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CIS Technical Committee Position Statements

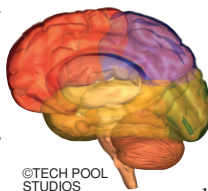I n my previous article that appeared in the November issue, I presented a brief overview on the goals and activities of all the technical committees (TCs) within the Society. Starting from this issue onward, individual TC chairs will write about their own TCs on exciting research topics, main achievements, and the future research directions in both CI techniques and applications. Here, I join the TC chairs in warmly inviting you once again to actively participate in these fascinating and fruitful activities!

NNTC Position Paper

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T he *Neural Networks Technical Committee* (NNTC), established in 1994, is one of the oldest technical committees of the Computational Intelligence Society (CIS). It came into existence even before the Neural Networks Council developed into a Society of the IEEE. The International Joint Conference on Neural Networks (IJCNN) originated from this technical committee. It is one of 11 technical committees (TCs) of the CIS, and is a technology-oriented TC, rather than an application-oriented TC. The main purpose of this committee is to provide a home for technical activities related to neural networks. The NNTC promotes the research, development, education, and understanding of neural networks, including both artificial and biologically plausible neural networks. Specific responsibilities of the TC include fostering scientific and technological development, proposing conferences and workshops, organizing invited sessions for existing conferences, proposing special issues in the transactions and the CI Magazine, and cooperating in nomination of awards candidates.

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Some Task Forces (TFs) have been established within NNTC to concentrate on the development of specialized focuses within the NNTC area of interest. At present, the NNTC has the following TFs: Vision and Image Processing, Evolvable Neural Networks (previously "Adaptive Systems"), Neural Hardware, Neuroinformatics, Speech and Audio Processing, Neural Dynamics, Computational Neuroscience, Hybrid Intelligent Systems, The Mind and Brain, and Undergraduate Research and Education.

The TFs and members of the NNTC organized a number of special sessions for the past IJCNN 2006, e.g., special sessions on temporal information processing, including speech and audio processing, evolvable neural networks, support vector machines and kernel methods, seven special sessions on topics related to mind and brain, and three special sessions on hybrid intelligent systems (Hybrid Neural Intelligent Systems, Hybrid Fuzzy Intelligent Systems, Hybrid Intelligent Systems Design). The NNTC also proposed special issues for the IEEE Transactions on Neural Networks (TNN) on support vector machines and kernel methods, and another on The Mind, Brain and Cognitively Inspired Neural Networks.

The TFs on Hybrid Intelligent Systems, Mind and Brain, and Undergraduate Research and Education are new. The purposes of these three TFs are presented subsequently.

There is a need for investigating hybrid approaches combining neural networks with other intelligent methodologies; for this reason, it is appropriate to provide a forum for the

interaction between the neural network community and the different communities in computational intelligence (like fuzzy logic and evolutionary computing). The *Hybrid Intelligent Systems Task Force* contributes to the integration of different Soft Computing (SC) methodologies for the development of hybrid intelligent systems for modeling, simulation and control of non-linear dynamical systems. SC methodologies at the moment include (at least) Neural Networks, Fuzzy Logic, Genetic Algorithms and Chaos Theory. Each of these methodologies has advantages and disadvantages, and many problems have been solved by using one of these methodologies. However, many real-world complex problems require the integration of several of these methodologies to really achieve the efficiency and accuracy needed in practice. In this TF, research on all SC methodologies will be considered, and careful consideration will also be given to their applications to modeling, simulation and control. Detailed methods for integrating the different SC methodologies in solving real-world problems and hybrid intelligent systems with applications to the

following areas are of interest: Robotic Dynamic Systems, Non-linear Plants, Manufacturing Systems, Pattern Recognition and Time Series Prediction. The Hybrid Intelligent Systems Task Force is chaired by Patricia Melin.

The purpose of the *Task Force on The Mind and Brain* is to promote the research, development, education, and understanding of neural network technology inspired by knowledge of functioning of the mind and brain. This was, of course, the original impetus of the neural network field. Currently, a significant amount of neural network research is devoted to development of various applications based on simplified neural paradigms, which represent only a small aspect of our knowledge about the mind and brain. This TF's aim is to stimulate development of neural networks inspired by and capable of modeling higher cognitive functions, including language and its interaction with cognition and culture. The Task Force on The Mind and Brain is chaired by Leonid Perlovsky.

So far, little, if any, attention has been given to research and education at the undergraduate level. Most research

and education activities focus on graduate students, in part due to the level of knowledge required to understand the advanced neural networks used today. However, with the maturity of the subject area, undergraduate students can also be activated to pursue an interest in CIS. The focus of the *Task Force on Undergraduate Research and Education* will thus be to survey to what extent neural networks (and even other subject areas of CI) are already used in teaching and in undergraduate research projects. The results could be disseminated through publications, special sessions or workshops, books or edited volumes. The aims are: (1) to find out which aspects of neural networks have been used at the undergraduate level, (2) to inspire more people to use these technologies at an early stage in university teaching and research, and (3) to raise more interest among students for these topics at an early stage. The Task Force on Undergraduate Research and Education is chaired by Ian Cloete.

