Welcome Message from the Chairs

Despite the unfortunate cancellation of the conference due to mounting fears of spreading the Covid-19 virus, we are delighted to welcome our colleagues from the UK, Europe and the rest of the world to this 22nd UKSim-AMSS International Conference on Mathematical Modelling and Computer Simulation, held at Emmanuel College, Cambridge, UK. It follows in the footsteps of last year's successful event, the 21st UKSim-AMSS International Conference on Modelling and Simulation, also held at Emmanuel College. The conference program committee has organized an exciting and balanced program comprising presentations from distinguished experts in the field, and important and wide-ranging contributions on state-of-the-art research that provide new insights into the latest innovations in the field of modelling and simulation. Being the UKSim's 22nd international conference, we are hopeful that its outstanding technical content contributed by leading researchers in the field from UK, Europe and worldwide will ensure its continued success.

The conference themes and topics are listed as Tracks, followed by the number of published papers in each Track:

- Neural Networks, 3
- Fuzzy Systems, 2
- Bioinformatics and Bioengineering, 2
- Computational Finance and Economics, 2
- Intelligent Systems and Applications, 2
- Control of Intelligent Systems and Control Intelligence, 1
- Robotics, Cybernetics, Engineering, Manufacturing and Control, 3
- Image, Speech and Signal Processing, 9
- Industry, Business, Management, Human Factors and Social Issues, 1
- Energy, Power, Transport, Logistics, Harbour, Shipping and Marine Simulation, 5
- Internet Modelling, Semantic Web and Ontologies, 1
- Mobile/Ad hoc wireless networks, mobicast, sensor placement, target tracking, 4
- Performance Engineering of Computer & Communication Systems, 1
- Circuits, Sensors and Devices, 1

UKSim 2020 is organized by UK Simulation Society, and technically co-sponsored by University of Stavanger, Norway, University of Canterbury in Kent, University of Aberystwyth, University of Oxford e-Research Centre, European Federation of Simulation Societies (EUROSIM), European Council for Modelling and Simulation (ECMS), Asia Modelling and Simulation Section, Cardiff Metropolitan University, University of Wales Trinity Saint David, Nottingham Trent University, University of Technology Malaysia (UTM), University of Science Malaysia (USM), University of Malaysia in Sabah, University of Technology Mara, University of Malaysia in Perlis, and University of Malaysia in Pahang. UKSim 2020 proved to be popular and received submissions far in excess of expectation from over 16 countries including: Benin, Cyprus, Georgia, Greece, India, Iraq, Italy, Japan, Nigeria, Algeria, Norway, Palestine, Qatar, Saudi Arabia, South Africa, UK. The conference program committee had a challenging task of choosing only the highest quality papers from those submitted, each paper was peer reviewed by several independent referees of the program committee and, based on the recommendation of the reviewers and the authors revised versions, 37 papers were finally accepted for publication. The papers offer stimulating insights into emerging modelling and simulation techniques and their applications in a wider variety of fields within science and technologies. We would like to express our sincere thanks to the plenary speakers, authors, session chairs, members of the program committee and additional reviewers who made this conference such an outstanding success. Finally, we hope that you will find the conference to be a valuable resource in your professional, research, and educational activities whether you are a student, academic, researcher, or a practicing professional.

The papers have been published in issue N2 of the Int. J. of Simulation: Systems, Science and Technology, IJSSST:

https://ijssst.info/Vol-21/No-2/cover-21-2.htm

The full text of each paper is available online through its title on the cover page of issue N2 of IJSSST in the above URL.

The presentation file for each paper is available from the conference website: http://uksim2020.info, through the paper title in the table of published papers.

UKSim2020 Chairs

Taha Osmnan, David Al-Dabass, Glenn Jenkins, Time Bashford

Special Theme Keynote Speaker

Using Citizen Science to Study Extreme Weather Around the Globe

Dr Sarah Sparrow

University of Oxford e-Research Centre
Department of Engineering Science.
Email: sarah.sparrow@oerc.ox.ac.uk

Abstract

Climateprediction.net (CPDN) is a citizen science project where idle time on peoples home computers is used to perform climate model simulations. This enables generation of very large ensembles of climate model data that would otherwise be too expensive to run. These large ensembles enable quantitative risk assessments to be made of the change in likelihood and potential impacts of different types of extreme weather events. This talk will give an overview of the projects we are currently involved with ranging from limiting global warming to 1.5C as set out by the Paris Agreement to the economic impact of bark beetle infestation in the Pacific North West.

