Editors: H. Fujita, J. Sasaki

SELECTED TOPICS IN APPLIED COMPUTER SCIENCE

10th WSEAS International Conference on Applied Computer Science (ACS '10)

SELECTED TOPICS IN APPLIED COMPUTER SCIENCE

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Iwate Prefectural University

Iwate Prefectural University, Japan, October 4-6, 2010

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Preface

This year the 10th WSEAS International Conference on APPLIED COMPUTER SCIENCE (ACS '10) was held at the Iwate Prefectural University, Japan, October 4-6, 2010. The conference remains faithful to its original idea of providing a platform to discuss programming languages, software engineering, project management, intelligent agents, data mining, web engineering, network applications, algorithms etc. with participants from all over the world, both from academia and from industry.

Its success is reflected in the papers received, with participants coming from several countries, allowing a real multinational multicultural exchange of experiences and ideas.

The accepted papers of this conference are published in this Book that will be indexed by ISI. Please, check it: www.worldses.org/indexes as well as in the CD-ROM Proceedings. They will be also available in the E-Library of the WSEAS. The best papers will be also promoted in many Journals for further evaluation.

A Conference such as this can only succeed as a team effort, so the Editors want to thank the International Scientific Committee and the Reviewers for their excellent work in reviewing the papers as well as their invaluable input and advice.

The Editors

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Plenary Lecture 1

Face Recognition Using Frequency Domain Feature Extraction Methods

Professor Hector Perez-Meana
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Abstract: The development of security systems based on biometric features has been a topic of active research during the last three decades, because the recognition of the people identity to access control is a fundamental issue in these days. Terrorist attacks happened during the last decade have demonstrated that it is indispensable to have reliable security systems in offices, banks, airports, etc.; increasing in such way the necessity to develop more reliable methods for people recognition. The biometrics systems consist of a group of automated methods for recognition or verification of people identity using the physical characteristics or personal behavior of the person under analysis. In particular the face recognition has been a topic of active research because the face is the most direct way to recognize the people. In addition, the data acquisition of this method consists, simply, of taking a picture with or without collaboration of the person under analysis, doing it one of the biometric methods with larger acceptance among the users.

The face recognition is a very complex activity of the human brain. For example, we can recognize hundred of faces learned throughout our life and to identify familiar faces at the first sight, even after several years of separation, with relative easy. However it is not a simple task for a computer. Thus to develop high performance face recognition systems, we must to develop accurate feature extraction and classification methods, because, as happens with any pattern recognition algorithm, the performance of a face recognition algorithm strongly depends on the feature extraction method and the classification systems used to carry out the face recognition task. Thus during the last decades several feature extraction methods for using in face recognition systems have been proposed during the last decades, which achieve high accurate recognition. Among the situations that drastically decrease the accuracy and that must be considered to develop high performance face recognition method we have: partial occlusion, illumination variations, size change, rotation and translation of the capture image, etc. To solve these problems several efficient feature extraction methods have been proposed, several of them using frequency domain transforms such as discrete Gabor transform, discrete Fourier transform, Discrete cosine transform, etc. These methods achieve recognition rates higher than 90%.

In this talk, we analyze several frequency domain feature extraction methods based on the Discrete Gabor transform, Discrete Fourier Transform, Discrete Wavelet Transform, Discrete Cosine Transform, Discrete Walsh-Hadamard Transform and Eigenphases. These feature extraction methods are used with different classifiers such as artificial neural networks (ANN), Gaussian Mixture Models (GMM) and Support vector machines (SVM). The evaluation results were obtained using well known public domain databases such as "AR Face Database".

Brief Biography of the Speaker:

Hector Perez-Meana received his M.S: Degree on Electrical Engineering from the Electro-Communications University of Tokyo Japan in 1986 and his Ph. D. degree in Electrical Engineering from the Tokyo Institute of Technology, Tokyo, Japan, in 1989. From March 1989 to September 1991, he was a visiting researcher at Fujitsu Laboratories Ltd, Kawasaki, Japan. From September 1991 to February 1997 he was with the Electrical Engineering Department of the Metropolitan University of Mexico City where he was a Professor. In February 1997, he joined the Graduate Studies and Research Section of The Mechanical and Electrical Engineering School, Culhuacan Campus, of the National Polytechnic Institute of Mexico, where he is now The Dean. In 1991 he received the IEICE excellent Paper Award, and in 2000 the IPN Research Award and the IPN Research Diploma. In 1998 he was Co-Chair of the ISITA'98, and in 2009 he was the General Chair of The IEEE Midwest Symposium on Circuit and Systems (MWSCAS). Prof. Perez-Meana has published more that 100 papers and two books. He also has directed 15 PhD theses and more than 30 Master theses. He is a Senior member of the IEEE, member of The IEICE, The Mexican Researcher System and The Mexican Academy of Science. Prof. Perez-Meana is member of the Editorial Board of The Journal of Telecommunications and Radio Engineering, he is also member of The Editorial Board of The Journal of Electromagnetic Waves and Radio Engineering. His principal research interests are adaptive systems, image processing, pattern recognition watermarking and related fields.