If you are interested to participate, then do not hesitate to contact the TC chair, the TF chairs or individual members of the NNTC. We welcome your contribution!

FSTC Position Paper

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The *Fuzzy Systems Technical Committee (FSTC)* deals with fuzzy systems technology, including the creation of fuzzy systems theory and models, development of new design procedures for fuzzy systems, computing with words, and applications of fuzzy technologies. The Chair of this TC is Jerry Mendel, and presently it has 30 members.

There are now eight task forces:

❏ Applications: Dimitar Filev, Chair
❏ Competitions: Neil Eklund, Chair
❏ Extensions to Type-1 Fuzzy Sets: Bob John, Chair, and Hani Hagras, Co-Chair
❏ Future of Fuzzy Sets and Systems: Woei Wan Tan, Chair
❏ Fuzzy Sets and Systems Hardware: Oscar Castillo, Chair
❏ Fuzzy Software: Plamen Angelov, Chair

❏ Genetic Fuzzy Systems: Oscar Cordon, Chair
❏ Interval Computations and Fuzzy Techniques: Vladik Kreinovich, Chair

These TFs have specific missions, e.g., the new *Fuzzy Software TF* will collect available MATLAB and Java-based (e.g., Weka plug-ins for fuzzy learning approaches) software and make them available to all members of the CIS, the

Extensions to Type-1 Fuzzy Sets TF promotes extensions to type-1 fuzzy sets (e.g., type-2 fuzzy sets, rough sets, intuitionistic fuzzy sets) and their applications within the fuzzy logic research community, and the new *Future of Fuzzy Sets and Systems TF* will canvas the leaders in the fuzzy field and collect their opinions on where they believe the field is or should be heading, and then disseminate this information to the CIS. Some of the TFs also organize special issues of the *IEEE Transactions on Fuzzy Systems*, and the *Extensions to Type-1 Fuzzy Sets TF* maintains two Web sites: www. cse.dmu.ac. uk/~rij/fstctf.html and www.type2fuzzy-logic.org.

A novel outcome from the *Extensions to Type-1 Fuzzy Sets TF* is a reference document titled "Standard Background Material About Interval Type-2 Fuzzy Logic Systems That Can Be Used By All Authors," prepared by Jerry Mendel, Hani Hagras and Bob John. It was submitted to the CIS Standards Committee and was approved and accepted as a CIS reference document. It is available on the CIS Web page, as well as on the TF Web page. This fundamental reference document consists of background material about interval type-2 fuzzy sets, interval type-2 fuzzy logic systems (IT2 FLSs), type-reduction and defuzzification in an IT2 FLS, and an IT2 FLS that does not use type-reduction. As a service to the fuzzy logic community, all authors have permission to use any or all of the material in their articles. The reference document is available in PC, MAC WORD, or PDF versions.

Members of the FSTC are also actively involved in the annual FUZZ-IEEE Conference, e.g., the Chair and Co-Chairs of FUZZ-IEEE 2007, which will be held July 23–26 in London, are Qiang Shen, Robert John and Hani Hagras, and many members are on the International Program Committee for this conference.

When the FSTC was recently canvassed about "what's hot in fuzzy," the hottest topics identified by the FSTC were:

❏ Type-2 fuzzy systems, including type-2 fuzzy logic controllers, and their applications in a myriad of fields
❏ Fuzzy logic applications in sensor networks, ad hoc networks, wireless networks, and high-speed networks
❏ Fuzzy logic applications in homeland security such as threat assessment
❏ T–S fuzzy model-based fuzzy control
❏ Fuzzy-logic hardware, especially for type-2 fuzzy logic systems
❏ Fuzzy logic applications for the Internet, especially search and question answering
❏ Computing with words, including linguistic summarizations
❏ Fuzzy logic in probability
❏ Aggregation using fuzzy logic techniques

# ECTC Position Paper

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The Evolutionary Computation Technical Committee (ECTC) promotes research, development, and teaching of computational techniques that use non-deterministic methods to adapt their behavior during time. These techniques are inspired by adaptive methods found in nature and solve problems by modeling evolutionary processes. Any such computational technique shall be referred to as an evolutionary computation (EC).

The ECTC engages in various activities in order to promote EC as a viable technology, including but not limited to the following: recommend candidates to the Awards Committee for the CIS Pioneer Award in the EC area, nominate papers for Outstanding Paper Awards to the Awards Committee from papers published in the Transactions on EC, propose special sessions to the CIS-sponsored conference organizers, participate in paper reviews and selection for CIS-sponsored conferences and publications, promote IEEE Senior Members and Fellows program, collaborate on production of tutorials, and book series with the Multimedia Committee, maintain the Committee's Web site, facilitate local chapters' activities and organize specialized workshops or

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meetings. The ECTC assists in soliciting conference proposals and actively works with the organizers of CIS-sponsored conferences to ensure their technical excellence. When requested by the CIS, the ECTC evaluates and reports on the technical merits of conference or symposium proposals submitted to the CIS.

