



# UKCI 2018

**The 18th Annual UK Workshop on Computational Intelligence**

**September 5-7, 2018  
Nottingham Trent University, Nottingham,  
UK**

Organised and Sponsored by:

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# INTRODUCTION

Welcome to the 18th Annual UK Workshop on Computational Intelligence, September 5-7, 2018 in Nottingham, United Kingdom. UKCI has been the premier UK event for presenting leading research on all aspects on Computational Intelligence since 2001. The overall objective of UKCI is to provide a forum for the academic community and industry to share and exchange recent ideas about the theoretical and practical aspects of Computational Intelligence techniques.

Computational Intelligence is a rapidly expanding research field, attracting a large number of scientists, engineers and practitioners working in areas such as fuzzy systems, neural networks, evolutionary computation, evolving systems and machine learning. A growing number of companies are employing Computational Intelligence techniques to improve previous solutions and to deal with new problems. These include evolving systems that allow high performance in spite of changes which are either external or internal to the system, thereby increasing the re-usability of developed systems. This also includes smart, intelligent and autonomous systems, self-learning, self-adapting, self-calibrating and self-tuning.

UKCI 2018 has attracted 41 submissions, on areas such as fuzzy systems, neural networks, evolutionary computation, clustering and classification, machine learning, data mining, cognition and robotics, and deep learning. Each paper was reviewed by at least three members of the programme committee and additional reviewers. Based on their recommendations, 32 papers have been accepted for presentation during the workshop.

UKCI-2018 will take place at Nottingham Trent University, located conveniently within the City Campus of the University, a few minutes walk from the city centre and all tourist attractions. The UKCI2018 programme features keynote talks by three established researchers in the field of Computational Intelligence – Prof. Plamen Angelov, Prof. Jon Garibaldi and Prof. Qiang Shen.

**Ahmad Lotfi**  
General Chair, UKCI2018

# ORGANISATION

## Organising Committee

General Chair, Prof. Ahmad Lotfi

General Co-Chair, Prof. Martin McGinnity

Programme Chairs, Prof. Hamid Bouchachia and Dr. Alexander Gegov

Publication Chair, Dr. Caroline Langensiepen

Local Organisation Chair, Dr. Amir Pourabdollah

## Programme Committee

Giovanni Acampora	University of Naples Federico II, Italy
Peter Andras	Keele University, UK
Plamen Angelov	Lancaster University, UK
Atta Badi	University of Reading, UK
Abdelhamid Bouchachia	Bournemouth University, UK
Fei Chao	Xiamen University, China
Tianhua Chen	University of Huddersfield, UK
George Coghill	University of Aberdeen, UK
Sonya Coleman	University of Ulster, UK
Simon Coupland	De Montfort University, UK
Keeley Crockett	Manchester Metropolitan University, UK
Jon Garibaldi	University of Nottingham, UK
Alexander Gegov	University of Portsmouth, UK
Hani Hagrass	University of Essex, UK
Hongmei He	Cranfield University, UK
Chris Hide	Loughborough University, UK
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Robert John	University of Nottingham, UK
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Shahin Rostami	Bournemouth University, UK
Steven Schockaert	Cardiff University, UK
Qiang Shen	Aberystwyth University, UK
Longzhi Yang	Northumbria University, UK
Shengxiang Yang	De Montfort University, UK
Shufan Yang	University of Glasgow, UK
Yingjie Yang	De Montfort University, UK

## Additional Reviewers

Georgina Cosma	Nottingham Trent University, UK
Omprakash Kaiwartya	Nottingham Trent University, UK
Pedro Machado	Nottingham Trent University, UK
Mufti Mahmud	Nottingham Trent University, UK
Aboozar Taherkhani	Nottingham Trent University, UK

