UNIVERSITY OF SURREY

2013 UK Workshop on Computational Intelligence

UKCI 2013

September 9-11, 2013

University of Surrey, Guildford

General Chair: Prof. Yaochu Jin

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Spencer Angus Thomas

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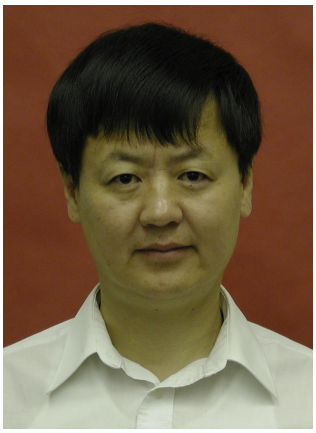
Keynote Speakers

The State of the Art of Neurodynamic Optimization: Past, Present, and Prospect

Prof. Jun Wang, Department of Mechanical & Automation Engineering,
The Chinese University of Hong Kong, Shatin, New Territories, Hong Kong
http://spring.mae.cuhk.edu.hk/∼jwang/



Abstract: Optimization problems arise in a wide variety of scientific and engineering applications. It is computationally challenging when optimization procedures have to be performed in real time to optimize the performance of dynamical systems. For such applications, classical optimization techniques may not be competent due to the problem dimensionality and stringent requirement on computational time. One attractive approach is neurodynamic optimization based on recurrent neural networks. Because of the inherent nature of parallel and distributed information processing in neural networks, the convergence rate of the solution process is not decreasing as the size of the problem increases. Neural networks can be implemented physically in designated hardware such as ASICs where optimization is carried out in a truly parallel and distributed manner. This feature is particularly desirable for dynamic optimization in decentralized decision-making situations. In this talk, we will present the historic review and the state of the art of neurodynamic optimization models and selected applications. Specifically, starting from the motivation of neurodynamic optimization, we will review various recurrent neural network models for optimization. Theoretical results about the stability and optimality of the neurodynamic optimization models will be given along with illustrative examples and simulation results. It will be shown that many computational problems in science and engineering can be readily solved by means of neurodynamic optimization. In addition, prospective future research directions will be discussed.

Biography: Jun Wang is a Professor and the Director of the Computational Intelligence Laboratory in the Department of Mechanical and Automation Engineering at the Chinese University of Hong Kong. Prior to this position, he held various academic positions at Dalian University of Technology, Case Western Reserve University, and University of North Dakota. He also held various short-term visiting positions at USAF Armstrong Laboratory (1995), RIKEN Brain Science Institute (2001), Universite Catholique de Louvain (2001), Chinese Academy of Sciences (2002), Huazhong University of Science and Technology (2006-2007), and Shanghai Jiao Tong University (2008-2011) as a Changjiang Chair Professor. Since 2011, he is a National Thousand-Talent Chair Professor at Dalian University of Technology on a part-time basis. He received a B.S. degree in electrical engineering and an M.S. degree in systems engineering from Dalian University of Technology, Dalian, China. He received his Ph.D. degree in systems engineering from Case Western Reserve University, Cleveland, Ohio, USA. His current research interests include neural networks and their applications. He published 160 journal papers, 13 book chapters, 8 edited books, and numerous conference papers in these areas. He has been an Associate Editor of the IEEE Transactions on Systems, Man, and Cybernetics - Part B since 2003 and a member of the editorial board or editorial advisory board of Neural Networks and International Journal of Neural Systems. He also served as an Associate Editor of the IEEE

Transactions on Neural Networks (1999-2009) and IEEE Transactions on Systems, Man, and Cybernetics - Part C (2002-2005), as a guest editor of special issues of European Journal of Operational Research (1996), International Journal of Neural Systems (2007), Neurocomputing (2008), and International Journal of Fuzzy Systems (2010, 2011). He was an organizer of several international conferences such as the General Chair of the 13th International Conference on Neural Information Processing (2006) and the 2008 IEEE World Congress on Computational Intelligence. He was also an IEEE Computational Intelligence Society Distinguished Lecturer (2010-2012). He is an IEEE Fellow, IAPR Fellow, and a recipient of an IEEE Transactions on Neural Networks Outstanding Paper Award and APNNA Outstanding Achievement Award in 2011.

Computational Intelligence for Engineering Designs

Prof. Bernhard Sendhoff
Honda Research Institute Europe, Germany
http://www.honda-ri.de/

Abstract: Engineering design is a complex process that involves many different disciplines and objectives. In my presentation, I will outline how we have used methods from computational intelligence at the Honda Research Institute Europe to augment the conventional engineering design process with a focus on surface design. Apart from increasing the quality of the design, it is also the aim to explore regions in the design space that can give the engineer new insights. In engineering design, data is generated from many sources. Using new techniques from data analytics we can extract knowledge about the design and about the process. This information can be fed back into the design framework and can be visualized interactively for the engineer. The next research challenges in computational intelligence for engineering design will be discussed at the end of my presentation.

Biography: Bernhard Sendhoff obtained a PhD in Applied Physics in May 1998, from the Ruhr-Universität Bochum, Germany. From 1999 to 2002 he worked for Honda R&D Europe GmbH, and since 2003, he has been with the Honda Research Institute Europe GmbH. Since 2007 he is Honorary Professor of the School of Computer Science of the University of Birmingham, UK. Since 2008, he is Honorary Professor at the Technical University of Darmstadt, Germany. Since 2011 he is President of the Honda Research Institute Europe GmbH. Bernhard Sendhoff is a senior member of the IEEE and a senior member of the ACM. His research focuses on methods from computational intelligence and their applications in development, production and services. He has authored and co-authored over 150 scientific papers and over 30 patents.

Physarum Chip: Towards Slime Mould Computers

Prof. Andy Adamatzky
University of West England, Bristol UK
http://uncomp.uwe.ac.uk

Abstract: Plasmodium of acellular slime mould Physarum polycephalum is a gigantic single cell visible by unaided eye. The cell shows a rich spectrum of behavioural patterns in response to environmental conditions. In a series of simple laboratory experiments we illustrate how to make computing, sensing and actuating devices from the slime mould. We show how to program living slime mould machines by configurations of repelling and attracting gradients and demonstrate workability of the living machines on tasks of computational geometry, logic, and arithmetic.

Biography: Andrew Adamatzky is Professor in the Department of Computer Science and Director of the Unconventional Computing Centre, University of the West of England, Bristol, UK. He does research in reaction-diffusion computing, cellular automata, physarum computing, massive parallel computation, applied mathematics, collective intelligence and robotics, bionics, computational psychology, non-linear science, novel hardware, and future and emergent computation.

