DETAILED PROGRAM

Tuesday, December 9, 12:00PM-6:00PM

Special Track: Registration
Tuesday, December 9, 12:00PM-6:00PM, Room: Grand Sierra Registration SOUTH

Tuesday, December 9, 6:00PM-8:00PM

Special Track: Reception
Tuesday, December 9, 6:00PM-8:00PM, Room: Grand Sierra D

Wednesday, December 10, 8:10AM-9:10AM

Plenary Talk: Sensor Fault Diagnosis in Cyber-Physical Systems
Wednesday, December 10, 8:10AM-9:10AM, Room: Grand Sierra A, B & C, Speaker: Marios M. Polycarpou,

Wednesday, December 10, 9:20AM-10:00AM

Special Lecture: CIBD'14 Keynote Talk: Big Data and Analytics at Verizon
Wednesday, December 10, 9:20AM-10:00AM, Room: Antigua 2, Speaker: Ashok Srivastava

Special Lecture: IES'14 Keynote Talk: Intelligent Embedded Systems: Artificial Neural Networks for Industrial Applications
Wednesday, December 10, 9:20AM-10:00AM, Room: Antigua 3, Speaker: Eros Pasero

Special Lecture: CIHLI'14 Keynote Talk: Towards Human-Like Intelligence: A Self-Organizing Neural Network Approach
Wednesday, December 10, 9:20AM-10:00AM, Room: Antigua 4, Speaker: Ah-Hwee Tan

Special Lecture: CCMB'14 Keynote Talk: Toward Physics of the Mind
Wednesday, December 10, 9:20AM-10:00AM, Room: Bonaire 1, Speaker: Leonid Perlovsky

CIHLI'14 Session 1: Various Aspects of Human-Level Intelligence

Wednesday, December 10, 10:20AM-12:00PM, Room: Antigua 4, Chair: Jacek Mandziuk

10:20AM *Immersive Virtual Reality Environment of a Subway Evacuation on a Cloud for Disaster Preparedness and Response Training [#14239]*

Sharad Sharma, Shanmukha Jerripothula, Stephon Mackey and Oumar Soumare, Bowie State University, United States

Virtual Reality (VR) based training and evacuation drills in disaster preparedness has been increasingly recognized as an alternative to traditional real-life drills and table-top exercises. Immersive collaborative VR evacuation drills offer a unique way for training in emergencies. The participants can enter the collaborative VR environment setup on the cloud and participate in the evacuation drill which leads to considerable cost advantages over large-scale real-life exercises. This paper presents an experimental design approach to gather data on human behavior and emergency response in a subway environment among a set of players in an immersive virtual reality environment. Our proposed multi-user VR-based training subway environment offers flexibility to run multiple scenarios and evacuation drills for disaster preparedness and response. We present three ways for controlling crowd behavior. First by defining rules for computer simulated agents, second by providing controls to the users to navigate in the VR environment as autonomous agents and the third by providing controls to the users with a keyboard/ joystick along with an immersive VR head set in real time. Our contribution lies in our approach to combine these three approaches of behavior in order to simulate the crowd behavior in emergencies.

10:40AM *Autonomic Behaviors in an Ambient Intelligence System [#14592]*

Alessandra De Paola, Pierluca Ferraro, Salvatore Gaglio and Giuseppe Lo Re, University of Palermo, Italy

Ambient Intelligence (Aml) systems are constantly evolving and becoming ever more complex, so it is increasingly difficult to design and develop them successfully. Moreover, because of the complexity of an Aml system as a whole, it is not always easy for developers to predict its behavior in the event of unforeseen circumstances. A possible solution to this problem might lie in delegating certain decisions to the machines themselves, making them more autonomous and able to self-configure and self-manage, in line with the paradigm of Autonomic Computing. In this regard, many researchers have emphasized the importance of adaptability in building agents that are suitable to operate in real-world environments, which are characterized by a high degree of uncertainty. In the light of these considerations, we propose a multi-tier architecture for an autonomic Aml system capable of analyzing itself and its monitoring processes, and consequently of managing and reconfiguring its own sub-modules to better satisfy users' needs. To achieve such a degree of autonomy and self-awareness, our Aml system exploits the knowledge contained in an ontology that formally describes the environment it operates in, as well as the structure of the system itself.

11:00AM *On efficiency-oriented support of consensus reaching in a group of agents in a fuzzy environment with a cost based preference updating approach [#14712]*

Dominika Golunska, Janusz Kacprzyk and Slawomi Zadrozny, Cracow Univ. of Technology, Poland; Systems Research Institute Pol. Acad. Sci., Poland

We deal with consensus reaching, and its related decision support system, based on the soft degree of consensus by Kacprzyk and Fedrizzi, fuzzy preferences, and a fuzzy majority. We assume that consensus reaching proceeds in a (small) group of agents who express their testimonies w.r.t.ith a set of options as fuzzy preferences. We develop tools and techniques to extract from those data, and from the consecutive steps of the consensus reaching process, additional information assumed as human consistent linguistic summaries that can be derived by using natural language generation (NLG). This information is meant to accelerate the consensus reaching process by pointing out to those individuals for whom the changed of testimonies, and with respect to specific pairs of options, can have the highest impact on the degree of consensus. It is therefore explicitly efficiency oriented. We assume a moderated consensus reaching process run by a specialized "super-agent", a moderator. In this paper we further extend a model and implementation of such a consensus reaching process proposed in our previous papers. We further develop linguistic tools and techniques, in the form of linguistic summaries, to help grasp relations and interplay between the agents' testimonies and their dynamics numerically analyzed by additional indicators pointing out agents and options that are most promising for the changes of preferences. We proposed a cost based scheme for the evaluation of preference updating so that the agents be not forced to change too often and too many of their preferences, which is not usually welcome by people for psychological reasons, and which should contribute to their better collaboration .