# KEYNOTE TALKS

## Prof. Plamen Angelov

### Title: Empirical Fuzzy Sets and Systems

Abstract: We witness an exponential growth in the scale and complexity of the data sets and streams being generated by sensors, people, society, industry, etc. This is being increasingly seen as an untapped resource which offers new opportunities for extracting aggregated information to inform decision-making in policy and commerce. The traditional Fuzzy Sets Theory and the Fuzzy Systems have been defined over 50 years ago in the seminal paper by Professor Lotfi Zadeh [1] and now matured. In 1990s in addition to the traditional subjective way of designing fuzzy sets the so-called *data driven* design method started to be popular and was developed. The subjective approach has its own very strong rationale in the two way process of: i) extracting expert knowledge and representing it in a mathematical form through the membership functions, and ii) the ability to represent and extract from data human intelligible and understandable, transparent linguistic information in the form of IF ...THEN rules. In addition, since mid-1970s (Mamdani or Zadeh-Mamdani) and since mid-1980s (Takagi-Sugeno) fuzzy rule-based (FRB) systems started to be developed and are now widely applied. Although, there are other types of fuzzy systems (relational, etc.) one particular type of FRB systems which was introduced recently by Angelov and Yager [2] called AnYa deserves a special attention. Both Mamdani and Takagi-Sugeno type of FRB share the exact same antecedent part (the IF) and only (although significantly) differ by the consequent (THEN) part. AnYa type FRB, however, has a quite different antecedent (IF) part. The main issue in the design of the fuzzy sets and systems is the very fundamental one – the membership function by which they are defined in first place. It is practically very difficult and controversial to define membership functions both from experts and from data. This is also related to the more general issue of assumptions made and handcrafting which machine learning (including statistical methods) are facing and is now hotly researched.

In this talk a new approach [3] will be discussed which leads to a new kind of fuzzy sets and systems – empirical fuzzy sets and FRB systems ( $\epsilon$ FS and  $\epsilon$ FRB). It is grounded at the recently introduced more general concept and a computational framework of Empirical Data Analytics (EDA) [4]. In this talk, EDA will be introduced and then on its basis the  $\epsilon$ FS and  $\epsilon$ FRB will be defined. It will be presented how  $\epsilon$ FS and  $\epsilon$ FRB allow preserving the subjective specifics that fuzzy sets and systems are strong with. At the same time, it will be shown how  $\epsilon$ FS and  $\epsilon$ FRB can benefit from the vast amount of data that may be available. For example,  $\epsilon$ FS and  $\epsilon$ FRB will still allow extracting expert knowledge by questionnaires or other forms, but will make this much more easy for the expert and not ambiguous (the experts will not be asked to define membership values or parameters, but only (optionally) the labels/names of the linguistic terms, classes (if any)). For example, if we chose a car, we can simply say which one we like (or possibly how much), but we do not need to specify why or define per feature (price, max speed, etc.). Moreover, with these new type of  $\epsilon$ FS and  $\epsilon$ FRB one can tackle heterogeneous data and combine categorical (e.g. gender, occupation, number of doors) with continuous variables like price, max speed, size, etc.

In the talk, it will be demonstrated how on the basis of  $\epsilon$ FS and  $\epsilon$ FRB one can build empirically fuzzy classifiers ( $\epsilon$ F Classifiers), predictors ( $\epsilon$ F Predictors), controllers ( $\epsilon$ F Controllers), recommender systems, etc. Moreover, these can be evolving, not just fixed structure. This will allow studying the dynamic changes in human preferences as well as to build more efficient recommender systems where the only necessary input from the users is the preference (“likes” or “retweets” or “clicks”).

### References:

[1] L. A. Zadeh, *Fuzzy Sets, Information and Control*, 8(3): 338-353, 1965.

[2] P. Angelov and R. Yager, A new type of simplified fuzzy rule-based system, *International Journal on General Systems*, 41(2):163–185, 2011.

[3] P. Angelov, X. Gu, Empirical Fuzzy Sets, *International Journal of Intelligent Systems*, DOI: 10.1002/int.21935, 2017

[4] P. Angelov, X. Gu, J. Principe, D. Kangin, Empirical Data Analysis: A New Tool for Data Analytics, *Proc. IEEE Systems, Man and Cybernetics Conference*, p.52-59, October 2016; an extended paper to appear in *International Journal on Intelligent Systems*.