UKCI 2013 Programme of Events

Day 1: Monday 9^{th} September 2013

08:00am - 12:00pm Registration

08:50am - 09:00am Welcome

Keynote speech
09:00am - 10:00am Chair: Yaochu Jin

The State of the Art of Neurodynamic Optimization: Past, Present, and Prospect
Prof. Jun Wang, The Chinese University of Hong Kong, Hong Kong

10:00am - 10:20am Coffee break

Session 1: Modelling of Biological Networks
10:20am - 12:00pm Chair: Trevor Martin

Evolving gene regulatory networks with mobile DNA mechanisms
Larry Bull and Andrew Adamatzky, UWE, UK

Combining biochemical network motifs within an ARN-Agent control system
Claire E. Gerrard, John McCall, and Christopher Macleod, Robert Gordon University and George Coghill, University of Aberdeen, UK

Evolving neural networks using ant colony optimization with pheromone trail limits
Michalis Mavrovouniotis and Shengxiang Yang, De Montfort University, UK

Reconstructing regulatory networks in Streptomyces using evolutionary algorithms
Spencer Angus Thomas, Yaochu Jin, Emma Laing and Colin Smith, University of Surrey

Stepwise modelling of biochemical pathways based on qualitative model learning
Zujian Wu, Wei Pang and George Coghill, University of Aberdeen, UK

12:00pm - 13:30pm Lunch break

Session 2: Fuzzy Sets and Fuzzy Rule Systems
13:30pm - 15:10pm Chair: Richard Everson

Measuring the directional distance between fuzzy sets
Josie McCulloch, Christian Wagner and Uwe Aickelin, University of Nottingham, UK

Fuzzy interpolation and extrapolation using shift ratio and overall weight measurement based on area of fuzzy sets
Weigui J. Zhou, Douglas L. Maskell and Chai Quek,
Nanyang Technological University, Singapore

Comparison of crisp systems and fuzzy systems in agent-based simulation: A case study of soccer penalties
Tuong Manh Vu, Peer-Olaf Siebers and Christian Wagner, University of Nottingham, UK

Minkowski compactness measure
Carlos Martinez-Ortiz and Richard Everson, University of Exeter, UK

The X-mu representation of fuzzy sets - Regaining the excluded middle
Trevor P. Martin, University of Bristol, UK

15:10pm - 15:30pm Coffee break

Session 3: Advances and Applications of Evolutionary Optimization
15:30pm - 17:10pm Chair: David Corne

Towards the evolution of novel vertical-axis wind turbines
Richard J. Preen and Larry Bull, UWE, UK

Simulating swarm behaviours for optimisation by learning from neighbours
Ran Cheng and Yaochu Jin, University of Surrey, UK

Multi-modal optimisation using a localised surrogates assisted evolutionary algorithm
Jonathan E. Fieldsend, University of Exeter, UK

Set-based genetic algorithms for solving many-objective optimization problems
Dunwei Gong, Gengxing Wang and Xiaoyan Sun,
China University of Mining and Technology, China

Large-scale optimization: Are co-operative co-evolution and fitness inheritance additive?
Aboubakar Hameed and David Corne, Heriot-Watt University, UK, and
David Morgan, Antony Waldock, Advanced Technology Centre, BAE Systems, UK

Day 2: Tuesday 10^{th} September 2013

Keynote speech
09:00am - 10:00am Chair: John McCall

Computational Intelligence for Engineering Design
Prof. Bernhard Sendhoff, Honda Research Institute Europe, Germany

10:00am - 10:20am Coffee break

Session 4: Inference and Learning
10:20am - 12:00pm Chair: Larry Bull

Maximal-margin case-based inference
Martin Anthony, LSE, UK and Joel Ratsaby, Ariel University of Samaria, Isreal

State Detection from Electromyographic Signals towards the Control of Prosthetic Limbs
Pamela Hardaker, Benjamin Passow and David Elizondo, De Montfort University, UK

Partial structure learning by subset Walsh transform
Lee A. Christie, David P. Lonie and John A. W. McCall, Robert Gordon University, UK

How clumpy is my image? Evaluating crowdsourced annotation tasks
Hugo Hutt, Richard Everson, Murray Grant, John Love and George Littlejohn,
University of Exeter, UK

The X-μ fuzzy association rule method
Daniel Lewis and Trevor P. Martin, University of Bristol, UK

12:00pm - 13:30pm Lunch break

Session 5: Evolution, Learning and Memetic Algorithms
13:30pm - 15:10pm Chair: Qiang Shen

Transfer learning across heterogeneous tasks using behavioural genetics
Maitrei Kohli, George D. Magoulas and Michael S. C. Thomas,
Birkbeck College, University of London, UK

Variable-based e-PAES with adaptive fertility rate
Amiram Moshaiov and Mor Elias, Tel-Aviv University, Israel

Efficient feature selection using a self-adjusting harmony search algorithm
Ling Zheng, Ren Diao and Qiang Shen, Aberystwyth University, UK

Memetic algorithms for cross-domain heuristic search
Ender Özcan, Shahriar Asta and Cevriye Altintaş, University of Nottingham, UK

A genetic programming hyper-heuristic: Turning features into heuristics for constraint satisfaction
José Carlos Ortiz-Bayliss, Ender Özcan, Andrew J. Parkes, University of Nottingham, UK
Hugo Terashima-Marín, ITESM, Mexico

15:10pm - 15:30pm Coffee break

Poster Session
15:30pm - 16:30pm Chair: Hyondong Oh

Recognizing facial expressions: Computational models and humans
Aruna Shenoy, Neil Davey and Ray Frank, University of Bedfordshire, UK

Novel hybrid bacterial foraging and spiral dynamics algorithms
Ahmad Nor Kasruddin Nasir, M. Osman Tokhi and N. M. A. Ghani, University of Sheffield, UK

Double-phase locality sensitive hashing of neighborhood development for multi-relational data
Ping Ling, Jiangsu Normal University and Xiangsheng Rong,
Air Force Logistics of P. L. A, China

Wavelet neural network approach applied to biomechanics of swimming
Weslly Puchalski, Felipe Fidelis Schauenburg, Viviana Cocco Mariani and
Leandro dos Santos Coelho, Pontifical Catholic University of Parana (PUCPR) / PPGEPS, Brazil

A fast and efficient semantic short text similarity metric
David Croft, Simon Coupland, Jethro Shell and Stephen Brown, De Montfort University, UK

Late acceptance-based selection hyper-heuristics for cross-domain heuristic search
Warren G. Jackson, Ender Özcan and John H. Drake, University of Nottingham, UK

Experimental evaluation of cluster quality measures
Oliver Kirkland and Beatriz De La Iglesia, University of East Anglia, UK

Towards machine learning based design pattern recognition
Sultan Alhusain, Simon Coupland, De Montfort University, UK, Robert John,
University of Nottingham, UK and Maria Kavanagh, Emerald Hill Limited, UK

A hybrid particle swarm optimization algorithm for parallel batch processing machines scheduling
Jun-lin Chang, Ying Chen and Xiao-ping Ma, China University of Mining and Technology, China

Towards a Method of Identifying the Causes of Poor User Experience on Websites
Robert S. K. Miles, Julie Greensmith, Holger Schnädelbach and Jonathan M. Garibaldi,
The University of Nottingham, UK

K-Nearest-Neighbours with a novel similarity measure for intrusion detection
Zhenghui Ma and Ata Kaban, University of Birmingham, UK

Face Clustering in Videos : GMM-based Hierarchical Clustering using Spatio-temporal Data
Subhradeep Kayal, Aalto University School of Science, Finland

16:30pm - 17:00pm UKCI matters

17:00pm - 19:00pm Tour to Guildford Castle

Conference Banquet and Presentation of Best Student Paper Award
19:00pm - 22:00pm Loch Fyne
Centenary Hall, Chapel St, Guildford GU1 3UH, Phone: +44 1483 230550

