

# CURRICULUM VITAE - ROBERT IVOR JOHN

## EXECUTIVE SUMMARY

Professor John is currently Professor of Computational Intelligence, Director of the Centre for Computational Intelligence and Head of the Department of Informatics at De Montfort University. He is a Senior Member of IEEE and Fellow of the British Computer Society.

### Research

**Prof. John is widely recognised by the international fuzzy logic community as leading and developing the theoretical foundations of type-2 fuzzy logic.** His work has produced many fundamental new results that have opened the field to new research enabling a broadening of scope and application.

Prof. John has developed a strong strand of theoretical work including the seminal paper ‘Type-2 Fuzzy Sets Made Simple’ [21]. This paper is amongst the top 1% most cited papers on the ISI Web of Science with, currently with 257 citations in ISI as at July 2010. This work deployed the **Decomposition Theorem** [82] which is a major breakthrough in this field. Mendel and John defined the Footprint of Uncertainty [79] for the first time and this is now accepted terminology within the type-2 fuzzy logic community. Indeed, all the current work in type-2 fuzzy logic uses the their definitions for all aspects of type-2 fuzzy sets.

More recently this work on decomposition has led to the development, for the first time, of type-2 fuzzy arithmetic [74] and a geometric approach to developing type-2 fuzzy systems that massively reduces their computational complexity [70, 65, 66, 13, 10, 12]. The paper on Geometric Fuzzy Systems [13] won the best paper award for IEEE Transactions on Fuzzy Systems in 2007<sup>1</sup>. This ongoing activity is leading to the development of generalised type-2 fuzzy logic control (not limited to interval-valued fuzzy sets). On his recent EPSRC grant he developed (with colleagues) an extension to Yagers’ OWA operator [45, 49, 50] and new algorithms for designing interval type-2 fuzzy systems [54].

The mission behind Prof. John’s application-led research is that of modelling human decision making, where he has tackled a number of applications. Of particular interest is his work on the application of fuzzy logic (type-1 and type-2) and artificial neural networks to tackle difficult **bio-medical** problems. This work has been collaborative in nature (with medics, nurses and colleagues from the Centre for Computational Intelligence). The research has led to many papers, all helping the mission of ‘Computing with Words’ in the medical domain including modelling nursing intuition[68, 75, 81], analysing medical images[28, 33] and clinical diagnosis[18, 19, 20].

### Funded Research

Some current and Recent grants:

- EPSRC (Principal Investigator): Towards a Framework for Modelling Variation - EPSRC EP/C542215/1 – Grant value: £145,356
- EPSRC (PI): Uncertainty Modelling in Technologies for the Elderly - EP/F013167/1 – Grant Value £45,447
- DTI (PI): Improving customer demand and cost forecasting methods - TP/5/DAT/6/1/H025E – Grant value: £380,000
- DTI KTP (PI): Knowledge Transfer Partnership with GoMad – Grant Value £145,000

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<sup>1</sup>IEEE Transactions on Fuzzy Systems is the premier journal in fuzzy logic with an impact factor of 3.343 in ISI making it 6th in the Computer Science Artificial Intelligence category

- Lachesis (PI): Data Perspective – Grant Value: £250,000
- Royal Society (PI): Incoming Travel Grant – Grant Value: £13,000
- EPSRC (Co Investigator): IMI: Improving the Cost Model Development Process (COSTMOD) - GR/M58818/01 – Grant Value: £293,531
- EPSRC (CI): Workshop on the Future of (UK) Fuzzy Systems Research - EP/E058388/1 – Grant Value: £12,026
- HIRF (CI): Hardware Implementation of a Type-2 Fuzzy Logic System - Grant value: £16,028

Prof. John also received other funding from the EU and the Teaching Company Scheme (all pre 2004). He is an international scientific adviser to OPTIMIST-RRT (OPTIMisation: using Intelligent Simulation Tools - Robust & Real-Time extensions) which has a grant value of 10 Million Swedish Kroner.

### **International Recognition**

The full version of the curriculum vitae provides a detailed breakdown of evidence of esteem. Prof John has played a leading role in the United Kingdom fuzzy logic community.