11:20AM *HICMA: A Human Imitating Cognitive Modeling Agent using Statistical Methods and Evolutionary Computation [#14783]*

Magda Fayek and Osama Farag, Cairo University, Egypt

Intelligent agents are becoming more sophisticated than ever. An intelligent agent (IA) interacts with the environment. It takes observations through sensors and acts on the environment through actuators for achieving some goals. An IA usually keeps models for the environment and the interesting objects in this environment. These models are adapted according to the environmental changes. Wide researches have been done on the techniques of building and tuning such models. This paper introduces the Human Imitating Cognitive Modeling Agent (HICMA) that combines different techniques for building and tuning appropriate models for dynamic environment objects. It is based on a proposed updated version of Minsky's society of mind theory where society agents evaluate and evolve each other in a novel way. HICMA has been tested by allowing it to play Robocode against the two opponents Shadow 3.66d and Walls. Results show that HICMA's evolved mathematical behavior models gracefully translate actual human behaviors.

11:40AM *A Cortex-inspired Episodic Memory Toward Interactive 3D Robotic Vision [#14805]*

Abdul Rahman Abdul Ghani and Kazuyuki Murase, Department of Human and Artificial Intelligence System, Graduate School of Engineering, University of Fukui, Japan

This paper shows the advantage of using a cortexinspired episodic memory model in a robotic vision-system. The robot can interact, learn, and recall 3D objects in real-time. The model forms sparse distributed memory traces of spatiotemporal episodes. These episodes consist of sequences of sensorimotor patterns. These patterns represent the visual scenes of 3D objects and the robot states when encountering the objects. The results show: 1) Dynamic recall, when the model is prompted with the initial items of the learned episode. 2) Recognition, by recalling the most similar stored objects when encountering new objects. 3) Sensorimotor learning, by generating the missing information when encountering either similar visual input or similar robot's states. The model learns by measuring the degree of similarity between the current input pattern on each time slice and the expected input given the preceding time slice (G). Then adding an amount of noise, inversely proportional to G, to the process of choosing the Internal Representation of the model.

independent expression data sets. Our finding suggest that further validation on wet-lab and large scale independent big data could provide additive knowledge on diagnosis of basal type or triple-negative breast cancer. The study also suggests cell cycle pathway plays an important role in the TNBC disease progression and may provide pivotal target for therapeutic intervention.

IES'14 Session 2

Wednesday, December 10, 1:30PM-3:10PM, Room: Antigua 3, Chair: Manuel Roveri

1:30PM *Self-aware and Self-expressive Driven Fault Tolerance for Embedded Systems [#14731]*
Tatiana Djaba Nya, Stephan C. Stilkerich and Christian Siemers, Airbus Group Innovations, Germany; Clausthal University of Technology, Germany

The growing complexity and size of computing systems as well as the unpredictability about changes in their deployment environment make their design increasingly challenging; especially for safety critical systems. Specifically the recognition of a fault within a system might be not only time consuming but also difficult in terms of reliability and completeness. This paper presents an approach to fault tolerance based on statistical features using the concepts of self-awareness and self-expression. These features characterize the behaviour of components, they are weighted and can be compared to measured values during runtime to characterize the well-behaviour of the system. Simulations show that this approach, used with the selfawareness and self-expression system layers, combines failure recognition and recovery with effective system design.

1:50PM *Learning Causal Dependencies to Detect and Diagnose Faults in Sensor Networks [#14436]*
Cesare Alippi, Manuel Roveri and Francesco Trovo', Politecnico di Milano, Italy

Exploiting spatial and temporal relationships in acquired datastreams is a primary ability of Cognitive Fault Detection and Diagnosis Systems (FDDSs) for sensor networks. In fact, this novel generation of FDDSs relies on the ability to correctly characterize the existing relationships among acquired datastreams to provide prompt detections of faults (while reducing false positives) and guarantee an effective isolation/identification of the sensor affected by the fault (once discriminated from a change in the environment or a model bias). The paper suggests a novel framework to automatically learn temporal and spatial relationships existing among streams of data to detect and diagnose faults. The suggested learning framework is based on a theoretically grounded hypothesis test, able to capture the Granger causal dependency existing among datastreams. Experimental results on both synthetic and real data demonstrate the effectiveness of the proposed solution for fault detection.