Day 3: Wednesday 11th September 2013

Keynote speech
09:00am - 10:00am Chair: Shengxiang Yang

Physarum Chip: Towards Slime Mould Computers
Prof. Andy Adamatzky, University of West England, UK

10:00am - 10:20am Coffee break

Session 6: Prediction and Classification
10:20am - 12:00pm Chair: Yaochu Jin

Prediction of viewed object sizes using features of visual evoked potentials and oculo-motors
Minoru Nakayama and Masashi Fujimoto, Tokyo Institute of Technology, Japan

Predicting fluctuations in foreign exchange rates
David W. Cross, Christopher J. Hinde and Martin D. Sykora, Loughborough University, UK

Interpolating DeSTIN features for image classification
Yongfeng Zhang, Changjing Shang and Qiang Shen, Aberystwyth University, UK

Towards an autonomous resilience strategy: The implementation of a self-evolving rate limiter
Azman Ali, David Hutchison, Plamen Angelov, Lancaster University and Paul Smith, Austrian Institute of Technology, Austria

Random projections versus random feature selection for classification of high dimensional data
Sachin Mylavarapu and Ata Kaban, University of Birmingham, UK

12:00pm - 13:30pm Lunch break

Session 7: Meta-heuristics for Optimisation and Real-world Applications
13:30pm - 15:10pm Chair: Jonathan Fieldsend

An evolutionary algorithm for bid-based dynamic economic load dispatch in a deregulated electricity market
Sunny Orike and David Corne, Heriot-Watt University, UK

A grouping hyper-heuristic framework based on linear linkage encoding for graph coloring
Anas Elhag and Ender Özcan, University of Nottingham, UK

Group decision making hyper-heuristics for function optimisation
Ender Özcan, University of Nottingham, Mustafa Misir, KU Leuven, Belgium
and Ahmed Kheiri, University of Nottingham, UK

A Novel Adaptive Spiral Dynamic Algorithm for Global Optimization
Ahmad Nor Kasruddin Nasir and M. Osman Tokhi, O. Sayidmarie, University of Sheffield, UK,
and R. M. T. Raja Ismail, University Malaysia Pahang, Malaysia

Re-scheduling in railway networks
Wei Fang, Jun Sun, Xiaojun Wu, Jiangnan University, China,
and Xin Yao, University of Birmingham, UK

15:10pm - 15:20pm Closing remarks

Evolving Gene Regulatory Networks with Mobile DNA Mechanisms

Larry Bull and Andrew Adamatzky

This paper uses a recently presented abstract, tuneable Boolean regulatory network model extended to consider aspects of mobile DNA, such as transposons. The significant role of mobile DNA in the evolution of natural systems is becoming increasingly clear. This paper shows how dynamically controlling network node connectivity and function via transposon-inspired mechanisms can be selected for in computational intelligence tasks to give improved performance. The designs of dynamical networks intended for implementation within the slime mould Physarum polycephalum and for the distributed control of a smart surface are considered.

Combining Biochemical Network Motifs within an ARN-Agent Control System

Claire E. Gerrard, John Mccall, George Coghill and Christopher Macleod

The Artificial Reaction Network (ARN) is an Artificial Chemistry representation inspired by cell signaling networks. The ARN has previously been applied to the simulation of the chemotaxis pathway of Escherichia coli and to the control of limbed robots. In this paper we discuss the design of an ARN control system composed of a combination of network motifs found in actual biochemical networks. Using this control system we create multiple cell-like autonomous agents capable of coordinating all aspects of their behavior, recognizing environmental patterns and communicating with other agents stigmergically. The agents are applied to simulate two phases of the life cycle of Dictyostelium discoideum: vegetative and aggregation phase including the transition. The results of the simulation show that the ARN is well suited for construction of biochemical regulatory networks. Furthermore, it is a powerful tool for modeling multi agent systems such as a population of amoebae or bacterial colony

Evolving neural networks using ant colony optimization with pheromone trail limits

Michalis Mavrovouniotis and Shengxiang Yang

The back-propagation (BP) technique is a widely used technique to train artificial neural networks (ANNs). However, BP often gets trapped in a local optimum. Hence, hybrid training was introduced, e.g., a global optimization algorithm with BP, to address this drawback. The key idea of hybrid training is to use global optimization algorithms to provide BP with good initial connection weights. In hybrid training, evolutionary algorithms are widely used, whereas ant colony optimization (ACO) algorithms are rarely used, as the global optimization algorithms. And so far, only the basic ACO algorithm has been used to evolve the connection weights of ANNs. In this paper, we hybridize one of the best performing variations of ACO with BP. The difference of the improved ACO variation from the basic ACO algorithm lies in that pheromone trail limits are imposed to avoid stagnation behaviour. The experimental results show that the proposed training method outperforms other peer training methods

Reconstructing Regulatory Networks in Streptomyces using Evolutionary Algorithms

Spencer Angus Thomas, Yaochu Jin, Emma Laing and Colin Smith

Reconstructing biological networks is vital in developing our understanding of nature. Biological systems of particular interest are bacteria that can produce antibiotics during their life cycle. Such an organism is the soil dwelling bacterium Streptomyces coelicolor. Although some of the genes involved in the production of antibiotics in the bacterium have been identified, how these genes are regulated and their specific role in antibiotic production is unknown. By understanding the network structure and gene regulation involved it may be possible to improve the production of antibiotics from this bacterium. Here we use an evolutionary algorithm to optimise parameters in the gene regulatory network of a sub-set of genes in S. coelicolor involved in antibiotic production. We present some of our preliminary results based on real gene expression data for continuous and discrete modelling techniques.

Stepwise Modelling of Biochemical Pathways Based on Qualitative Model Learning

Zujian Wu, Wei Pang and George Coghill

Modelling of biochemical pathways in a computational way has received considerable attention over the last decade from biochemistry, computing sciences, and mathematics. In this paper we present an approach to evolutionarily stepwise constructing models of biochemical pathways by a qualitative model learning methodology. Given a set of reactants involved in a target biochemical pathway, atomic components can be generated and preserved in a components library for further model composition. These synthetic components are then reused to compose models which are qualitatively evaluated by referring to experimental qualitative states of the given reactants. Simulation results show that our stepwise evolutionary qualitative model learning approach can learn the relationships among reactants in biochemical pathway, by exploring topology space of alternative models. In addition, synthetic biochemical complex can be obtained as hidden reactants in composed models. The inferred hidden reactants and topologies of the synthetic models can be further investigated by biologists in experimental environment for understanding biological principles.

Measuring the Directional Distance Between Fuzzy Sets

Josie McCulloch, Christian Wagner and Uwe Aickelin

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. In this paper, 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. We demonstrate the new distance measure using real data from the MovieLens dataset and establish the benefits of measuring the direction between fuzzy sets.

Fuzzy Interpolation and Extrapolation Using Shift Ratio and Overall Weight Measurement Based on Area of Fuzzy Sets

Weigui Jair Zhou, Douglas Leslie Maskell and Chai Quek

Conventional fuzzy reasoning methods requires compact fuzzy rule base to infer a result, but due to incomplete data or lack of expertise knowledge, compact rule bases are not always available. Fuzzy interpolation methods have been widely researched to reasonably allow the interpolation a fuzzy result using the nearest available rules. Chang et al. [24] proposed a novel interpolation method which employs the weighted average on the area of the fuzzy set. However, the interpolated observation does not fully represent the actual observation that is given. In our proposed extension to this method, a different weight computation and a shift technique are included to ensure that the normal point of the observation and the normal point of the interpolated observation are mapped together. This weight computation and shift technique has also enabled the capability of extrapolation to be performed implicitly.