Profile: Prof. Angelov (MEng 1989, PhD 1993, DSc 2015) is a Fellow of the IEEE, of the IET and of the HEA. He is Vice President of the International Neural Networks Society (INNS) and IEEE Distinguished Lecturer (2017-2019). He has 25+ years of professional experience in high level research and holds a Personal Chair in Intelligent Systems at Lancaster University, UK. He formed and led two research groups (Intelligent Systems, 2010-2013 and Data Science, 2014-2017) at the School of Computing and Communications with over 20 academics, researchers and PhD students each and now is the Director of LIRA (Lancaster Intelligent, Robotic and Autonomous systems) Research Centre with over 30 academics. He has authored or co-authored over 300 peer-reviewed publications in leading journals, peer-reviewed conference proceedings, 6 patents, two research monographs (by Wiley, 2012 and Springer, 2002) cited over 7000 times with an h-index of 39 and i10-index of 115. His single most cited paper has 840 citations. He has an active research portfolio in the area of computational intelligence and machine learning and internationally recognised results into online and evolving learning and algorithms for knowledge extraction in the form of human-intelligible fuzzy rule-based systems. Prof. Angelov leads numerous projects (including several multimillion ones) funded by UK research councils, EU, industry, UK MoD. His research was recognised by 'The Engineer Innovation and Technology 2008 Special Award' and 'For outstanding Services' (2013) by IEEE and INNS. He is also the founding co-Editor-in-Chief of Springer's journal on *Evolving Systems* and Associate Editor of several leading international scientific journals, including *IEEE Transactions on Cybernetics*. He gave over 20 key note talks at high profile conferences. Prof. Angelov was General co-Chair of a number of high profile conferences and a series of annual *IEEE Symposia on Evolving and Adaptive Intelligent Systems* and more recently on *Deep Learning*. Dr Angelov is the founding Chair of the Technical Committee on Evolving Intelligent Systems, SMC Society of the IEEE and was previously chairing the Standards Committee of the Computational Intelligent Society of the IEEE (2010-2012). He was also a member of International Program Committee of over 100 international conferences (primarily IEEE).

## **Prof. Jon Garibaldi**

### **Title: Type-2 Fuzzy Systems for Human Decision Making**

Abstract: Type-2 fuzzy sets and systems, including both interval and general type-2 sets, are now firmly established as tools for the fuzzy researcher that may be deployed on a wide range of applications and in a wide set of contexts. However, in many situations the output of type-2 systems are type-reduced and then defuzzified to an interval centroid, which are then often even simply averaged to obtain a single crisp output. Many successful applications of type-2 have been in control contexts, often focussing on reducing the RMSE. This is not taking full advantage of the extra modelling capabilities inherent in type-2 fuzzy sets. In this talk, I will present some of the current research being carried out within the LUCID group at Nottingham, and wider, into type-2 for modelling human reasoning. I will cover approaches and methodologies which make more use of type-2 capabilities, illustrating these with reference to practical applications such as classification of breast cancer tumours, modelling expert variability in cyber-security contexts, and other decision support problems.

Profile: Professor Jon Garibaldi received the BSc degree in Physics from University of Bristol, UK, in 1984, and MSc degree and PhD degree from the University of Plymouth, UK, in 1990 and 1997, respectively. Prof. Garibaldi is currently Head of School of Computer Science, University of Nottingham, Head of the Intelligent Modelling and Analysis (IMA) Research Group, Member of the Lab for Uncertainty in Data and Decision Making (LUCID) and joint Director of the Advanced Data Analysis Centre (ADAC). His main research interests include modelling uncertainty and variation in human reasoning, and in modelling and interpreting complex data to enable better decision making, particularly in medical domains. Prof. Garibaldi is the current Editor-in-Chief of *IEEE Transactions on Fuzzy Systems*. He has served regularly in the organising committees and programme committees of a range of leading international conferences and workshops, such as FUZZ-IEEE, WCCI, EURO and PPSN.

## **Prof. Qiang Shen**

### **Title: Imprecise Data-Driven Feature Selection for Systems Modelling**

Abstract: Feature selection (FS) addresses the problem of selecting those system descriptors that are most predictive of a given outcome. Unlike other dimensionality reduction methods, with FS the original meaning of the features is preserved. This has found application in tasks that involve datasets containing very large numbers of features that might otherwise be impractical to model and process (e.g., large-scale image analysis, text processing and Web content classification), where feature semantics play an important role.