2:10PM *Salted Hashes for Message Authentication - Proof of concept on Tiny Embedded Systems [#14636]*
Rene Romann and Ralf Salomon, University of Rostock, Germany

Intelligent embedded systems become more and more widespread. Especially in the field of smart environments, such as smart homes, the systems are communicating with each other. If wireless communication is used, security becomes important. This paper explores to what extent salted hashes might be used on tiny embedded systems to provide message authentication. To this end, this paper uses two very different microcontrollers for calculating salted hases using SHA-1 and SHA-256. The execution times vary between 2.5 and 160 milliseconds, which is fast enough to provide user responses in time.

2:30PM *Novelty Detection in Images by Sparse Representations [#14943]*
Giacomo Boracchi, Diego Carrera and Brendt Wohlberg, Politecnico di Milano, Italy; Los Alamos National Laboratory, United States

We address the problem of automatically detecting anomalies in images, i.e., patterns that do not conform to those appearing in a reference training set. This is a very important feature for enabling an intelligent system to autonomously check the validity of acquired data, thus performing a preliminary, automatic, diagnosis. We approach this problem in a patch-wise manner, by learning a model to represent patches belonging to a training set of normal images. Here, we consider a model based on sparse representations, and we show that jointly monitoring the sparsity and the reconstruction error of such representation substantially improves the detection performance with respect to other approaches leveraging sparse models. As an illustrative application, we consider the detection of anomalies in scanning electron microscope (SEM) images, which is essential for supervising the production of nanofibrous materials.

Special Session: CIHLI'14 Session 2: Grounded Cognition, Creativity and Motivated Learning

Wednesday, December 10, 1:30PM-3:10PM, Room: Antigua 4, Chair: Kathryn Merrick and Janusz Starzyk

1:30PM *Evolution of Intrinsic Motives in a Multi-Player Common Pool Resource Game [#14089]*
Kathryn Merrick, University of New South Wales, Australia

This paper proposes a game theoretic framework to model the evolution of individuals with different motives. First, the altered perception of individuals with different motives is modeled assuming they are engaged in a common pool resource game. It is shown that agents with different motives perceive the payoff matrix of the game differently. An evolutionary process is then simulated using replicator dynamics and mutation rules to study the evolution of agents with different motives. Results demonstrate that the average objective payoff achieved by a population of agents is higher in the presence of agents with different motives, even though some of these agents may misperceive the original game. These results illustrate the evolutionary benefit of motivation and provide evidence in support of further study of subjective rationality as a result of motivation in game theoretic settings.

1:50PM *Self-Motivated Learning of Achievement and Maintenance Tasks for Non-Player Characters in Computer Games [#14146]*
Hafsa Ismail, Kathryn Merrick and Michael Barlow, University of New South Wales, Australia

This paper presents a framework for motivated reinforcement learning agents that can identify and solve either achievement or maintenance tasks. To evaluate and compare agents using these approaches, we also introduce two new metrics to better characterise and differentiate the behaviour of characters motivated to learn different kinds of tasks. These metrics quantify the focus of attention and dwell time of agents. We perform an empirical evaluation of motivated reinforcement learning agents controlling characters in a simulated game scenario, comparing the effect of three different motivations for learning achievement and maintenance tasks. Results show that we can generate characters with quantifiably different achievement and maintenance oriented behaviour using our proposed task identification approach. Of the three motivations studied - novelty, interest and

competence - novelty-seeking motivation is the most effective for creating agents with distinctive maintenance or achievement oriented behaviours.

2:10PM *Effective Motive Profiles and Swarm Compositions for Motivated Particle Swarm Optimisation Applied to Task Allocation [#14314]*
Medria Hardhienata, Kathryn Merrick and Valery Ugrinovskii, University of New South Wales Canberra, Australia

This paper examines the behaviour of agents with four distinct motive profiles with the aim of identifying the most effective profiles and swarm compositions to aid task discovery and allocation in a motivated particle swarm optimisation algorithm. We first examine the behaviour of agents with affiliation, achievement and power motive profiles and the impact on behaviour when these profiles are perturbed. We then examine the behaviour of swarms with different compositions of agents motivated by affiliation, achievement, power and a new leadership motive profile. Results show that affiliation- motivated agents tend to perform local search and allocate themselves to tasks. In contrast, power-motivated agents tend to explore to find new tasks. These agents perform better in the presence of achievement-motivated agents, informing the design of the leadership motive profile, which demonstrates good performance in two task allocation settings studied in this paper.

2:30PM *Applying Behavior Models in a System Architecture [#14238]*
Bruce Toy, Lockheed Martin (Retired), United States

This paper describes a functional model for understanding the multiple roles that internal behavior modeling plays in an integrated functional architecture of the brain. Using a protocol for AI structure that is based on system engineering principles, we can look at the individual's process for understanding the behavior of, and interaction with, other entities. The analysis shows a complex inter-relationship between behavior models, motivations, and location models in the brain that allow us to interact with our environment with minimum demand on our mental resources.

2:50PM *Advancing Motivated Learningn with Goal Creation [#14132]*
James Graham, Janusz Starzyk, Zhen Ni and Haibo He, Ohio University, United States; University of Rhode Island, United States

This paper reports improvements to our Motivated Learning (ML) model. These include modifications to the calculation of need/pain biases, pain-goal weights, and how actions are selected. Resource based abstract pains are complemented with pains related to desired and undesired actions by other agents. Probability based selection of goals is discussed. The minimum amount of desired resources is now set automatically by the agent. Additionally, we have presented several comparisons of Motivated Learning performance against some well-known reinforcement learning algorithms.

