for many transport modellers world wide. Enhancements in Technology over the last 20 years have been a major breakthrough for the types of model that are built and the complexity that is built into them. Many Items that are included now, previously would not have been considered due to the high compute demands. Going forward over the next 5 years what developments in Machine learning can enhance the transport modelling field.

Ayman Boustati
10 minutes

Amortized Variance Reduction for Doubly Stochastic Objectives
Variational inference is widely used as a tractable method for performing inference in Bayesian machine learning models. The black-box version of this method turns the problem of inference into a stochastic optimisation problem, where the objective function has two sources of stochasticity: mini-batch stochasticity due to data subsampling and sampling stochasticity from computing Monte Carlo expectations. If the variance of the objective function is high, the optimisation problem becomes difficult with a slow rate of convergence. In this talk, I will present a novel method for reducing this variance based on the method of control variates, where I use a recognition network to approximates an optimal coefficient that controls the variance of the objective function gradient.

Alvaro Cabrejas
10 minutes

My experience in the Turing as an Enrichment Student
A little introduction on how was my application, summer internship and first 6 months of the Enrichment Programme. An overview of who could find interesting to apply, requirements, and the different ways it can benefit your

research via talks, activities and collaborations. Not recommended for people with less than 12 months of funding left. (If this sounds too low effort I will go on and ramble about Recent Advances in Value-Based Reinforcement Learning Methods until everyone is sufficiently confused).

Susanna Cant
3 minutes

Evolution and Epidemiology
Pathogens can be a selective force on a population. I will talk about genetic diversity and the impact of infectious diseases on population genetics.

Christopher Davis
3 minutes

Village-scale persistence and elimination of human African trypanosomiasis
Gambiense human African trypanosomiasis (HAT) is one of several neglected tropical diseases targeted for elimination as a public-health problem by the World Health Organization by 2020. Regional elimination, and ultimately global eradication, rests on understanding the dynamics and persistence of this infection at the local population scale. We develop a stochastic model of HAT dynamics, which is underpinned by screening and reporting data from one of the highest HAT incidence regions, Kwilu Province, in the Democratic Republic of Congo.

Emma Davis
10 minutes

Branching processes: predicting extinction
What is it? How do you calculate it? What can it be used for? Come along and find out :).

Samuel Forbes
3 minutes

Agent Based Models of the Wealth Distribution
My talk will discuss the distribution of wealth in society, the importance of studying it and how agent based models could hold key insights to the distribution.

Robert Gowers
10 minutes

The Colour and Sound of Noise
For continuous-time systems there is more to stochasticity than additive Gaussian white noise. Using mathematics, plots, and audio, I will demonstrate the relations between Gaussian white noise, coloured noise, shot noise and dichotomous Markov processes. See and hear the different types of noise!

Simon Graham
3 minutes

To be confirmed
To be confirmed.

Laura Guzmán
3 minutes

Campylobacteriosis Outbreak detection using time and genetic information
The burden of Campylobacteriosis is traditionally studied based on the epidemiological data collected at hospitals. The inclusion of the whole genome sequences into the routine clinical data collection has provided this

project with an outstanding source of information. A Bayesian hierarchical model with a Gaussian process prior has been developed to detect outbreaks on a routine basis.

Andrew Hilditch
3 minutes

Agent-Based Modelling of Railways
An exploration of my work in modelling railway traffic.

Roger Hill
3 minutes

Chronotherapy in three minutes
This will be a quick summary of what chronotherapy is and how my research relates to it.

Alexander Holmes
10 minutes

Assessing the 2030 WHO targets for Yaws
We look at why the 2020 WHO targets for Yaws are unlikely to be met, and the role mathematical modelling has to play in helping ensure we meet the new 2030 goals for Yaws as set out by the WHO.