This talk will focus on the development and application of approximate FS mechanisms based on rough and fuzzy-rough theories. Such techniques provide a means by which imprecisely described data can be effectively reduced without the need for user-supplied information. In particular, fuzzy-rough feature selection (FRFS) works with discrete and real-valued noisy data (or a mixture of both). As such, it is suitable for regression as well as for classification. The only additional information required is the fuzzy partition for each feature, which can be automatically derived from the data. FRFS has been shown to be a powerful technique for semantics-preserving data dimensionality reduction. In introducing the general background of FS, this talk will first cover the rough-set-based approach, before focusing on FRFS and its application to real-world problems. The talk will conclude with an outline of opportunities for further development.

# PROGRAMME (UPDATED)

	<b>Wednesday 5 Sept 2018</b>	<b>Thursday 6 Sept 2018</b>	<b>Friday 7 Sept. 2018</b>
Time/Room	NEWTON – LT9	NEWTON - LT9	NEWTOWN - LT9
8:30 - 9:15	Registration	Registration	Registration
9:15 - 9:30	Welcome and Opening Professor Mark J. Biggs, Pro Vice-Chancellor and Head of College of Science & Technology  Ahmad Lotfi, Conference Chair		
9:30-10:30	Keynote Talk A Prof. Plamen Angelov	Keynote Talk C Prof. Qiang Shen	Session 6: Learning and Adaptation - Papers 30, 26, 37
10:30-11:00	Coffee Break	Coffee Break	Coffee Break
11:00-12:45	Session 1: Clustering and Regression - Papers 11, 13, 15, 22, 28	Session 3: Modelling and Representation - Papers 2, 14, 17, 27, 40	Session 7: Clustering and Regression - Papers 33, 39, 31, 20, 8  <i>Closing and Prize Giving.</i>
12:45-14:00	Lunch	Lunch	Lunch
14:00-15:15	Keynote Talk B Prof. Jon Garibaldi	Session 4: Search and Optimisation - Papers 3, 12, 19, 32	
15:15-15:45	Coffee Break	Coffee Break	
15:45 - 17:45	Session 2: Learning and Adaptation - Papers 5, 6, , 23, 16, 24	Session 5: Analysis and Detection - Papers 25, 35, 7, 38, 41	
17:45-18:00		<i>Business Meeting</i>	
18:00-19:00	<i>Robin Hood Town Tour.</i>		
19:00-21:00		<i>Conference Dinner</i>	

# SESSIONS

**Wednesday 5 Sept 2018**

**Keynote Talk A – Prof. Plamen Angelov**

**9:30 -10:30**

**Empirical Fuzzy Sets and Systems**

**SESSION 1: CLUSTERING AND REGRESSION**

**11:00 – 12:45**

**CHAIR: DR. AMIR POURABDOLLAH**

- **Xiaomei Wang**, Chang Su and Yijiang Chen: A Method of Abstractness Ratings for Chinese Concepts [#11]
- **Tianhua Chen**, Changjing Shang, Pan Su, Grigoris Antoniou and Qiang Shen: Effective Diagnosis of Diabetes with a Decision Tree-initialised Neuro-fuzzy Approach [#13]
- **Marcia Amstelvina Saul** and Shahin Rostami: A Comparison of Re-sampling Techniques for Pattern Classification in Imbalanced Data-Sets [#15]
- **Najat Ali**, Daniel Neagu and Paul Trundle: Classification Of Heterogeneous Data Based On Data Type Impact On Similarity [#22]
- **Gadelhag Mohamed**, Ahmad Lotfi, Caroline Langensiepen and Amir Pourabdollah: Clustering-based Fuzzy Finite State Machine for Human Activity Recognition [#28]