CCMB'14 Session 2: Cognitive, Mind, and Brain

Wednesday, December 10, 1:30PM-3:10PM, Room: Bonaire 1, Chair: Angelo Cangelosi

1:30PM *Assessing real-time cognitive load based on psycho-physiological measures for younger and older adults [#14743]*
Eija Ferreira, Denzil Ferreira, SeungJun Kim, Pekka Siirtola, Juha Roning, Jodi F. Forlizzi and Anind K. Dey, Department of Computer Science and Engineering, University of Oulu, Finland; Human-Computer Interaction Institute, Carnegie Mellon University, United States

We are increasingly in situations of divided attention, subject to interruptions, and having to deal with an abundance of information. Our cognitive load changes in these situations of divided attention, task interruption or multitasking; this is particularly true for older adults. To help mediate our finite attention resources in performing cognitive tasks, we have to be able to measure the real-time changes in the cognitive load of individuals. This paper investigates how to assess real-time cognitive load based on psycho-physiological measurements. We use two different cognitive tasks that test perceptual speed and visio-spatial cognitive processing capabilities, and build accurate models that differentiate an individual's cognitive load (low and high) for both young and older adults. Our models perform well in assessing load every second with two different time windows: 10 seconds and 60 seconds, although less accurately for older participants. Our results show that it is possible to build a real-time assessment method for cognitive load. Based on these results, we discuss how to integrate such models into deployable systems that mediate attention effectively.

1:50PM *Toward a Neural Network Model of Framing with Fuzzy Traces [#14404]*
Daniel Levine, University of Texas at Arlington, United States

In a decision study called the Asian Disease Problem, Tversky and Kahneman [1] found that framing risky health choices in terms of gains or losses of lives leads to radically different choices: risk seeking for losses and risk avoidance for gains. The difference between the two choices is called the framing effect. The authors explained framing effects via psychophysics of the numbers of lives saved or lost. Yet Reyna and Brainerd [2] showed that the strength of the framing effect depended not on the numbers but on whether one of options explicitly contained the possibility of no lives lost or saved. They fit their explanation into fuzzy trace theory whereby decisions are based not on details of the options given but on the gist (underlying meaning) of the options. We discuss how a brain-based neural network model of other decision data [3] that combines fuzzy trace theory with adaptive resonance theory can be extended to these framing data. Simulations are in progress.

2:10PM *An Arousal-Based Neural Model of Infant Attachment [#14688]*
David Cittern and Abbas Edalat, Imperial College London, United Kingdom

We develop an arousal-based neural model of infant attachment using a deep learning architecture. We show how our model can differentiate between attachment classifications during strange situation-like separation and reunion episodes, in terms of both signalling behaviour and patterns of autonomic arousal, according to the sensitivity of previous interaction.

2:30PM *Solving a Cryptarithmetic Problem Using a Social Learning Heuristic [#14036]*
Jose Fontanari, Universidade de Sao Paulo, Brazil

The premiss that a group of cooperating agents - a collective brain - can solve a problem more efficiently than the same group of agents working independently is widespread, despite the little quantitative groundwork to support it. Here we use extensive agent-based simulations to investigate the performance of a system of N agents in solving a cryptarithmetic problem. Cooperation is taken into account through imitative learning which allows information to pass from one agent to another. At each trial the agents can either perform individual trial-and-test operations to explore the solution space or copy cues from a model agent, i.e., the agent that exhibits the lowest cost solution at the trial. We find a trade-off between the number of trial and-test operations and the number of imitation attempts: too much imitation results in a performance which is poorer than that exhibited by

4:50PM *TCM Syndrome Classification of AIDS based on Manifold Ranking [#14394]*

Yufeng Zhao, Lin Luo, Liyun He, Baoyan Liu, Qi Xie, Xiaoping Zhang, Jian Wang, Guanli Song and Xianghong Jing, Institute of Basic Research in Clinical Medicine, China Academy of Chinese Medical Sciences, China; China Academy of Chinese Medical Sciences, China; Guang An Men Hospital, China Academy of Chinese Medical Sciences, China; Institute of acupuncture and moxibustion China Academy of Chinese Medical Sciences, China

Treatment based on the syndrome differentiation is the key of Traditional Chinese Medicine (TCM) treating the disease of acquired immune deficiency syndrome (AIDS). Therefore, a feasible way of improving the clinical therapy effectiveness is to correctly explore the syndrome classifications. Recently, more and more AIDS researchers are focused on exploring the syndrome classifications. In this paper, a novel data mining method based on Manifold Ranking (MR) is proposed to analyze the syndrome classifications for the disease of AIDS. Compared with the previous methods, three weaknesses, which are linear relation of the clinical data, mutually exclusive symptoms among different syndromes, confused application of expert knowledge, are avoided so as to effectively exploit the latent relation between syndromes and symptoms. Better performance of syndrome classifications is able to be achieved according to the experimental results and the clinical experts.