Comparison of Crisp Systems and Fuzzy Systems in Agent-Based Simulation: A Case Study of Soccer Penalties

Tuong Manh Vu, Peer-Olaf Siebers and Christian Wagner

The Belief-Desire-Intention (BDI) software model is an example of a reasoning architecture for a bounded rational software agent. In our research we plan to expand the application of the BDI software model to the area of simulating human behaviour in social and socio-technical systems. To this effect, in this paper we explore the differences in using a classical crisp rule-based approach and a fuzzy rule-based approach for the reasoning within the BDI system. As a test case we have chosen a football penalty shootout. We have kept the case study example deliberately simple so that we can focus on the effects the different BDI implementations have on the decisions made. Our experiments highlight that the crisp system can result in unwanted "preferred" actions because of sudden leaps or drops between different ranges of decision variables, while the fuzzy system results have smoother transitions which results in more consistent decisions. The behaviour, as showcased in this simple context, underlines that a change from crisp to fuzzy rule based systems as the underlying reasoning model in BDI systems can provide the path to a superior approach for the simulation of human behaviour, which we will explore further in the future.

Minkowski compactness measure

Carlos Martinez-Ortiz and Richard Everson

Many compactness measures are available in the literature. In this paper we present a generalised compactness measure $C_q(S)$ which unifies previously existing definitions of compactness. The new measure is based on Minkowski distances and incorporates a parameter q which modifies the behaviour of the compactness measure. Different shapes are considered to be most compact depending on the value of q: for q=2, the most compact shape in 2D (3D) is a circle (a sphere); for q tends to infinity, the most compact shape is a square (a cube); and for q=1, the most compact shape is a square (a octahedron). For a given shape S, measure $C_q(S)$ can be understood as a function of q and as such it is possible to calculate a spectum of $C_q(S)$ for a range of q. This produces a particular compactness signature for the shape S, which provides additional shape information. The experiments section of this paper provides illustrative examples where measure $C_q(S)$ is applied to various shapes and describes how measure and its spectrum can be used for image processing applications.

The X-mu Representation of Fuzzy Sets - Regaining the Excluded Middle

Trevor P. Martin

Fuzzy sets are a good model of the flexible definitions used in human language, but are not always in accordance with human reasoning because they do not satisfy the law of the excluded middle. In this paper, we outline the X- approach, a new method of representing, visualizing and calculating functions of fuzzy quantities. Using simple examples, we illustrate that the law of the excluded middle is satisfied with the X- approach, although it is not always possible to recover standard membership functions from the results of a calculation.

Towards the Evolution of Novel Vertical-Axis Wind Turbines

Richard J. Preen and Larry Bull

Renewable and sustainable energy is one of the most important challenges currently facing mankind. Wind has made an increasing contribution to the worlds energy supply mix, but still remains a long way from reaching its full potential. In this paper, we investigate the use of artificial evolution to design vertical-axis wind turbine prototypes that are physically instantiated and evaluated under approximated wind tunnel conditions. An artificial neural network is used as a surrogate model to assist learning and found to reduce the number of fabrications required to reach a higher aerodynamic efficiency, resulting in an important cost reduction. Unlike in other approaches, such as computational fluid dynamics simulations, no mathematical formulations are used and no model assumptions are made.

Simulating Swarm Behaviuors for Optimisation by Learning from Neighbours

Ran Cheng and Yaochu Jin

Competitive particle swarm optimizer (ComPSO) is a novel swarm intelligence algorithm that does not need any memory. Different from the canonical particle swarm optimizer (PSO), neither *gbest* nor *pbest* needs to be stored in ComPSO, and the algorithm is extremely simple in implementation. ComPSO has shown to be highly scalable to the search dimension. In the original ComPSO, two particles are randomly chosen to compete. This work investigates the influence of the competition rule on the search performance of ComPSO and proposes a new competition rule operating on a sorted swarm with neighborhood control. Empirical studies have been performed on a set of widely used test functions to compare the new competition rule with the random strategy. Results show that the new competition rule can speed up the convergence with a big neighborhood size, while with a small neighborhood size, the convergence speed can be slowed down.

Multi-Modal Optimisation using a Localised Surrogates Assisted Evolutionary Algorithm

Jonathan E. Fieldsend

There has been a steady growth in interest in niching approaches within the evolutionary computation community, as an increasing number of real world problems are discovered that exhibit multi-modality of varying degrees of intensity (modes). It is often useful to locate and memorise the modes encountered this is because the optimal decision parameter combinations discovered may not be feasible when moving from a mathematical model emulating the real problem to engineering an actual solution, or the model may be in error in some regions. As such a range of disparate modal solutions is of practical use. This paper investigates the use of a collection of localised surrogate models for niche/mode discovery, and analyses the performance of a novel evolutionary algorithm (EA) which embeds these surrogates into its search process. Results obtained are compared to the published performance of state-of-the-art evolutionary algorithms developed for multi-modal problems. We find that using a collection of localised surrogates not only makes the problem tractable from a model-fitting viewpoint, it also produces competitive results with other EA approaches.

Set-based Genetic Algorithms for Solving Many-objective Optimization Problems

Dunwei Gong, Gengxing Wang and Xiaoyan Sun

Many-objective optimization problems are very common and important in real-world applications, and there exist few methods suitable for them. Therefore, many-objective optimization problems are focused on in this study, and a set-based genetic algorithm is presented to effectively solve them. First, each objective of the original optimization problem is transformed into a desirability function according to the preferred region defined by the decision-maker. Thereafter, the transformed problem is further converted to a bi-objective optimization one by taking hyper-volume and the decision-makers satisfaction as the new objectives, and a set of solutions of the original optimization problem as the new decision variable. To tackle the converted bi-objective optimization problem by using genetic algorithms, the crossover operator inside a set is designed based on the simplex method by using solutions of the original optimization problem, and the crossover operator between sets is developed by using the entropy of sets. In addition, the mutation operator of a set is presented to obey the Gaussian distribution and change along with the decision-makers preferences. The proposed method is applied to five benchmark many-objective optimization problems, and compared with other six methods. The experimental results empirically demonstrate its effectiveness.

Large-Scale Optimization: are Co-operative Co-evolution and Fitness Inheritance Additive?

Aboubakar Hameed, David Corne, David Morgan and Antony Waldock

Large-scale optimization - here referring mainly to problems with many design parameters - remains a serious challenge for optimization algorithms. When the problem at hand does not succumb to analytical treatment (an overwhelmingly commonplace situation), the engineering and adaptation of stochastic black box optimization methods tends to be a favoured approach, particularly the use of Evolutionary Algorithms (EAs). In this context, many approaches are currently under investigation for accelerating performance on large-scale problems, and we focus on two of those in this paper. The first is co-operative co-evolution (CC), where the strategy is to successively optimize only subsets of the design parameters at a time, keeping the remainder fixed, with an organized approach to managing and reconciling these subspace optimizations. The second is fitness inheritance (FI), which is essentially a very simple surrogate model strategy, in which, with some probability, the fitness of a solution is simply guessed to be a simple function of the fitnesses of that solutions parents. Both CC and FI have been found successful on nontrivial and multiple test cases, and they use fundamentally distinct strategies. In this article we explore the extent to which employing both of these strategies at once provides additional benefit. We find that our CCEA-FI algorithm is highly effective, especially when a random grouping scheme is used in the CC component.