Prof. John has made a significant impact on the international fuzzy logic community. Some highlights:

- Dr John gave a plenary talk at the World Congress on Computational Intelligence in 2006.
- He is part of a national team that was awarded the right to hold the prestigious FUZZ-IEEE conference in London in 2007. He presented the proposal and was Vice Chair of the conference. This is the most important conference in the world for fuzzy logic.
- Was Vice Chair of the Fuzzy Technical Committee (FTC) of the IEEE Computational Intelligence Society.
- Member of the Editorial Board of the International Journal of Cognitive Neurodynamics
- Edited special issues of the Information Sciences Journal, Fuzzy Sets and Systems and IEEE Transactions on Fuzzy Systems.

### **Research Management**

Prof John has managed the growth of the Centre for Computational Intelligence (CCI – [www.cci.dmu.ac.uk](http://www.cci.dmu.ac.uk)) since 2000. He has strategically developed the group in a number of ways:

- The group has more than doubled in size to eleven academic staff covering a diverse set of computational intelligence theories and application areas.
- The CCI now has 29 PhD students (both full time and part time, self funded and on EPSRC grants). Since the 2001 RAE we have had six successful completions.
- The CCI has a MSc in Intelligent Systems and Intelligent Systems and Robotics (FT, PT and DL).

# **CURRICULUM VITAE - ROBERT IVOR JOHN**

## **Personal Information**

### **Qualifications**

B.Sc. (Hons) Mathematics First Class – Leicester Polytechnic – 1979

M.Sc. Statistics – UMIST – 1981

Ph.D. in Type-2 Fuzzy Systems – De Montfort University – 2000

### **Current Employment – De Montfort University**

Senior Lecturer (1989 – 1994)

Principal Lecturer (1994 – 2003)

Head of Division of Artificial Intelligence and Computer Modelling (Sept 2002 – July 2006)

Reader in Computer Science (January 2003 – June 2005)

Professor in Computational Intelligence (June 2005 – Present)

Head of Department of Informatics (September 2008 – Present)

### **Previous Employment**

Softserv Ltd (Technical Director) (1986 – 1988)

Systems Designers (Senior Systems Engineer) (1985 – 1986)

British Gas (Senior Scientist) (1981 – 1985)

### **National and International Recognition**

#### **National Recognition**

I have been involved in a number of activities at what would be considered the national level, although most of my reserach activities have an international dimension.

- An elected member of the EPSRC College.
- Conference co-chair for the Recent Advances in Soft Computing 2002 conference.
- Conference Chair and organiser for EUSFLAT2001 organised on behalf of the European Society of Fuzzy Logic and Technology and held at De Montfort University. This conference is one of the leading European Fuzzy Logic Conferences and was attended by approximately 150 delegates. Plenary speakers included Professor Zadeh - the founder of fuzzy logic. This led to a special issue of Fuzzy Sets and Systems (one of the top fuzzy logic journals) [22].
- The Recent Advances in Soft Computing series conferences at De Montfort University in 1998, 1999 and 2000 were organised by the Centre for Computational Intelligence and I acted as Conference Chair. These averaged about 60 attendees from all over the world. Two of the conference proceedings were published by Springer-Verlag [115, 116].
- Was external member of Southampton Institute Research Degrees Committee.
- Was external examiner to the various MSc Computing programs at the University of Ulster.
- Currently external examiner to the MSc Business Intelligence Sheffield Hallam University.

- Currently external examiner to the MSc Intelligent Agents University of Westminster.
- Invited speaker at Essex University, Oxford Brookes University and Leicester University.
- Keynote Speaker at UKCI 2010

### **International Recognition**

The following highlights some of the evidence of international recognition:

- Invited to give a plenary talk at the World Congress on Computational Intelligence in 2006. This conference, organised by the IEEE combines three conferences every four years - FUZZ-IEEE, CEC and IJCNN.
- He is part of a national team (with the universities of Essex, Aberystwyth and Bristol) that was awarded the right to hold the prestigious FUZZ-IEEE conference in Imperial College, London in 2007. He presented the proposal and was Vice Chair of the conference. This is the most important conference in the world for fuzzy logic.
- Was, for 4 years, Vice Chair of the Fuzzy Technical Committee (FTC) of the IEEE Computational Intelligence Society. This is a very prestigious committee that drives the fuzzy logic aspects of the Society. I co-chair a special task force on 'Extensions to Type-1 Fuzzy Sets' which has organised a number of two special sessions at FUZZ-IEEE 2004-2007 and edited a special issue of IEEE Transaction on Fuzzy Systems.
- Member of the 'Future in Fuzzy Sets and Systems' Task Force of the IEEE Technical Committee on Granular Computing
- Active member in the Spanish National Network in Decision Making (REDEMAP II - TIN2004-21700-E: Preference Modelling and Aggregation) for the period 2005-2006
- Member of various program committees:
  - EUROFUSE 2001 Workshop on Preference Modelling and Application;
  - ISDA2001 and ISDA2002
  - International Conference on Hybrid Intelligent Systems (HIS 2003),
  - RASC (98,99,2000 and 2003),
  - FUZZ-IEEE 2004, 2005, 2006, 2007, 2008, 2009, 2010
  - UKCI 2004, 2005, 2008,
  - PPSN2006, 2008, 2010
  - FLINS08
  - 2007 IEEE Symposium Series on Computational Intelligence (SSCI 2007)
  - 2006 IEEE International Conference on Granular Computing)
  - Robots in Education 2010
  - 2011 IEEE Symposium on Computational Intelligence in Industry (CII 2011)
  - Intelligent Systems 2010
  - FLINS 2010
  - Area Chair for FUZZ-IEEE 2010

- IFSA/EUSFLAT 2010
- European Conference on Modelling and Simulation 2010
- Symposium on Mathematics of Uncertainty: Theory & Applications 2010
- Co-organising the 2011 IEEE Symposium on Advances in Type-2 Fuzzy Logic Systems
- Member of the Editorial Board of: the International Journal of Cognitive Neurodynamics, Grey Systems: Theory and Application, Turkish Journal of Fuzzy Systems
- Invited member of the BISC Special Interest Group on Fuzzy Logic and the Internet.
- Edited a special issue of the Information Sciences Journal [114].
- Edited a special issue of the Journal of Knowledge Based Intelligent Engineering [26].
- Edited a special issue of Fuzzy sets and Systems [22].
- Organised special sessions at NAFIPS 2001, FUZZ-IEEE 2002, 2004, 2005, 2006 and 2008.
- Have been a referee for a number of journals including IEEE Transactions on Fuzzy Systems, the Journal of the O.R. Society, IEEE Transactions on Signal Processing, IEEE Transactions on Neural Networks, International Journal of Electrical Engineering Education, International Journal of Systems Science, FUZZ-IEEE conference and various other conferences.
- Invited speaker at the BISC Workshop on Fuzzy Logic and the Internet held at the University of Berkeley. This workshop was by invitation only and included Professor Zadeh (the father of fuzzy logic), James Keller (Editor in Chief IEEE Transactions on Fuzzy Systems) and Professor Burhan Turksen (ex President of NAFIPS).
- Member of the editorial board of the International Journal for Computational Intelligence and Information and Systems Sciences.
- Associate Editor of the International Journal of Information & Systems Sciences
- Assistant Director of the McLeod Institute of Simulation Sciences (De Montfort University)
- Funded to give a talk on type-2 fuzzy logic to staff and students at the University of Granada in Spain - the premier fuzzy logic group in Spain.
- Funded to give a talk on type-2 fuzzy logic at the University of Pamplona, Spain.
- Led type-2 fuzzy logic workshop BCS SigAI 2007.

## **Management Duties**

As Director of the CCI I manage the research activities of eleven academic members of staff and the PhD students, the resources of the Centre and motivate and generate research.

- The group has more than doubled in size to eleven academic staff covering a diverse set of computational intelligence theories and application areas.
- I managed the move into a new building where the staff offices and the large PhD students office occupy one wing. The group also has a brand new state-of-the-art mobile robotics laboratory with a range of robots.

- The CCI now has 29 PhD students (both full time and part time, self funded and on EPSRC grants).
- I have deliberately concentrated on developing and improving the research culture of the Centre. For example we hold fortnightly seminars (internal and external speakers), social activities, joint collaboration and an internal reviewing process for papers and grant proposals.
- We hosted a recent Grand Challenge Workshop<sup>2</sup>. This meeting brought together leading academics from all over the UK to discuss the way forward for intelligent robotics.
- The CCI has a MSc in Intelligent Systems and Robotics and MSc Bioinformatics.
- The CCI is an integral part of the SRIF funded Institute of Creative Technology. I am on the steering committee.
- I mentor staff in the Centre on new grant applications (e.g. EPSRC first grant)
- I handle PhD applications to the CCI.

Member of the Faculty Research Committee and the Faculty Research Degrees Committee.