IES'14 Session 3

Wednesday, December 10, 3:30PM-5:10PM, Room: Antigua 3, Chair: Manuel Roveri

3:30PM *High precision FPGA implementation of neural network activation functions [#14156]*

Francisco Ortega, Jose Jerez, Gustavo Juarez, Jorge Perez and Leonardo Franco, Malaga University, Spain; Tucuman National University, Argentina

The efficient implementation of artificial neural networks in FPGA boards requires tackling several issues that strongly affect the final result. One of these issues is the computation of the neuron's activation function. In this work, an analysis of the implementation of the sigmoid and the exponential functions are carried out, using a lookup table approach combined with a linear interpolation procedure. Also a time division multiplexing of the multiplier attached to the neurons was used, with the aim of saving board resources. The results are evaluated in terms of the absolute and relative error values obtained and also through a quality factor, showing a clear improvement in relationship to previously published works.

3:50PM *An Intelligent Embedded System for Real-Time Adaptive Extreme Learning Machine [#14432]*

Raul Finker, Ines del Campo, Javier Echanobe and Victoria Martinez, University of the Basque Country, Spain

Extreme learning machine (ELM) is an emerging approach that has attracted the attention of the research community because it outperforms conventional back-propagation feed-forward neural networks and support vector machines (SVM) in some aspects. ELM provides a robust learning algorithm, free of local minima, suitable for high speed computation, and less dependant on human intervention than the above methods. ELM is appropriate for the implementation of intelligent embedded systems with real-time learning capability. Moreover, a number of cutting-edge applications demanding a high performance solution could benefit from this approach. In this work, a scalable hardware/software architecture for ELM is presented, and the details of its implementation on a field programmable gate array (FPGA) are analyzed. The proposed solution provides high speed, small size, low power consumption, autonomy, and true capability for real-time adaptation (i.e. the learning stage is performed on-chip). The developed system is able to deal with highly demanding multiclass classification problems. Two real-world applications are presented, a benchmark problem, the Landsat images classifier, and a novel driver identification system for smart car applications. Experimental results that validate the proposal are provided.

4:10PM *A differential flatness theory approach to adaptive fuzzy control of chaotic dynamical systems [#14626]*

Gerasimos Rigatos, Industrial Systems Institute / Unit of Industrial Automation, Greece

A solution to the problem of control of nonlinear chaotic dynamical systems, is proposed with the use of differential flatness theory and of adaptive fuzzy control theory. Considering that the dynamical model of chaotic systems is unknown, an adaptive fuzzy controller is designed. By applying differential flatness theory the chaotic system's model is written in a linear form, and the resulting control inputs are shown to contain nonlinear elements which depend on the system's parameters. The nonlinear terms which appear in the control inputs of the transformed dynamical model are approximated with the use of neuro-fuzzy networks. It is proven that a suitable learning law can be defined for the aforementioned neuro-fuzzy approximators so as to preserve the closed-loop system stability. Moreover, with the use of Lyapunov stability analysis it is proven that the proposed adaptive fuzzy control scheme results in H-infinity tracking performance, which means that the influence of the modeling errors and the external disturbances on the tracking error is attenuated to an arbitrary desirable level. Simulation experiments confirm the efficiency of the proposed adaptive fuzzy control method, using as a case study the model of the Lorenz chaotic oscillator.

CIHLI'14 Session 3: Applications

Wednesday, December 10, 3:30PM-5:10PM, Room: Antigua 4, Chair: Jacek Mandziuk and Janusz Starzyk

3:30PM *The Leaning Intelligent Distribution Agent (LIDA) and Medical Agent X (MAX): Computational Intelligence for Medical Diagnosis [#14934]*

Steve Strain, Sean Kugele and Stan Franklin, University of Memphis, United States

The complexity of medical problem solving presents a formidable challenge to current theories of cognition. Building on earlier work, we claim that the systems-level cognitive model LIDA (for "Learning Intelligent Distribution Agent") offers a number of specific advantages for modeling diagnostic thinking. The LIDA Model employs a consciousness mechanism in an iterative cognitive cycle of understanding, attention, and action, endowing it with the ability to integrate multiple sensory modalities into flexible, dynamic, multimodal representations according to strategies that support specific task demands. These representations enable diverse, asynchronous cognitive processes to be dynamically activated according to rapidly changing contexts, much like in biological cognition. The recent completion of the LIDA Framework, a software API supporting the domain-independent LIDA Model, allows the construction of domain-specific agents that test the Model and/or enhance traditional machine learning algorithms with human-style problem solving. Medical Agent X (MAX) is a medical diagnosis agent under development using the LIDA Model and Framework. We review LIDA's

approach to exploring cognition, assert its appropriateness for problem solving in complex domains such as diagnosis, and outline the design of an initial implementation for MAX.

3:50PM *Two-Phase Multi-Swarm PSO and the Dynamic Vehicle Routing Problem [#15076]*
Michal Okulewicz and Jacek Mandziuk, Warsaw University of Technology, Poland

In this paper a new 2-phase multi-swarm Particle Swarm Optimization approach to solving Dynamic Vehicle Routing Problem is proposed and compared with our previous single-swarm approach and with the PSO-based method proposed by other authors. Furthermore, several evaluation functions and problem encodings are proposed and experimentally verified on a set of standard benchmark sets. For the cut-off time set in the middle of a day our method found new best- literature results for 17 out of 21 tested problem instances.