Cameron Lack
3 minutes

Modelling the within host dynamics of Mycobacterium tuberculosis infections
Tuberculosis (TB) is a globally endemic disease with up to a quarter of the population worldwide carrying the latent form of the disease. The interactions between alveloar macrophages and the causitive agent of TB (Mycobacterium tuberculosis, Mtb) are highly complex and are difficult to study. We have developed the first exhaustive model of the early interactions with parameters all fitted to data from one experiment. With this model we investigate the effects of various parameters and access which areas of the model should be targeted.

Son Le
3 minutes

Covariance Matrix Adaptation Evolution Strategy
What do algorithms have to do with evolution? Do they even mate, reproduce or even mutate? In this talk, I will give a brief introduction into one of the most used evolutionary algorithms called CMA-ES.

Trystan Leng
3 minutes

Modelling epidemics on networks: challenges at every scale
Epidemics can be conceptualised as network processes, where links between nodes represent infectious contacts. Such an approach is particularly relevant when considering STIs, where infectious contacts are often sparse but relatively longstanding. However, challenges remain. In my Ph.D. and in this talk I explore some of the challenges such an approach faces - from applying moment-closure approximations to diseases with SIS-dynamics, to reconstructing realistic temporal networks from egocentric data.

Michael Luya
3 minutes

Neural Network Infrasturctures within Computational Chemistry
I will be reviewing how neural networks have been used in computational chemistry to predict for various physical and chemical properties of materials.

Benjamin Miller
10 minutes

Who should be prioritised in screening campaigns for Human African Trypanosomiasis (HAT)?
We know that there exists a subset of the population who is at greater risk of HAT infection, as they come into contact with tsetse flies at a greater rate than others. Furthermore, it is this "high-risk" group of people who routinely fail to turn up to be screened for the disease [1]. Following on from our age-structured extension to the original "Warwick model" for HAT [1], we have now adapted the model to include the screening process itself, letting us input who turns up to screening campaigns and at what rate. We have begun to investigate what happens to the disease dynamics when different subsets of the population are screened at a higher rate than others. Most importantly, we wish to determine the impact of those in the "high-risk" group beginning to participate in screening, and whether this will lead us any closer to elimination of the disease. [1] Rock, KS, Torr, SJ, Lumbala, C, & Keeling, MJ (2015). Quantitative evaluation of the strategy to eliminate human African trypanosomiasis in the Democratic Republic of Congo. Parasites & vectors, 8(1), 532.

Chris Norman
10 minutes

A Mechanistic Model for Synaptic Vesicle Release
The timely release of chemical neurotransmitters stored in synaptic vesicles is central to all information processing in the brain. While the key structures responsible have been identified, the molecular mechanisms which efficiently couple neuronal signal to vesicle release remain the subject of debate. We use stochastic simulation to test a novel model of this system motivated by recent biochemical insights.

Joe Pollard
3 minutes

Topology and Geometry in Liquid Crystals
I'll talk a little about how topology and geometry connect to material properties in liquid crystals.

Tim Pollington
10 minutes

Automating real-time epidemic forecasting with Shiny in R
Infectious disease modellers formulate valuable models to inform decision makers during epidemics. However committing to providing real-time forecasting is quite a time burden for the modeller in this context. I'll show a rudimentary web app hosted on a Shiny server that automates forecast scheduling and publishes to a public microsite.

Charlotte Roman
3 minutes

Collective intelligence and Braess' paradox
Looking at how sharing information in traffic systems can negatively affect congestion.

Aditi Shenvi
3 minutes

Modelling Recurrent Events
In my three minute thesis talk, I will discuss the motivation for my work on using graphical models for modelling recurrent events based on observational data.

Emma Southall
3 minutes

How close are we to disease elimination?
Every elimination program shares one fundamental challenge: how do we know when we can stop? If campaigns are stopped prematurely it can result in disease resurgence and subsequently put control efforts back by decades. This talk presents the use of statistical indicators to inform disease elimination.