LUNCH

**Keynote Talk B - Prof. Jon Garibaldi**

**14:00 - 15:15**

**Type-2 Fuzzy Systems for Human Decision Making**

**SESSION 2: LEARNING AND ADAPTATION**

**15:45 – 17:45**

**CHAIR: DR. TIANHUA CHEN**

- **Omololu Makinde**, Daniel Neagu and Marian Gheorghe: Agent Based Micro-Simulation of a Passenger Rail System Using Customer Survey Data [#5]
- **Will Serrano**: Fintech Bitcoin Smart Investment based on The Random Neural Network with a Genetic Algorithm [#6]
- **Jing Yang**, Changjing Shang, Ying Li, Fangyi Li and Qiang Shen: Generating ANFISs through Rule Interpolation: An Initial Investigation [#23]
- **Dario Ortega Anderez**, Ahmad Lotfi and Caroline Langensiepen: A Novel Crossings-based Segmentation Approach for Gesture Recognition [#16]



- Gino Brunner, Yuyi Wang, Roger Wattenhofer and **Michael Weigelt**: Disentangling the Latent Space of (Variational) Autoencoders for NLP [#24]

## Thursday 6 Sept 2018

### Keynote Talk C - Prof. Qiang Shen

09:30 - 10:30

### Imprecise Data-Driven Feature Selection for Systems Modelling

#### SESSION 3: MODELLING AND REPRESENTATION

11:00 - 12:45

CHAIR: DR LONGZHI YANG

- Sina Razvarz, **Raheleh Jafari** and Alexander Gegov: Solving Partial Differential Equations with Bernstein Neural Networks [#2]
- **Catherine McHugh**, Sonya Coleman, Dermot Kerr and Daniel McGlynn: Daily Energy Price Forecasting Using a Polynomial NARMAX Model [#14]
- **Waqas Jamil** and Abdelhamid Bouchachia: Model Selection in Time Series Forecasting [#17]
- **David Ada Adama**, Ahmad Lotfi and Caroline Langensiepen: Key Frame Extraction and Classification of Human Activities using Motion Energy [#40]
- **Raheleh Jafari**, Sina Razvarz, Alexander Gegov and Satyam Paul: Fuzzy Modeling for Uncertain Nonlinear Systems using Fuzzy Equations and Z-numbers [#27]

LUNCH

#### SESSION 4: SEARCH AND OPTIMISATION

14:00 - 15:15

CHAIR: PROF. QIANG SHEN

- **Kevin Wilson** and Shahin Rostami: On the Integrity of Performance Comparison for Evolutionary Multi-objective Optimisation Algorithms [#3]
- Alessandro Vitale, Antonino Di Stefano, Vincenzo Cutello and **Mario Pavone**: The Influence of Age Assignments on the Performance of Immune Algorithms [#12]
- **Alexander Turner**, George Lacey, Annika Schoene and Nina Dethlefs: Evolutionary Constraint in Artificial Gene Regulatory Networks [#19]
- **Darren Michael Chitty**: Exploiting Tournament Selection for Efficient Parallel Genetic Programming [#32]

## SESSION 5: ANALYSIS AND DETECTION

15:45 – 17:30

CHAIR: DR RAHELEH JAFARI

- **Abubakr Awad**, Wei Pang and George M. Coghill: Physarum Inspired Connectivity and Restoration for Wireless Sensor and Actor Networks [#25]
- **Zainab Mutlaq Ibrahim**, Mohamed Bader-El-Den and Mihaela Cocea: Mining Unit Feedback to Explore Students' Learning Experiences [#35]
- **Naohiro Ishii**, Ippei Torii, Kazunori Iwata, Kazuya Odagiri and Toyoshiro Nakashima: Dimension Reduction Based on Geometric Reasoning for Reducts [#7]
- **Salisu Wada Yahaya**, Caroline Langensiepen and Ahmad Lotfi: Anomaly Detection in Activities of Daily Living using One-Class Support Vector Machine [#38]
- Noe Elisa, Jie Li, Zheming Zuo and **Longzhi Yang**: Dendritic Cell Algorithm with Fuzzy Inference System for Input Signal Generation [#41]

**Friday 7 Sept 2018**

## SESSION 6: LEARNING AND ADAPTATION

9:30 – 10:30

CHAIR: DR HONGMEI HE

- Jordan Bird, Aniko Ekart and **Diego Faria**: Learning from Interaction: An Intelligent Networked based Human-bot and Bot-bot Chatbot System [#30]
- **Zheqi Yu**, Shufan Yang, Keliang Zhou and Amar Aggoun: A Low Computational Approach for Assistive Esophageal Adenocarcinoma and Colorectal Cancer Detection [#26]
- Mahbub Hussain, Jordan Bird and **Diego Faria**: A Study on CNN Transfer Learning for Image Classification [#37]