4:10PM *Proactive and Reactive Risk-Aware Project Scheduling [#14605]*
Karol Waledzik, Jacek Mandziuk and Slawomir Zadrozny, Warsaw University of Technology, Poland; Polish Academy of Science, Poland

In order to create a test-bed for Computational Intelligence (CI) methods dealing with complex, non-deterministic and dynamic environments we propose a definition of a new class of problems, based on the real-world task of project scheduling and executing with risk management. Therefore, we define Risk-Aware Project Scheduling Problem (RAPSP) as a (significant) modification of the Resource-Constrained Project Scheduling Problem (RCPSP). We argue that this task is, considering its daunting complexity, sometimes surprisingly well solved by experienced humans, relying both on tools and their intuition. We speculate that a CI-based solver for RAPSP should also employ multiple cognitively-inspired approaches to the problem and we propose three such solvers of varying complexity and inspiration. Their efficacy comparison is in line with our expectations and supports our claims.

4:30PM *Towards Intelligent Caring Agents for Aging-In-Place: Issues and Challenges [#15089]*
Di Wang, Budhitama Subagdja, Yilin Kang, Ah-Hwee Tan and Daqing Zhang, Nanyang Technological University, Singapore; Institut Mines-Telecom/Telecom SudParis, France

The aging of the world's population presents vast societal and individual challenges. The relatively shrinking workforce to support the growing population of the elderly leads to a rapidly increasing amount of technological innovations in the field of elderly care. In this paper, we present an integrated framework consisting of various intelligent agents with their own expertise and responsibilities working in a holistic manner to assist, care, and accompany the elderly around the clock in the home environment. To support the independence of the elderly for Aging-In-Place (AIP), the intelligent agents must well understand the elderly, be fully aware of the home environment, possess high-level reasoning and learning capabilities, and provide appropriate tender care in the physical, cognitive, emotional, and social aspects. The intelligent agents sense in non-intrusive ways from different sources and provide wellness monitoring, recommendations, and services across diverse platforms and locations. They collaborate together and interact with the elderly in a natural and holistic manner to provide all-around tender care reactively and proactively. We present our implementation of the collaboration framework with a number of realized functionalities of the intelligent agents, highlighting its feasibility and importance in addressing various challenges in AIP.

4:50PM *A Rapid Learning and Problem Solving Method: Application to the Starcraft Game Environment [#14153]*
Seng-Beng Ho and Fiona Liausvia, National University of Singapore, Singapore

Building on a paradigm of rapid causal learning and problem solving for the purpose of creating adaptive general intelligent systems and autonomous agents that we have reported previously, we report in this paper improved methods of rapid learning of causal rules that are robust and applicable to a wide variety of general situations. The robust rapid causal learning mechanism is also applied to the rapid learning of scripts - knowledge structures that encode extended sequences of actions with certain intended outcomes and goals. Our method requires only a small number of training instances for the learning of basic causal rules and scripts. We demonstrate, using the Starcraft game environment, how scripts can vastly accelerate problem solving processes and obviate the need for computationally expensive and relatively blind search processes. Our system exhibits human-like intelligence in terms of the rapid learning of causality and learning and packaging of knowledge in increasingly larger chunks in the form of scripts for accelerated problem solving.

CCMB'14 Session 3: Cognitive, Mind, and Brain

Wednesday, December 10, 3:30PM-5:10PM, Room: Bonaire 1, Chair: Robert Kozma

3:30PM *Limit Cycle Representation of Spatial Locations Using Self-Organizing Maps [#14520]*
Di-Wei Huang, Rodolphe Gentili and James Reggia, Department of Computer Science, University of Maryland, College Park, United States; Department of Kinesiology, University of Maryland, College Park, United States

We use the term ``neurocognitive architecture" here to refer to any artificially intelligent agent where cognitive functions are implemented using brain-inspired neurocomputational methods. Creating and studying neurocognitive architectures is a very active and increasing focus of research efforts. We have recently been exploring the use of neural activity limit cycles as representations of perceived external information in self-organizing maps (SOMs). Specifically, we have been examining limit cycle representations in terms of their compatibility with self-organizing map formation and as working memory encodings for cognitively-relevant stimuli (e.g., for images of objects and their corresponding names expressed as phoneme sequences \cite{huang14}). Here we evaluate the use of limit cycle representations in a new context of relevance to any cognitive agent: representing a spatial location. We find that, following repeated exposure to external 2D coordinate input values, robust limit cycles occur in a network's map region, the limit cycles representing nearby locations in external space are close to one another in activity state space, and the limit cycles representing widely separated external locations are very different from one another. Further, and in spite of the continually varying activity patterns in the network (instead of the fixed activity patterns used in most SOM work), map formation based on the learned limit cycles still occurs. We believe that these results, along with those in our earlier work, make limit cycle representations potentially useful for encoding information in the working memory of neurocognitive architectures.