Maximal-margin case-based inference

Martin Anthony and Joel Ratsaby

The central problem in case based reasoning (CBR) is to infer a solution for a new problem-instance by using a collection of existing problem-solution cases. The basic heuristic guiding CBR is the hypothesis that similar problems have similar solutions. CBR has been often criticized for lacking a sound theoretical basis, and there has only recently been some attempts at formalizing CBR in a theoretical framework, including work by Hullermeier who made the link between CBR and the probably approximately correct (PAC) theoretical model of learning in his 'case-based inference' (CBI) formulation. In this paper we present a new framework of CBI which models it as a multi-category classification problem. We use a recently-developed notion of geometric margin of classification to obtain generalization error bounds.

State Detection from Electromyographic Signals towards the Control of Prosthetic Limbs

Pamela Hardaker, Benjamin Passow and David Elizondo

This paper presents experiments in the use of an Electromyographic sensor to determine whether a person is standing, walking or running. The output of the sensor was captured and processed in a variety of different ways to extract those features that were seen to be changing as the movement state of the person changed. Experiments were carried out by adjusting the parameters used for the collection of the features. These extracted features where then passed to a set of Artificial Neural Networks trained to recognise each state. This methodology exhibits an accuracy needed to control a prosthetic leg.

Partial Structure Learning by Subset Walsh Transform

Lee A. Christie, David P. Lonie and John A. W. McCall

EDAs use structure learning to build a statistical model of good solutions discovered so far, in effort to discover better solutions. The non-zero Walsh coefficients of a binary function is indicative of the problem structure, however, computation of the complete Walsh transform involves exhaustive evaluation of the search space. In this paper, we propose a method of determining all Walsh coefficients involving only a selected subset of the variables at a time to detect low-order structure with confidence, and demonstrate how this method may also be used to detect indications of variables involved with higher-order structure.

How Clumpy is my Image? Evaluating Crowdsourced Annotation Tasks

Hugo Hutt, Richard Everson, Murray Grant, John Love and George Littlejohn

The use of citizen science to obtain annotations from multiple annotators has been shown to be an effective method for annotating datasets in which computational methods alone are not feasible. The way in which the annotations are obtained is an important consideration which affects the quality of the resulting consensus estimates. In this paper, we examine three separate approaches to obtaining scores for instances rather than merely classifications. To obtain a consensus score annotators were asked to make annotations in one of three paradigms: classification, scoring and ranking. A web-based citizen science experiment is described which implements the three approaches as crowdsourced annotation tasks. The tasks are evaluated in relation to the accuracy and agreement among the participants using both simulated and real-world data from the experiment. The results show a clear difference in performance between the three tasks, with the ranking task obtaining the highest accuracy and agreement among the participants. We show how a simple evolutionary optimiser may be used to improve the performance by reweighting the importance of annotators.

The X-μ Fuzzy Association Rule Method

Daniel Lewis and Trevor P. Martin

Association rule mining theory, and practice, requires the ability to calculate the cardinalities of subsets. In association rule mining on fuzzy sets, this is also the case. However, there are multiple options for calculating cardinalities due to the nature of fuzzy sets. In this paper we introduce the "X-μ Fuzzy Association Rule method" of calculation, a methodology for use within fuzzy association rule mining. This method uses the X-μ representation of fuzzy sets and its respective cardinality calculation, which retains the fuzzy nature of fuzzy set cardinality through the full process of association rule processing.

Transfer Learning Across Heterogeneous Tasks Using Behavioural Genetics

Maitrei Kohli, George D. Magoulas and Michael S. C. Thomas

We explore the use of Artificial Neural Networks (ANNs) as computational models capable of sharing, retaining and reusing knowledge when they are combined via Behavioural Genetic principles. Our aim is to design a hybrid framework for learning various tasks whose statistical characteristics change with time. In behavioural genetics, the performance and the variability in performance (in case of population studies) stems from structure (intrinsic factors or genes) and environment (training dataset). We simulate the effects of genetic influences via variations in the neuro-computational parameters of the ANNs, and the effects of environmental influences via a filter applied to the training set. Our approach uses the twin method to disentangle genetic and environmental influences on performance, capturing transfer effects via changes to the heritability measure. Our model captures the wide range of variability exhibited by population members as they are trained on five different tasks. Preliminary experiments produced encouraging results as to the utility of this method. Results provide a foundation for future work in using a computational framework to capture population-level variability, optimising performance on multiple tasks, and establishing a relationship between selective pressure on cognitive skills and the change in the heritability of these skills across generations.

Variable-based e-PAES with Adaptive Fertility Rate

Amiram Moshaiov and Mor Elias

This paper suggests a new multi-objective evolutionary algorithm. The proposed e - PAES combines ideas from two well-known algorithms, namely PAES and e -MOEA. The adopted ideas are accompanied with a front-based adaptive fertility-rate and a variable-based approach. The algorithm performs the optimization process using separated local searches per each one of the problem's decision variables, by adaptation of the associated step sizes. The performance of the algorithm is checked on several test cases and is statistically compared with the performance of e -MOEA. It is found that the proposed algorithm achieves results of similar quality to e -MOEA while consuming less computational resources.

Efficient Feature Selection using a Self-Adjusting Harmony Search Algorithm

Ling Zheng, Ren Diao and Qiang Shen

Many strategies have been exploited for the task of feature selection, in an effort to identify more compact and better quality subsets. A number of evaluation metrics have been developed recently that can judge the quality of a given subset as a whole, rather than a combination of individual features. Powerful nature-inspired stochastic search techniques have also emerged, allowing multiple good quality features to be discovered without resorting to exhaustive search. Harmony search in particular, is a recently developed technique that mimics musicians' experience, which has been successfully applied to solving feature selection problems. This paper proposes three improvements to the harmony search algorithm that are designed to further enhance its feature selection performance. The resultant technique is more efficient, capable of automatically adjusting the internal components of the algorithm. Systematic experimental evaluation using high dimensional, real-valued data sets has been carried out to verify the benefits of the presented work.

Memetic Algorithms for Cross-domain Heuristic Search

Ender Özcan, Shahriar Asta and Cevriye Altintaş

Hyper-heuristic Flexible Framework (HyFlex) is an interface designed to enable the development, testing and com- parison of iterative general-purpose heuristic search algorithms, particularly selection hyper-heuristics. A selection hyper-heuristic is a high level methodology that coordinates the interaction of a fixed set of low level heuristics (operators) during the search process. The Java implementation of HyFlex along with different problem domains was recently used in a competition, referred to as Cross-domain Heuristic Search Challenge (CHeSC2011). CHeSC2011 sought for the best selection hyper-heuristic with the best median performance over a set of instances from six different problem domains. Each problem domain implementa- tion contained four different types of operators, namely mutation, ruin-recreate, hill climbing and crossover. CHeSC2011 including the competing hyper-heuristic methods currently serves as a benchmark for hyper-heuristic research. Considering the type of the operators implemented under the HyFlex framework, CHeSC2011 could also be used as a benchmark to empiri- cally compare the performance of appropriate variants of the evolutionary computation methods across a variety of problem domains for discrete optimisation. In this study, we investigate the performance and generality level of generic steady-state and transgenerational memetic algorithms which hybridize genetic algorithms with hill climbing across six problem domains of the CHeSC2011 benchmark.