Annika Stechemesser
10 minutes

Straight to the network - generating meaningful graph representations from high-dimensional data
For some data sets many common dimensionality reduction approaches come with a high loss of information as underlying mathematical assumptions are not fulfilled. As an alternative, we will explore in this talk how it is computationally feasible to compute to pairwise similarities on a large high-dimensional data set and translate these into a meaningful network. We will consider different distance measures and their effect on the outcome as well as optimise statistical parameters to reduce noise. Finally, the networks will be put to test by applying clustering methods in order to identify cell types in Single Cell Data.

Danielle Varjosalmi
10 minutes

A Selection of Nature-inspired Global Optimisation Algorithms
An introduction to techniques designed to find the global optima of black-box functions for which analytical methods cannot be used. The focus will be on a few algorithms that are based on concepts from physics and biology.

Connor White
3 minutes

The Evolution of the Major Histocompatibility Complex
General overview of what the Major Histocompatibility Complex (MHC) is and what questions were trying to answer about the MHC in my Ph.D.

WARP CHOICES

Pure Ways to Destroy Your Opponents at Playground Games
Organiser   Paul Kent
Students   Kendal Foster, Tim Pollington, George Watkins

Cakes, Foams and Bulletproof Custards
Organiser   Sami Al-Izzi
Students   Emma Davis, Chatchuea Kimchaiwong, Yuanyi Zhu, Connah Johnson

Lizard Warp
Organiser   Cameron Lack
Students   Son Le, Alexander Holmes, Connor White, Moh Huda, Trent Barnard, Alvaro Cabrejas Egea, Christopher Davis

Rearrangement Puzzles
Organiser   Robert Gowers
Students   Benjamin Miller, Matthew MacPherson, Helen Le, Joe Pollard

Wellbeing, Art, Recreation and Positivity in your Studies (WARPS)
Organisers   Emma Southall, Annika Stechemesser
Students   Charlotte Roman, Michael Luya, Stas Zhydkov, Kutlwano Bashe, Aditi Shenvi, Huaying Qiu, Benjamin Atkins, Susie Cant, Ayman Boustati, Roger Hill

Generative Art With Processing
Organiser   Charlie Pilgrim
Students   Simon Graham, Danielle Varjosalmi, Chris Norman, Steve Bennett, Alexis Mercadal Ramírez, Trystan Leng, Leander Cascorbi

Some Questions About Armed Conflicts: a 60-years-old Conflict Analysis
Organiser   Laura Guzmán Rincón
Students   Andrew Hilditch, Peter Strong, Samuel Forbes, Richard Fox, Callum Jones Jack Cowlard

ROOM ALLOCATIONS (STUDENTS)

1ST FLOOR - ZONE 2

Room 202
Aditi Shenvi
Emma Davis
Huaying Qiu

Room 205
Callum Jones
Chatchuea Kimchaiwong
Matthew MacPherson

Room 204
Álvaro Cabrejas
Roger Hill
Simon Graham
Tim Pollington

Room 209
Kutlwano Bashe
Michael Luya
Benjamin Miller
Joe Pollard
Son Le

2ND FLOOR - ZONE 1

Room 101
Andrew Hilditch
Charlie Pilgrim
George Watkins
Jack Cowlard
Kendal Foster
Moh Huda
Steve Bennett

Room 102
Ayman Boustati
Cameron Lack
Robert Gowers
Sami Al-Izzi

Room 103
Annika Stechemesser
Charlotte Roman
Danielle Varjosalmi
Helen Le

Room 104
Emma Southall
Laura Guzmán
Susie Cant

Room 105
Alexander Holmes
Connah Johnson
Paul Kent
Richard Fox
Samuel Forbes
Yuanyi Zhu

Room 106
Alexis Mercadal
Benjamin Atkins
Chris Norman
Christopher Davis
Connor White
Leander Cascorbi
Peter Strong
Stas Zhydkov
Trent Barnard
Trystan Leng