P149 *A Sparsity-Based Training Algorithm for Least Squares SVM [#14550]*

Jie Yang and Jun Ma, University of Wollongong, Australia

We address the training problem of the sparse Least Squares Support Vector Machines (SVM) using compressed sensing. The proposed algorithm regards the support vectors as a dictionary and selects the important ones that minimize the residual output error iteratively. A measurement matrix is also introduced to reduce the computational cost. The main advantage is that the proposed algorithm performs model training and support vector selection simultaneously. The performance of the proposed algorithm is tested with several benchmark classification problems in terms of number of selected support vectors and size of the measurement matrix. Simulation results show that the proposed algorithm performs competitively when compared to existing methods.

P150 *Wolf Search Algorithm for Attribute Reduction in classification [#14909]*

Waleed Yamany, Eid Emary and Aboul Ella Hassanien, Fayoum University, Egypt; Cairo university, Egypt; Cairo unviersity (SRGE), Egypt

Data sets ordinarily includes a huge number of attributes, with irrelevant and redundant attributes. Redundant and irrelevant attributes might minimize the classification accuracy because of the huge search space. The main goal of attribute reduction is choose a subset of relevant attributes from a huge number of available attributes to obtain comparable or even better classification accuracy than using all attributes. A system for feature selection is proposed in this paper using a modified version of the wolf search algorithm optimization. WSA is a bio-inspired heuristic optimization algorithm that imitates the way wolves search for food and survive by avoiding their enemies. The WSA can quickly search the feature space for optimal or near-optimal feature subset minimizing a given fitness function. The proposed fitness function used incorporate both classification accuracy and feature reduction size. The proposed system is applied on a set of the UCI machine learning data sets and proves good performance in comparison with the GA and PSO optimizers commonly used in this context.

P151 *Alarm prediction in industrial machines using autoregressive LS-SVM models [#14072]*

Rocco Langone, Carlos Alzate, Abdellatif Bey-Temsamani and Johan A. K. Suykens, KU LEUVEN (ESAT-STADIUS), Belgium; Smarter Cities Technology Center, IBM Research-Ireland, Ireland; Flanders Mechatronics Technology Centre (FMTC vzw), Belgium

In industrial machines different alarms are embedded in machines controllers. They make use of sensors and machine states to indicate to end-users various information (e.g. diagnostics or need of maintenance) or to put machines in a specific mode (e.g. shut-down when thermal protection is activated). More specifically, the alarms are often triggered based on comparing sensors data to a threshold defined in the controllers software. In batch production machines, triggering an alarm (e.g. thermal protection) in the middle of a batch production is crucial for the quality of the produced batch and results into a high production loss. This situation can be avoided if the settings of the production machine (e.g. production speed) is adjusted accordingly based on the temperature monitoring. Therefore, predicting a temperature alarm and adjusting the production speed to avoid triggering the alarm seems logical. In this paper we show the effectiveness of Least Squares Support Vector Machines (LS-SVMs) in predicting the evolution of the temperature in a steel production machine and, as a consequence, possible alarms due to overheating. Firstly, in an offline fashion, we develop a nonlinear autoregressive (NAR) model, where a systematic model selection procedure allows to carefully tune the model parameters. Afterwards, the NAR model is used online to forecast the future temperature trend. Finally, a classifier which uses as input the outcomes of the NAR model allows to foresee future alarms.

P152 *Sensor dynamics in high dimensional phase spaces via nonlinear transformations: Application to helicopter loads monitoring [#14137]*

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Accurately determining component loads on a helicopter is an important goal in the helicopter structural integrity field, with repercussions on safety, component damage, maintenance schedules and other operations. Measuring dynamic component loads directly is possible, but these measurement methods are costly and are difficult to maintain. While the ultimate goal is to estimate the loads from flight state and control system parameters available in most helicopters, a necessary step is understanding the behavior of the loads under different flight conditions. This paper explores the behavior of the main rotor normal bending loads in level flight, steady turn and rolling pullout flight conditions, as well as the potential of computational intelligence methods in understanding the dynamics. Time delay methods, residual variance analysis (gamma test) using genetic algorithms, unsupervised non-linear mapping and recurrence plot and quantification analysis were used. The results from this initial work demonstrate that there are important differences in the load behavior of the main rotor blade under the different flight conditions which must be taken into account when working with machine learning methods for developing prediction models.

P153 *Automatic Text Categorization Using a System of High-Precision and High-Recall Models [#15075]*

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This paper presents an automatic text document categorization system, HPHR. HPHR contains high precision, high recall and noise-filtered text categorization models. The text categorization models are generated through a suite of machine learning algorithms, a fast clustering algorithm that efficiently and effectively group documents into subcategories, and a text category generation algorithm that automatically generates text subcategories that represent high precision, high recall and noise-filtered text categorization models from a given set of training documents. The HPHR system was evaluated on documents drawn from two different applications, vehicle fault diagnostic documents, which are in a form of unstructured and verbatim text descriptions, and Reuters corpus. The performance of the proposed system, HPHR, on both document collections showed superiority over the systems commonly used in text document categorization.

P154 *Simplified firefly algorithm for 2D image key-points search [#14840]*

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In order to identify an object, human eyes firstly search the field of view for points or areas which have particular properties. These properties are used to recognise an image or an object. Then this process could be taken as a model to develop computer algorithms for images identification. This paper proposes the idea of applying the simplified firefly algorithm to search for key-areas in 2D images. For a set of input test images the proposed version of firefly algorithm has been examined. Research results are presented and discussed to show the efficiency of this evolutionary computation method.