A Genetic Programming Hyper-heuristic: Turning Features into Heuristics for Constraint Satisfaction

José Carlos Ortiz-Bayliss, Ender Özcan, Andrew J. Parkes and Hugo Terashima-Marín

A constraint satisfaction problem (CSP) is a combinatorial optimisation problem with many real world applications. One of the key aspects to consider when solving a CSP is the order in which the variables are selected to be instantiated. In this study, we describe a genetic programming hyper-heuristic approach to automatically produce heuristics for CSPs. Human-designed 'standard' heuristics are used as components enabling construction of new variable ordering heuristics which is achieved through the proposed approach. We present empirical evidence that the heuristics produced by our approach are competitive considering the cost of the search when compared to the standard heuristics used to obtain the components for the new heuristics. The proposed approach is able to produce specialised heuristics for specific classes of instances that outperform the best standard heuristics for the same instances.

Recognizing facial expressions: Computational models and humans

Aruna Shenoy, Neil Davey and Ray Frank

The paper discusses various biologically plausible computational models that recognize human facial expression and analyze them. Identifying facial expressions is a non trivial task for a human and is a key part of social interactions. However, it is not as simple as that for a computational system. Here we analyze six different universally accepted facial expressions for analysis with the aid of six biologically plausible computational models. There have been a limited number of studies comparing the performance of human subjects with computational models for facial expression recognition. This paper does a genuine attempt in making this comparison.

Novel Hybrid Bacterial Foraging and Spiral Dynamics Algorithms

Ahmad Nor Kasruddin Nasir, M. Osman Tokhi and N. M. A. Ghani

This paper presents three novel hybrid optimization algorithms based on bacterial foraging and spiral dynamics algorithms and their application to modelling of flexible maneuvering systems. Hybrid bacteria-chemotaxis spiral-dynamics algorithm is a combination of chemotaxis strategy in bacterial foraging algorithm and linear adaptive spiral dynamics algorithm. Chemotactic behaviour of bacteria is a good strategy for fast exploration if large value of step size is defined in the motion. However, this results in oscillation in the search process and bacteria cannot reach optimum fitness accuracy in the final solution. On the contrary, spiral dynamics provides good exploitation strategy due to its dynamic step size. However, it suffers from getting trapped at local optima due to poor exploration in the diversification phase. Employing the chemotaxis and spiral dynamics strategies at the initial and final stages respectively will thus balance the exploration and exploitation. Hybrid spiral-bacterial foraging algorithm and hybrid chemotaxis-spiral algorithm, on the other hand are developed based on adaptation of spiral dynamics model into chemotaxis phase of bacterial foraging with the aim to guide bacteria movement globally. The proposed algorithms are used to optimize parameters of a linear parametric model of a flexible robot manipulator system. The performances of the proposed hybrid algorithms are presented in comparison to their predecessor algorithms in terms of fitness accuracy, time-domain and frequency-domain responses of the models. The results show that the proposed algorithms achieve better performance.

Double-Phase Locality Sensitive Hashing of Neighborhood Development for Multi-Relational Data

Ping Ling and Xiangsheng Rong

As a fundamental issue of machine learning, neighborhood development is closely connected with neighbor searching, data index, clustering, classification, etc. Multi-Relational (MR) data correspond to objects of relational database, and they are widely used in multiple applications. Yet, neighborhood development algorithm for MR data has been missed since MR data is high-dimensional and highly-structured. So a Double-Phase Locality Sensitiveness Hashing (DPLSH) algorithm is proposed in this study to develop neighborhood of MR data. DPLSH consists of offline and online hashing schemas, and is encoded with parameterization heuristics to make the algorithm data-adaptively and less costly. Based on hashing projections of DPLSH, a method family of neighborhood formulation is defined to specify diverse criteria of identifying the neighborhood. Extensive experiments show that for MR data, the quality of neighborhood produced by DPLSH is better than its peers; for common data, its performance is competitive with the state of the art.

Wavelet Neural Network Approach Applied to Biomechanics of Swimming

Weslly Puchalski, Felipe Fidelis Schauenburg, Viviana Cocco Mariani and Leandro dos Santos Coelho

An artificial neural network (ANN) consists of a number of interconnecting artificial neurons and employs mathematical or computational models for information processing. ANNs are suitable for handling large amounts of dynamic, noisy and nonlinear data. The combination of the wavelet transforms theory with the basic concept of ANNs leads to new mapping networks called wavelet neural networks (WNNs) or wavenets, which are proposed as an alternative to feedforward ANNs for approximating arbitrary nonlinear functions. Generalized from radial basis function ANNs, WNNs are in fact feed-forward neural networks with one hidden layer, radial wavelets as activation functions in the hidden nodes and a linear output layer. The contribution of this paper is to evaluate the WNNs to model a parathlete swimmer behavior. The parathlete swimmer swims the breaststroke style using biomechanics data generated by the software tool called SWUMSUIT, which was developed in Tokyo Technological Institute in Japan. The forecasted results clearly show that WNN has good prediction properties. The proposed WNN modeling approach can benefit disabled swimmers (parathletes) to gain competitive advantage by studying the biomechanics involved in the sport and considering the help of simulations systems.

A Fast and Efficient Semantic Short Text Similarity Metric

David Croft, Simon Coupland, Jethro Shell and Stephen Brown

The semantic comparison of short sections of text is an emerging aspect of Natural Language Processing (NLP). In this paper we present a novel Short Text Semantic Similarity (STSS) method, Lightweight Semantic Similarity (LSS), to address the issues that arise with sparse text representation. The proposed approach captures the semantic information contained when comparing text to process the similarity. The methodology combines semantic term similarities with a vector similarity method used within statistical analysis. A modification of the term vectors using synset similarity values addresses issues that are encountered with sparse text. LSS is shown to be comparable to current semantic similarity approaches, LSA and STASIS, whilst having a lower computational footprint.

Late Acceptance-based Selection Hyper-heuristics for Cross-domain Heuristic Search

Warren G. Jackson, Ender Özcan and John H. Drake

Hyper-heuristics are high-level search methodologies used to find solutions to difficult real-world optimisation problems. Hyper-heuristics differ from many traditional optimisation techniques as they operate on a search space of low-level heuristics, rather than directly on a search space of potential solutions. A traditional iterative selection hyper-heuristic relies on two core components, a method for selecting a heuristic to apply at a given point and a method to decide whether or not to accept the result of the heuristic application. Raising the level of generality at which search methods operate is a key goal in hyper-heuristic research. Many existing selection hyper-heuristics make use of complex acceptance criteria which require problem specific expertise in controlling the various parameters. Such hyper-heuristics are often not general enough to be successful in a variety of problem domains. Late Acceptance is a simple yet powerful local search method which has only a single parameter to control. The contributions of this paper are twofold. Firstly, we will test the effect of the set of low-level heuristics on the performance of a simple stochastic selection mechanism within a Late Acceptance hyper-heuristic framework. Secondly, we will introduce a new class of heuristic selection methods based on roulette wheel selection and combine them with Late Acceptance acceptance criteria. The performance of these hyper-heuristics will be compared to a number of methods from the literature over six benchmark problem domains.