In pursuing the ECTC activities, the TC members are joined by a number of colleagues organized currently in ten workgroups (WGs). The collective activities during the last year included two books (Multi-Objective Machine Learning,
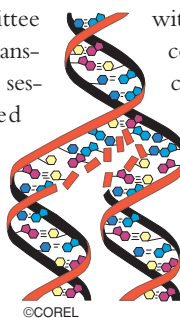
Introduction to Evolvable Hardware: A Practical Guide for Designing Self-Adaptive Systems); three special journal issues (Evolutionary Multi-objective optimization (International Journal of Computational Intelligence Research, European Journal of Operational Research), Evolutionary Optimization in the Presence of Uncertainties (IEEE Transactions on Evolutionary Computation)); twelve special sessions in conferences (Evolutionary Algorithms Based on Probabilistic Models (CEC'05/06), Evolvable Machines (CEC'06, 1st Conference on Adaptive Hardware and Systems), ALife and CAS (CEC'05), ECiDUE and Evolutionary Computation for Expensive Optimization Problems (CEC'06), Swarm Intelligence (WCCI2006), Games sessions (CEC'05/06); four conferences (2nd Australian Conference on Artificial Life, IPCAT, AHS2006, and CEC); and six workshops/symposiums (2005 and 2006 IEEE Symposium on Computational Intelligence and Games, FDEC Workshop (CEC'05), Workshop on Multi-objective Robotics (2006 IEEE/RSJ International Conference on Intelligent Robots and Systems), 2006 IEEE Swarm Intelligence Symposium, 3rd European Workshop on Evolutionary Algorithms in Stochastic and Dynamic Environments). The WG on Games was approved to become a new TC.

Each WG is building an active and healthy infrastructure to promote specific well-focused topical areas within the EC field. The WG on *Artificial Immune Systems* (Chair: Dipankar Dasgupta) investigates the remarkable information-processing abilities of the biological immune system that provides important aspects in the field of computation with its highly parallel and distributed adaptive system. AIS is used in many applications including anomaly detection, data mining, and computer security.

Multi-objective optimization refers to the solution of problems with two or more objectives to be satisfied simultaneously. Normally, such objectives are in conflict with one another and are expressed in different units, and problems normally have not one but a set of solutions. The WG on *Multi-Objective Evolutionary Algorithms* (Chair: Carlos Coello) presents valuable resources demonstrating why EC algorithms are particularly suitable for these problems despite the existence of numerous mathematical programming techniques.

Unlike other evolutionary computation techniques, particle swarm optimization is associated with a velocity, where the particles have a tendency to fly toward the better search area during the course of a search process. The WG on *Swarm Intelligence* (Chair: Yuhui Shi) considers problems including constrained optimization, min-max problems and dynamic tracking.

The WG on *Evolutionary Scheduling and Timetabling* (Chair: Rong Qu) redresses a research area at the interface of Artificial Intelligence and Operational Research, with interest in both the theoretical and practical aspects related to the application of evolutionary methods.

The WG on *Evolutionary Algorithms Based on Probabilistic Models* (Chair: José Antonio Lozano) considers the systematic way to solve hard search and optimization problems, joining researchers and practitioners in EC, machine learning, statistics and simulation.

Complex adaptive systems involve the study of many agents and their rich interactions, combining agent-based modeling and an EC model in order to develop insight and foster predictive methodologies. In 2007, the WG on *Artificial Life and Complex Adaptive Systems* (Chair: Hussein Abbass) is organizing the first IEEE Symposium on Artificial Life in Honolulu, USA.

Other WGs are *Coevolution* (Chair: Graham Kendall), *Evolutionary Computa-tion in Dynamic and Uncertain Environments* (Chair: Yaochu Jin) covering evolutionary computation with evaluations of noisy, imprecise, or time-varying fitness, and *Evolvable Hardware* (Chair: Andy Tyrrell) promoting simulated evolution to search for new hardware configurations.

The ECTC activities assist with defining future development of the theory and application of Evolutionary Computation. During an annual workshop associated with the IEEE Congress on Evolutionary Computation, the WG on *Future Directions of Evolutionary Computation* (Chair: Ali Zalzala) moderated a number of presentations, debates and discussions from leaders in the EC field. These culminated in defining three items in each of four themes along which a better understanding of the EC field may be pursued: (1) Working with other fields (terminologies, hybridization, domain experts and EC experts), (2) Getting industry on-board (defining their problems, having convincing applications, fast answers to meaningful problems), (3) Education issues (proper background e.g., lack of mathematics for biology/computer science students, career development and convincing research, interdisciplinary area for students and researchers), and (4) Is EC the answer? (scalability and time complexity, balance of applications and theory, industry input in EC meetings). A white paper on Evolutionary Computation Market Introduction was presented, providing a possible implementation roadmap for the FDEC workshops recommendations.

We strive to serve the wider community, but can only enhance our contributions through the engagement of members of the community. Active participation including the formation of new WGs is always welcomed, so please visit our Web page http://ieee-cis.org/ec/ for further information and contact details. 🕽