## Research

### Context

Fuzzy Logic is a mature research area but the applications have been primarily in control. The holy grail as proposed by Zadeh is ‘Computing with Words’. That is, can one get a computer to understand the meaning of words and combine these words in real systems that model human decision making in difficult problems? Type-2 fuzzy logic is a developing field that appears to offer a step change in moving toward this demanding goal.

My work is at the forefront of theoretical and application-led research in type-2 fuzzy logic. I believe my work on type-2 fuzzy logic sits alongside Professor Mendel’s at the leading edge. This position has been arrived at by following the research route outlined in the next section. The type-2 representation theorem and our decompositional approach have had a significant impact on other researchers.

### Research Narrative

Initially I worked on using fuzzy logic in community transport scheduling. This was a unique application and led to some interesting results and a number of publications [34, 120, 108, 109]. An important strand of my research is collaborative work (with Peter Innocent of the CCI) on the use of neural networks and fuzzy logic in medical applications. The work concentrated on the role of neural networks in the classification of stress fractures of the tibia [103, 33]. Bringing my expertise on fuzzy logic to the problem we combined type-1 fuzzy logic and neural networks to tackle the same problem [118] and carried out an exhaustive investigation using type-2 fuzzy sets which led to some interesting results [95, 28]. Other medical applications of type-2 fuzzy sets include the modelling of nursing intuition [85, 81, 83] and using type-2 fuzzy sets to predict pulmonary emboli [84]. Our current EPSRC grant is investigating breast cancer diagnosis [46].

A consistent thread throughout my recent work has been that of type-2 fuzzy logic. I have published a number of papers on the theoretical foundations as well as applications of type-2 fuzzy logic already described. These include journal review papers [32, 31] and adaptive type-2 fuzzy systems [93, 92]. Recently I have developed some fundamental new theoretical results in type-2 fuzzy logic [82, 21, 78, 79]. Along with Professor Mendel

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<sup>2</sup><http://www.cs.bham.ac.uk/research/cogaff/gc/events/workshop-jan-04.html>

and Professor Turksen I am one of the leading researchers into the theoretical underpinning of type-2 fuzzy logic as well as the use of type-2 fuzzy logic in medical applications. I have also been looking at type-2 OWAs [45, 49, 50]

Through working with PhD students, colleagues and grants I have published in a number of different areas. For example, the work of Mooney and I led to a new approach to user modelling using fuzzy logic to enhance information retrieval [100, 24]. An enhancement and full implementation of this work was included in the ELVIL project (a web portal for European law and politics) as the ‘virtual librarian’ [80].

I am currently supervising twelve Phd students .

I have successfully supervised the following PhD students to completion:

1. Anne Chisnall. Grounded Theory for Knowledge Acquisition (1997)
2. Gary J. Mooney. Fuzzy User Modelling and the World Wide Web (2000)
3. M.L. Nasir. Forecasting Corporate Bankruptcy using Artificial Neural Networks (2000)
4. Geraldine Clarke. Consumer Attitudes to the Higher Application Process (2000)
5. Rafee Ebrahim. Fuzzy Logic Programming (2003)
6. Dmitri Doubovitsky. Fuzzy Logic and Image Analysis (2005)
7. Laurence Tyler. Biologically Inspired Mobile Robots (2005)
8. Paul Baguley. Fuzzy Logic for Cost Modelling (2005)
9. Simon Coupland. Geometric Fuzzy Logic Systems (2006)
10. Mousa Al Akhras. Quality of Media Traffic over Lossy Internet Protocol Networks: Measurement and Improvement (2007)
11. Abdul Manaf Mohd Rasol. An Agent-Based Framework for Forest Planning (2007)
12. Hasan Al Serhan. Extraction of Arabic Word Roots: An Approach Based on Computational Model and Multi-Backpropagation Neural Network (2008)
13. Shihadeh Alrainy. A Morphological Syntactical Analysis Approach for Arabic Textual Tagging (2008)
14. Eric Goodyer. The Biomechanical Properties of the Human Vocal Fold (2009)

## **Grants & Patent**

- EPSRC (PI): Towards a Framework for Modelling Variation - EPSRC EP/C542215/1 – Grant value: £145,356
- EPSRC (PI): Uncertainty Modelling in Technologies for the Elderly - EP/F013167/1 – Grant Value £45,447
- DTI (PI): Improving customer demand and cost forecasting methods - TP/5/DAT/6/1/H025E – Grant value: £380,000
- TSB/EPSRC KTP (PI): Knowledge Transfer Partnership with GoMad – Grant Value £145,000
- Lachesis (PI): Data Perspective – Grant Value: £250,000