## SESSION 7: CLUSTERING AND REGRESSION

11:00 – 12:45

CHAIR: PROF. NAOHIRO ISHII

- Ioannis Vourgidis, Shadreck Joseph Mafuma, Paul Wilson, **Jenny Carter** and Georgina Cosma: Medical Expert Systems – A Study of Trust and Acceptance by Healthcare Stakeholders [#31]
- **Saad Mohamad**, Damla Arifoglu, Chemseddine Mansouri and Abdelhamid Bouchachia: Deep Online Hierarchical Unsupervised Learning for Pattern Mining from Utility Usage Data [#33]
- Pranjali Shinde, **Pedro Machado**, Filipe Santos and Martin McGinnity: Online Object Trajectory Classification using FPGA-SoC Devices [#39]
- Meng Yun Chen, Yong Jian Wu, **Hongmei He**: A comprehensive Obstacle Avoidance System of Mobile Robots Using an Adaptive Threshold Clustering and the Morphin Algorithm [#20]
- Jiahan Li, Yinfeng Fang, Yongan Huang, Gongfa Li, **Zhaojie Ju** and Hon-ghai Liu: Towards Active Muscle Pattern Analysis for Dynamic Hand Motions via sEMG [#8]

# DELEGATE INFORMATION

**Access times:** the opening hours for the Newton Building, Nottingham Trent University are Mon-Thursday (7:30 am – 8:00 pm) and Friday – Saturday (7:30 am – 7:30 pm). Should you require access outside of these times then prior arrangements would need to be made via the conference organiser.

**Car Parking:** There are a number of car parks located near to Nottingham Trent University; the nearest being on Talbot Street.

**Fire Alarm:** In the event of a fire alarm, please evacuate the building via the nearest exits. The university has dedicated Fire Marshalls who will ask you to wait at an assembly point. Note, the Newton building fire system test will take place every Friday between 8 am and 9 am.

**Printing:** If you require printing, please contact the event organiser.

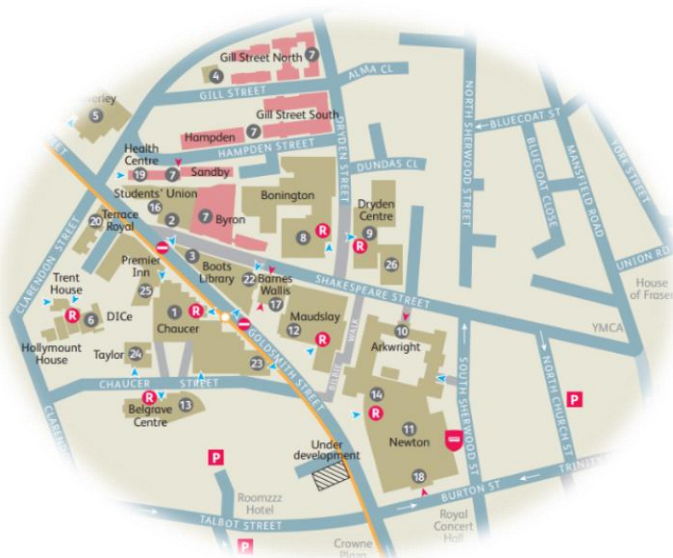
**Reception:** the contact reception during the conference, please dial 83899 from an internal telephone or telephone Nottingham Trent University main switchboard on 0115 941 8418.

**Audio visual equipment:** All AV equipment is tested prior to your arrival. If you are using AV equipment and counter a problem, please contact our AV support team or the event organiser. The login details on all university computers is **Username:** ntupresent and **Password:** present

**WiFi:** To access NTU's WiFi, please select "ntu-guest" from the list of options and follow the instructions.

**Non-smoking venue:** Nottingham Trent University is a non-smoking venue. Smoking is permitted offsite on Goldsmith Street, away from the entrance and steps.

## VENUE MAP



**UKCI 2018 will be held in Newton Building Lecture Theatre 9 (LT9).**