Currently most CPDN simulations are performed using the weather@home model where a coarse resolution Met Office global atmospheric model drives a higher resolution regional model. Recently, two new models have been introduced into the CPDN platform. The first of these is a Met Office global atmospheric model running at a resolution similar to other state-of-the art systems (~60km in middle latitudes). This is sufficient to simulate extratropical synoptic features such as storms well and reduces the need for regional downscaling. The second new model is the European Centre for Medium Range Weather Forecasts (ECMWF) portable research version of its integrated forecast model, OpenIFS. In the OpenIFS@home project, the enormous volunteer computing resource will be utilised to study the predictability of weather forecasts and test the sensitivity of the forecasts to physical parameter choices in the model.

In planning for future climate resilience, it is necessary to understand quantitatively the likely future change in impactful extreme weather events. To study such events large ensembles, ideally of more than one model, are needed to produce robust scientific results. This in turn presents new challenges to the scientific community on how to generate, store, access and process the associated data. The citizen science approach provides a method to address the first of these areas subject to certain operational constraints, but the community must come together to address the latter challenges effectively.

Brief Biography

Dr Sparrow is the programme co-ordinator for the climateprediction.net distributive computing project at the University of Oxford e-Research Centre within the department of Engineering Science and deputy director of the Energy Systems MSc course. She holds a doctorate in atmospheric physics from the University of Oxford, following which she worked in the IT industry on business management systems and as a post-doctoral research scientist looking at drivers of atmospheric variability. Whilst working at the Environmental Change Institute as a scientist for climateprediction.net, she was involved with near real-time attribution of human influences on extreme weather events using the weather@home system, and establishing how large ensembles of climate models can be used to identify new model configurations that are capable of capturing recent climate. She has also applied model enhancements (in collaboration with the Met Office) to allow different vegetative model configurations for a project looking at forest dieback in the north western United States. Leading projects on Brahmaputra flooding, Amazon Wildfires and the impacts of climate change on cultural heritage, she is experienced in the diverse way that large ensemble experiments can be applied. Recently she has been involved in enabling two new model configurations to run under the distributive computing framework; namely a high global resolution version of the Met Office Hadley Centre model HadAM4 and the European Centre for Medium Range Weather Forecasts (ECMWF) OpenIFS model. Dr Sparrow also tutors at international workshops and summer schools on extreme event attribution and global teleconnections.

Tutorial

GPenSIM: A New Tool for Modelling and Performance Analysis of Large Industrial Discrete-Event Systems

Professor Dr Reggie Davidrajuh

Department of Electrical Engineering and Computer Science
University of Stavanger, Norway.
Email: reggie.davidrajuh@uis.no

Abstract

Modelling, simulation and performance analysis of discrete-event systems is an important activity in many branches of engineering, especially in computer science, industrial engineering, and production engineering. If the system under scrutiny is driven by discrete events (i.e. discrete-event systems), then the mathematical tools such as Petri Nets, Max-Plus algebra, Automata, and Markov chains, can be used for the development of more useful mathematical models. By running simulations of these models, we can analyse the performance of these systems, and hence propose performance improvements for these systems.

At the University of Stavanger, Norway, a tool known as General Purpose Petri Net Simulator (GPenSIM) was developed for modelling and simulation of large-scale real-life industrial discrete-event systems. Some major industrial problems in diverse fields were solved using this tool. For example, airport capacity evaluation for the aviation authority, locating and resolving bottlenecks in the fish supply chain, scheduling the drilling processes in the oil and gas industry, optimal scheduling of jobs in grid computing, etc. Some universities around the world are also using GPenSIM for their research on discrete-event systems.

In this tutorial: Firstly, an overview of the projects carried out using GPenSIM will be presented. Secondly, the design and implementation of GPenSIM will be presented. Thirdly, some of the important features of GPenSIM (e.g., the abstraction of resources, modularization, and parallel execution of modules) will be explained. These features help the modelling of large and complex discrete-event systems.