- Royal Society (PI): Incoming Travel Grant – Grant Value: £13,000
- EPSRC (CI): IMI: Improving the Cost Model Development Process (COSTMOD) - GR/M58818/01 – Grant Value: £293,531
- EPSRC (CI): Workshop on the Future of (UK) Fuzzy Systems Research - EP/E058388/1 – Grant Value: £12,026
- HIRF (CI): Hardware Implementation of a Type-2 Fuzzy Logic System - Grant value: £16,028
- DTI KTP (PI) KTP002611 Branall Ltd Grant £52,000
- DTI KTP (PI) KTP005270 Branall Ltd Grant £59,112

I also received other funding from the EU on part of a larger project (ELVIL). I am an international scientific adviser to OPTIMIST-RRT (OPTIMisation: using Intelligent Simulation Tools - Robust & Real-Time extensions) which has a grant value of 10 Million Swedish Kroner.

I recently submitted a UK patent application for my work on a new algorithm for fast and efficient type-2 fuzzy inferencing. This will allow for application of generalised type-2 fuzzy logic in control applications for the first time.

I have conducted various paid consultancy projects for British Gas, Guardian PLC, Donnisthorpe Ltd, NCR, Manx Telecom, Context Ltd and Barclays Bank. These projects ranged over a variety of topics in statistics, fuzzy logic, soft computing and knowledge based systems.

## **Teaching**

Throughout my career I have always considered teaching to be important. The approach I adopt is that of ‘active learning’. That is, I believe computing and statistics is best taught by active participation by the student developing their understanding and skills in an incremental manner. Students learn by being stretched mentally at an appropriate level for the course they are undertaking. As my research has flourished I have used it to inform teaching where at all possible. For example a Masters module on artificial intelligence uses my work on medical image classification as a case study.

I have taught numerous modules at both undergraduate and postgraduate level. It would not be appropriate to list them all. They can be categorised in the following way:

- Undergraduate modules on statistics for our Mathematics and Management Science Students.
- Undergraduate modules on operations research for our Mathematics and Management Science Students.
- Various undergraduate modules on artificial intelligence (fuzzy logic, neural networks and genetic algorithms).
- Modules on artificial intelligence for MSc Computing, MSc Information Technology and MSc Digital Signal Processing.

Recently I was instrumental in developing a number of undergraduate computational intelligence modules covering various aspects of computational intelligence including knowledge based systems, artificial neural networks, genetic algorithms and fuzzy logic. I have supervised many undergraduate and postgraduate projects in a variety of topics including fuzzy logic and neural networks.

I jointly led the development of BSc(Hons) Management Science and drove the development of a new advanced MSc in Computational Intelligence and Robotics for start in 2004.

## References

### International Journals

- [1] S. Miller and R John (2010) An Interval Type-2 Fuzzy Multiple Echelon Supply Chain Model. *Knowledge-Based Systems*, 23(4), pp 363–368
- [2] Anna Syberfeldt, Amos Ng, Robert John, Phillip Moore (2010) Evolutionary optimisation of noisy multi-objective problems using confidence-based dynamic resampling. *European Journal of Operational Research*, 204(3,1), pp 533-544
- [3] Shang-Ming Zhou, Robert John, Francisco Chiclana, Jon Garibaldi (2010) On Aggregating Uncertain Information by Type-2 OWA Operators for Soft Decision Making. Accepted for *International Journal of Intelligent Systems*
- [4] Mansoor Zolghadri Jahromi, Elham Parvinnia, Robert John (2009) A Method of Learning Weighted Similarity Function to Improve the Performance of Nearest Neighbour. *Information Sciences*, 179(17), pp 2964–2973.
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### **International Conferences**

- [35] Simon Miller, Mario Gongora, Robert John (2010) Optimising Resource Plans using an Interval Type-2 Fuzzy Model. *Proceedings of Fourth International Workshop on Genetic and Evolutionary Fuzzy Systems (GEFS 2010)*
- [36] Simon Miller, Mario Gongora, Robert John (2010) Inventory Optimisation with an Interval Type-2 Fuzzy Model *Proceedings of 2010 IEEE World Congress on Computational Intelligence (WCCI 2010)*
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