Experimental Evaluation of Cluster Quality Measures

Oliver Kirkland and Beatriz De La Iglesia

Selecting a "good" clustering solution is one of the major difficulties in clustering data as there are many possible clustering solutions for a given problem, including solutions that contain varying numbers of clusters. Our objective is to select measures of clustering quality that can be applied in a multi-objective optimisation context. Such measures may represent potentially conflicting objectives but should give rise to the "best" clustering solutions from which the user can select a compromise solution. There exists a wide range of cluster quality measures for assessing the quality of a given clustering solution. We begin by summarise some of these. We then propose an experimental evaluation to capture the robustness of different measures under changing conditions. Our experimental setup includes the creation of a number of synthetic clustering solutions which are then degraded in a systematic manner. We measure how the degradation of each measure correlates with the degradation of the solutions according to an external quality measure evaluation. We consider as good those measures that show good correlation. In this context, measures based upon the concept of connectivity show good performance in comparison to others.

Towards Machine Learning Based Design Pattern Recognition

Sultan Alhusain, Simon Coupland, Robert John and Maria Kavanagh

Software design patterns are abstract descriptions of best practice solutions for recurring design problems. The information about which design pattern is implemented where in a software design is very helpful and important for software maintenance and evolution. This information is usually lost due to poor, obsolete or lack of documentation which raise the importance of automatic recognition tools. However, their vague and abstract nature allows them to be implemented in various ways, which gives them resistance to be automatically and accurately recognized. This paper presents the first recognition approach to be solely based on machine learning techniques. We build the training dataset by using several existing tools and we use feature selection methods to select the input feature vectors. Our approach is evaluated by conducting an experiment to recognize six design patterns in an open source application.

A hybrid particle swarm optimization algorithm for parallel batch processing machines scheduling

Jun-lin Chang, Ying Chen and Xiao-ping Ma

The paper studies the scheduling problem of minimizing maximum lateness on parallel identical batch processing machines with dynamic job arrivals and incompatible job families. Each machine can process several jobs simultaneously as a batch and each job is characterized by its release time, processing time, due date and job family. In view of the strongly NP-hard of this problem, heuristics are first proposed to solve the problem in a modest amount of computer time. In general, the quality of the solutions provided by heuristics degrades with the increase of the problems scale. Combined the global search ability of particle swarm optimization (PSO), we proposed a hybrid PSO to improve the quality of solutions further. Computational results show that the hybrid heuristic combines the advantages of heuristic and genetic algorithm effectively and can provide very good solutions to some large problems in a reasonable amount of computer time.

Towards a Method of Identifying the Causes of Poor User Experience on Websites

Robert S. K. Miles, Julie Greensmith, Holger Schnädelbach and Jonathan M. Garibaldi

User Experience, in particular the affective state of the user, is an important consideration in Human Computer Interaction. Integrating affective measurements with software user experience testing would be valuable. Current approaches to this problem either lack the level of detail required to identify the causes of poor user experience, or can do so only with considerable human expertise and input. We hope to examine the possibility of automatically identifying the specific elements of a software system which cause problems, without human input, by combining psychophysiological measurements and detailed user interaction data. This paper describes ongoing work to collect a dataset suitable for exploring the problem, and briefly discusses some future directions in which the data may allow us to proceed.

K-Nearest-Neighbours with a Novel Similarity Measure for Intrusion Detection

Zhenghui Ma and Ata Kaban

K-nearest neighbours is one of the simplest yet effective classification methods. The core computation behind it is to calculate the distance from a query point to all of its neighbours and to choose the closest one. The Euclidean distance is the most frequent choice, although other distances are sometimes required. This paper explores a simple yet effective similarity definition within Nearest Neighbours for intrusion detection applications. This novel similarity rule is fast to compute and achieves a very satisfactory performance on the intrusion detection benchmark data sets tested.

Face Clustering in Videos : GMM-based Hierarchical Clustering using Spatio-temporal Data

Subhradeep Kayal

In recent years, an increase in multimedia data generation and efficient forms of storage have given rise to needs like quick browsing, efficient summarization and techniques for information retrieval. Face Clustering, together with other technologies such as speech recognition, can effectively solve these problems. Applications such as video indexing, major cast detection and video summarization greatly benefit from the development of accurate face clustering algorithms. Since videos represent a temporally ordered collection of faces, it is only natural to use the knowledge of the temporal ordering of these faces, in conjunction with the spatial features extracted from them, to obtain optimal clusterings. This paper is aimed at developing a novel clustering algorithm, by modifying the highly successful hierarchical agglomerative clustering (HAC) process, so that it includes an effective initialization mechanism, via an initial temporal clustering and Gaussian Mixture Model based cluster splitting, and introduces a temporal aspect during cluster combination, in addition to the spatial distances. Experiments show that it significantly outperforms HAC while being equally flexible.

Prediction of Viewed Object Sizes using Features of Visual Evoked Potentials and Oculo-motors

Minoru Nakayama and Masashi Fujimoto

In order to develop a type of automatic viewing assistance system, the prediction performance of viewing six sizes of Landolt circles was measured using pupil diameters, eye movements and the viewer's occipital single channel potentials. To reduce the influence of artefacts produced by these signals, appropriate processing techniques were applied. Discriminant prediction of the visual sizes of stimuli was conducted using feature sets extracted from these signals. The prediction performance increased when these feature sets were combined to optimise performance. Also, differences in the performance between stimulus sizes and individual subjects were evaluated.

Predicting Fluctuations in Foreign Exchange Rates

David W. Cross, Christopher J. Hinde and Martin D. Sykora

This paper assesses the viability of predicting fluctuations in the foreign exchange markets. It investigates the new Weka filter that evolves the input space of the decision system. The new Weka filter only enhances one file and so falls short of the requirements for this project. Subsequent experiments used an earlier version that kept the training and testing data separate but enhanced both. The test data was taken from an earlier project that used the various techniques available in the Weka library and so the hypothesis tested was that the new system would give improvements. Various systems were constructed that simplified the execution of multiple tests. There are important factors that need to be taken into account when conducting learning schemes on continuous financial data. A price history model was constructed, which shows that short period financial predictions are very difficult to predict and highly volatile. The system was then tested on the new Weka filter based on genetic algorithms with a multiple price point model. This was compared against a prior publication using ensemble learning but only using the previously existing Weka library. The GA based system, which enhances the input space, and was the foundation of the new Weka filter but took into account the need for separate training and test data was used in the final tests. Results indicate that in an ensemble combination, this technique attains a higher accuracy than the earlier ensemble based learning system with a confidence of 97%

Interpolating DeSTIN Features for Image Classification

Yongfeng Zhang, Changjing Shang and Qiang Shen

This paper presents a novel approach for image classification, by integrating advanced machine learning techniques and the concept of feature interpolation. In particular, a recently introduced learning architecture, the Deep Spatio-Temporal Inference Network (DeSTIN), is employed to perform feature extraction for support vector machine (SVM) based image classification. The system is supported by use of a simple interpolation mechanism, which allows the improvement of the original low-dimensionality of feature sets to a significantly higher dimensionality with inimal computation. This in turn, improves the performance of SVM classifiers while reducing the computation otherwise required to generate directly measured features. The work is tested against the popular MNIST dataset of handwritten digits. Experimental results indicate that the proposed approach is highly promising, with the integrated system generally outperforming that which makes use of pure DeSTIN as the feature extraction preprocessor to SVM classifiers.