Biography

Professor Reggie Davidrajuh received a Masters Degree in Control Systems Engineering and a PhD in Industrial Engineering, both from the Norwegian University of Science and Technology (NTNU). He also received a DSc (habilitation degree) from the AGH University of Science and Technology, Poland. He is now a professor of Informatics at the department of Electrical Engineering and Computer Science, the University of Stavanger, Norway. His current research interests are discrete-event dynamic systems, modelling, simulation and performance analysis, algorithms, and graph theory. He is a senior member of IEEE and a Fellow of British Computer Society. He is also a member of the Norwegian Academy of Technological Sciences (NTVA).

DOI 10.5013/IJSSST.a.21.02.00 0.3 ISSN: 1473-804x online, 1473-8031 print

Keynote Speaker-1

Deep Learning & Brain-Inspired AI2.0

Professor Frank Wang

Head of School of Computing, University of Kent
Canterbury, UK
Chair, IEEE Computer Society, UKRI Chapter
Email: frankwang@ieee.org

Abstract

Deep learning was inspired by the 1981 Nobel Prize work by David H. Hubel & Torsten Wiesel, who found a cascading model in the human brain. We are building an intelligent machine that works similarly to the human brain. Most of previous efforts to build brain-like machines have failed because it took about the same silicon area to emulate a CMOS synapse as that needed to emulate a neuron. In theory, any realistic implementation of a synapse should ideally be at least four orders of magnitude smaller than that required to build a neuron. The invention of the memristor opens a new way to implement synapses. A memristor is a simple 2-terminal element, which means a vast number of memristors could be integrated together with other CMOS elements, in a brain-like machine.

Biography

Frank Z. Wang is Professor in Future Computing and Head of School of Computing (2010-2016), University of Kent, the UK. The School of Computing was formally opened by Her Majesty the Queen. His led school achieved an outstanding result in the 2014 UK government REF (Research Excellence Framework): the research intensity was ranked 12th out of over 150 computing departments in the UK. Professor Wang's research interests include brain-like computer, memristor theory and applications, deep learning, cloud computing, big data, and green computing, etc. He has been invited to deliver keynote speeches and invited talks to report his research worldwide, for example at Princeton University, Carnegie Mellon University, CERN, Hong Kong University of Sci. & Tech., Tsinghua University (Taiwan), Jawaharlal Nehru University, Sydney University of Technology, and University of Johannesburg. In 2004, he was appointed as Chair & Professor, Director of Centre for Grid Computing at CCHPCF (Cambridge-Cranfield High Performance Computing Facility). CCHPCF is a collaborative research facility in the Universities of Cambridge and Cranfield (with an investment size of Pound-Sterling 40 million). Prof Wang and his team have won an ACM/IEEE Super Computing finalist award. Prof Wang is Chairman (UK & Republic of Ireland Chapter) of the IEEE Computer Society and Fellow of British Computer Society.

Keynote Speaker-2

Dynamic Knowledge Interpolation and its Application to Network Security

Professor Qiang Shen

Director, Institute of Mathematics, Physics and Computer Science
Aberystwyth University, Wales, UK.
Email: qqs@aber.ac.uk

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 of FS mechanisms based on harmony search. Such techniques provide a powerful means by which multiple feature subsets can be obtained simultaneously, offering significant flexibilities for systems modelling, including applications for regression and classification. In addition to introducing the basic concepts of harmony search-based FS (HSFS), the talk will extend to covering the topics of feature selection ensembles and learning classifier ensembles inspired by HSFS. It will conclude with an outline of opportunities for further development.

Biography

Professor Qiang Shen received a PhD in Knowledge-Based Systems and a DSc in Computational Intelligence. He holds the Established Chair of Computer Science and is Pro Vice-Chancellor: Faculty of Business and Physical Sciences at Aberystwyth University. He is a Fellow of the Learned Society of Wales and a member of the Computer Science and Informatics panel for the UK Research Excellence Framework (2008-2014 and 2014-2021). He has been a long-serving Associate Editor or Editorial Board member of many leading international journals (e.g., IEEE Transactions on Cybernetics and IEEE Transactions on Fuzzy Systems), and has chaired and given keynotes at numerous international conferences.

Professor Shens current research interests include: computational intelligence, learning and reasoning under uncertainty, pattern recognition, data modelling and analysis, and their applications for intelligent decision support (e.g., space exploration, crime detection, consumer profiling, systems monitoring, and medical diagnosis). He has authored 2 research monographs and over 380 peer-reviewed papers, including an award-winning IEEE Outstanding Transactions paper. He has served as the first supervisor of 60+ PDRAs/PhDs, including one UK Distinguished Dissertation Award winner.