P155 *Human-Mobile Agents Partnerships in Complex Environment [#15094]*

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This article shall explore the robotic and software support strategies based on a sample activity providing optimum inputs, namely a simulated human missions. This mission will be treated as a clean-sheet approach for operating multiple, diverse and adaptive agents in complex environments. Building upon existing state-of-the-art hardware, like mobile robots, astrobiological instruments and software architectures, results and experiences from previous missions involving the partners, high-fidelity analog field tests shall demonstrate the added value, potential and limitations of adaptive machines supporting humans in a challenging environment.

P156 *K-means based Double-bit Quantization For Hashing [#14406]*

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Hashing function is an efficient way for nearest neighbor search in massive dataset because of low storage cost and low computational cost. However, it is NP hard problem to transform data points from the original space into a new hypercube space directly. Typically, the most of hashing methods choose a two-stage strategy. In the first stage, dimension reduction methods are used to project original data into desired dimensionality with real values. Then in the second stage, the real values are simply quantized into binary codes by thresholding for the most of existing methods. Although there is double-bit quantization (DBQ) strategy to improve quantization results. The existing solutions assume that the input data subject to gaussian distribution. In this paper, we propose a novel approach based on DBQ strategy, which can efficiently handle the situation under non-Gaussian distribution input. In the experiments, we demonstrate that our method is an efficient alternative to other methods based on DBQ strategy.

P157 *Fast Overcomplete Topographical Independent Component Analysis (FOTICA) and its Implementation using GPUs [#14810]*

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Overcomplete and topographic representation of natural images is an important concept in computational neuroscience due to its similarity to the anatomy of visual cortex. In this paper, we propose a novel approach, which applies the fixed-point technique of the method called FastICA \cite{Hyvarinen:99:626} to the ICA model with the properties of overcomplete and topographic representation, named Fast Overcomplete Topographic ICA (FOTICA). This method inherits the features of FastICA, such as faster time to convergence, simpler structure, and less parameters. The proposed FOTICA can easily be implemented in GPUs. In this paper, we also compare the performances with different system configurations. Through the comparison, we will show the performance of the proposed FOTICA and the power of implementing FOTICA using GPUs.

P158 *Toward an under specified queries enhancement using retrieval and classification platforms [#14412]*

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Radiography images are used usually for diseases detection and fracture that can be visible on lateral view. Magnification of the contrast and sharpness of the x-ray image will afford plenty and satisfactory visual information to the radiologist and clinician. In addition, increasing the accuracy of the segmentation and indexing subsequent modules in the CADs system for an autonomous disease diagnosis. Therefore, this paper describes a new strategy toward an under-specified queries enhancement using retrieval and classification platforms. In the retrieval platform, employing gamma correction (GC) function on under specified query image to generate DL descriptor that measures the relationship between the local contrast and the local brightness, measured respectively with the help of estimators of location and dispersion. Subsequently, it employs appropriate searching nearly optimal between the DL features of the query image and their corresponding similarity measurement in the archive database. In the classification platform, an approach was examined to predict gain value of GC function using statistical pixel-level (SPL) features extracted from the radiography images along with ANN's model classifier. The quality of the retrieved images is obtained with referring to their under-specified query images. In addition, the problem of gain value estimation is transformed to a classification problem solved using ANN's model with three different modes measurement. Results indicate that the proposed approach significantly improve the image quality with revealed under imbalance condition that can help in image segmentation for vertebral detection and mobility analysis.

P159 *A Multi-modal Moving Object Detection Method Based on GrowCut Segmentation [#14494]*

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Commonly-used motion detection methods, such as background subtraction, optical flow and frame subtraction are all based on the differences between consecutive image frames. There are many difficulties, including similarities between objects and background, shadows, low illumination, thermal halo. Visible light images and thermal images are complementary. Many difficulties in motion detection do not occur simultaneously in visible and thermal images. The proposed multimodal detection method combines the advantages of multi-modal image and GrowCut segmentation, overcomes the difficulties mentioned above and works well in complicated outdoor surveillance environments. Experiments showed our method yields better results than commonly-used fusion methods.

P160 *Inertial-Visual Pose Tracking Using Optical Flow-aided Particle Filtering [#15011]*

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This paper proposes an algorithm for visual-inertial camera pose tracking, using adaptive recursive particle filtering. The method benefits from the agility of inertial-based and robustness of vision-based tracking. A proposal distribution has been developed for the selection of the particles, which takes into account the characteristics of the Inertial Measurement Unit (IMU) and the motion kinematics of the moving camera. A set of state-space equations are formulated, particles are selected and then evaluated using the corresponding features tracked by optical flow. The system state is estimated using the weighted particles through an iterative sequential importance resampling algorithm. For the particle assessment, epipolar geometry, and the characteristics of focus of expansion (FoE) are considered. In the proposed system the computational cost is reduced by excluding the rotation matrix from the process of recursive state estimations. This system implements an intelligent decision making process, which decides on the best source of tracking whether IMU only, hybrid only or hybrid with past state