Towards an Autonomous Resilience Strategy, The Implementation of a Self Evolving Rate Limiter

Azman Ali, David Hutchison, Plamen Angelov and Paul Smith

Distributed Denial of Service (DDoS) attacks on network infrastructure are one of the major challenges facing network service providers. Despite the recent rise of low-volume application-level attacks, volume-based DDoS attacks still dominate, with peak traffic rates of 80Gbps being observed recently. This prompts the need for more efficient ways to deal with them. Mean while, service providers are struggling to acquire the right technology, resources and expertise to offer more resilient and reliable services. One of the solutions to help address this issue is to adopt an autonomous resilience strategy that systematically coordinates resilience related activities such as detecting and mitigating attacks. In this paper, we study an implementation of an autonomous traffic rate limiter a function that can be used to mitigate DDoS attacks - that capitalises on the AnYa algorithm, an autonomous learning systems (ALS) algorithm that provides advanced features that are crucial to support an autonomous resilience strategy. These features include self-structuring and support for online learning. In our study, we experimentally show how remediation and recovery processes can be realized autonomously, in response to changes in the operational policy.

Random projections versus random selection of features for classification of high dimensional data

Sachin Mylavarapu and Ata Kaban

Random projections and random subspace methods are very simple and computationally efficient techniques to reduce dimensionality for learning from high dimensional data. Since high dimensional data tends to be prevalent in many domains, such techniques are the subject of much recent interest. Random projections (RP) are motivated by their proven ability to preserve inter-point distances. By contrary, the random selection of features (RF) appears to be a heuristic, which nevertheless exhibits good performance in previous studies. In this paper we conduct a thorough empirical comparison between these two approaches in a variety of data sets with different characteristics. We also extend our study to multi-class problems. We find that RP tends to perform better than RF in terms of the classification accuracy in small sample settings, although RF is surprisingly good as well in many cases.

An Evolutionary Algorithm for Bid-Based Dynamic Economic Load Dispatch in a Deregulated Electricity Market

Sunny Orike and David Corne

The paper presents a novel evolutionary algorithm (EA) approach to solving the bid-based dynamic economic load dispatch problem in a deregulated electricity market. Power generating companies and customers submit bids in advance of each trading transaction, and these bids are matched by the market controller the independent system operator (ISO), who conducts the dispatch, determines the prevailing market prices and corresponding supply/demand schedules for all generators and customers in a multi-player/multi-period transaction to maximize social profit. The optimization problem faced by the ISO is addressed in very recent literature, and is more realistic than related problems that have been studied in the optimization literature for several years, the so-called static and dynamic economic load dispatch problems (SELD and DELD). In this paper we use an EA with a smart mutation operator (which has proven successful on the SELD and DELD), which focuses mutation on genes co Abstract: ntributing most to costs and penalty violations. We find our EA outperforms previous results on the bid-based problem, we also test three versions of the smart mutation operator, and we also define and show results on a new, larger test case for the bid-based problem.

A Grouping Hyper-heuristic Framework based on Linear Linkage Encoding For Graph Coloring

Anas Elhag and Ender Özcan

Grouping problems are a class of combinatorial optimization problems in which the task is to search for the best partition of a set of objects into a collection of mutually disjoint subsets while satisfying a given set of constraints. Typical examples include data clustering, graph coloring and exam timetabling problems. Selection hyper-heuristics based on iterative search frameworks are high level general problem solving methodologies which operate on a set of low level heuristics to improve an initially generated solution via heuristic selection and move acceptance. In this paper, we describe a selection hyper-heuristic framework based on an efficient representation referred to as linear linkage encoding for multi-objective grouping problems. This framework provides the implementation of a fixed set of low level heuristics that can work on all grouping problems where a trade-off between a given objective and number of groups is sought. The empirical results on graph coloring problem indicates that the proposed grouping hyper-heuristic framework can indeed provide high quality solutions.

Group Decision Making in Selection Hyper-heuristics

Ender Özcan, Mustafa Misir and Ahmed Kheiri

A hyper-heuristic is a high level methodology which performs search over the space of heuristics each operating on the space of solutions to solve hard computational problems. This search process is based on either generation or selection of low level heuristics. The latter approach is used in selection hyper-heuristics. A generic selection hyper-heuristic has two main components which operate successively: heuristic selection and move acceptance methods. An initially generated solution is improved iteratively using these methods. At a given step, the most appropriate heuristic is selected from a fixed set of low level heuristics and applied to a candidate solution producing a new one. Then, a decision is made whether to accept or reject the new solution. This process is repeated until the termination criterion is satisfied. There is strong empirical evidence that the choice of selection hyper-heuristic influences its overall performance. This is one of the first studies to the best of our knowledge that suggests and explores the use of group decision making methods for move acceptance in selection hyper-heuristics. The acceptance decision for a move is performed by multiple methods instead of a single one. The performance of four such group decision making move acceptance methods are analysed within different hyper-heuristics over a set of benchmark functions. The experimental results show that the group decision making strategies have potential to improve the overall performance of selection hyper-heuristics.

A Novel Adaptive Spiral Dynamic Algorithm for Global Optimization

Ahmad Nor Kasruddin Nasir and M. Osman Tokhi, O. Sayidmarie and R. M. T. Raja Ismail

This paper presents a novel adaptive spiral dynamic algorithm for global optimization. Through a spiral model, spiral dynamic algorithm has a balanced exploration and exploitation strategy. Defining suitable value for the radius and displacement in its spiral model may lead the algorithm to converge with high speed. The dynamic step size produced by the model also allows the algorithm to avoid oscillation around the optimum point. However, for higher dimension problems, the algorithm may easily get trapped into local optima. This is due to the incorporation of a constant radius and displacement in the model. In order to solve the problem, a novel adaptive formulation is proposed in this paper by varying radius and displacement of a spiral model. The proposed algorithm is applied to acquire and optimize parameters of an autoregressive with exogenous terms dynamic model of a flexible manipulator system. Comparison with original spiral dynamic algorithm has shown that the proposed algorithm has better accuracy. Moreover, the time domain and frequency domain responses of the flexible manipulator system have shown that the proposed algorithm outperforms its predecessor algorithm.

Re-scheduling in railway networks

Wei Fang, Jun Sun, Xiaojun Wu and Xin Yao

Railway transport is one of the convenient public transports, known for its safety, reliability of service, and punctuality. Railway networks, as an important part of railway infrastructure, have been extended in the scale and complexity to meet constantly increasing demand of passengers and goods transports. Since railway networks face disturbances more frequently than before as a result of severe weather conditions and signal faults etc., highly efficient re-scheduling approaches are needed to help train dispatchers to re-schedule trains. Several re-scheduling approaches in railway networks have been proposed considering different disturbances scenarios. These approaches are classified by their characteristics and reviewed in detail in this paper. The re-scheduling problem is usually formulated by different models in the literature. These models are also reviewed along with the approaches. Conclusions and future work on the re-scheduling approaches are given in the end.