Plenary Lecture 2

Computations in Hyperbolic Spaces with Surprising Applications

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Abstract: Computations in hyperbolic spaces are difficult due to the group properties of these spaces which make it difficult to use these tools, in sharp contrast with the Euclidean situation.
The author devised a way to navigate in the tessellations of the hyperbolic plane and one of the four tessellations of the hyperbolic 3D space. This constitutes an actual GPS which allows to know the position of each tile with respect to the others and to go from one tile to another one. From this, true coordinates for the points of these spaces themselves can be devised which have a nice behaviour undeer shifts which preserve the tessellation.
In the talk, we sketchilly remind the Poincare"s disc model which we use in order to try to see something in these spaces. Then, we describe the coordinate system. In the main part of the talk, we present and discuss the wide range of its applications: this goes from cosmology to computer science itself, including the Internet. We shall look at already realized applications and at those waiting for realization as well.

Brief Biography of the Speaker:
MARGENSTERN Maurice, born on June, 6, 1947, Paris, France, married, 2 children, 1 grand-child, is full professor at the University of Metz, IUT of Metz, France, from 1995. Formerly, he was associated professor at the department of mathematics of the University Paris-Sud. He was the head of LITA (Laboratoire d'Informatique The'orique et Applique'e), from 2000 up to 2008 and an elected member of the scientific council of his university from 2000 up to 2004. He was also the head of the hiring committee of his university for computer science from 1998 up to 2004. Recently, he was promoted to the exceptional class for university professors by the National Council of Universities in France.
His scientific activity deals with the frontier between decidability and undecidability which is studied in various models of discrete computations. He has important results in Turing machines, in cellular automata and in (bio)molecular computing. He wrote 183 papers, among them 55 in well known international journals, 48 in international conferences with proceedings. He is a member of the Editorial Board of the Journal of Universal Computer Science, of the Journal of Cellular Auotmata and he is a member of the Advisory Board of the Computer Science Journal of Moldova. He is a member of WG 1.5 in the TC1 of IFIP.
He is very active in the field of cellular automata. He introduced an original method in order to implement these automata in hyperbolic spaces. This has very interesting connections with elementary theory of numbers and the theory of languages. It may also have surprising applications. He published many papers on this topic and a two-volumed book, "Cellular Automata in Hyperbolic Spaces", an important scientific event. He is also a contributor to Springer Encyclopedia of Complexity and Systems Science.
Maurice Margenstern edited several special issues in international journals of Computer Science: in Theoretical Computer Science, in Fundamenta Informaticae and a new issue is currently planned for the International Journal of Foundations of Computer Science.
Maurice Margenstern organised a cycle of conferences, called "Machines, Computations and Universality", MCU-conferences, which hold each third year starting from 1995. Each edition of the conference is followed by a special issue of a well know journal: TCS for the first three editions, FI for the fourth and fifth editions (Saint-Petersburg, 2004 and Orle'ans, 2007). The sixth edition is to be held at Pittsburgh, USA, in September, 21-25, 2010. The proceedings will be published in EPTCS and a special issue of IJFCS will follow the conference, devoted to its topics.

Plenary Lecture 3

Pervasive Business Intelligence Architecture

Professor Zeljko Panian
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University of Zagreb
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Abstract: Pervasive business intelligence (BI) is the ability to deliver integrated right-time information to all users – including managers at all levels, front-line and back-office employees, suppliers, customers, and business partners. It provides an enterprise with the necessary visibility, insight, and facts to make smarter decisions in all processes at all times. In most companies, this means leveraging the existing BI infrastructure by providing decision services to multiple managerial and operational business processes.
The pervasive BI architecture illustrates both transactional services (i.e., Online Transaction Processing, OLTP) and decision-making services as peers in the existing infrastructure. Enterprise users may access the IT infrastructure via internal and external Web portals, enterprise and Web applications, POS terminals, self-service kiosks, hand-held devices, and interactive voice response servers.
Transaction services are applications that provide the enterprise bookkeeping function. This is where we find traditional call center automation (operational customer relationship management, CRM), enterprise resource planning (ERP), supply chain management (SCM), and legacy applications.
Data integration services bridge multiple domains, providing both continuous streams of information, as well as batch file data acquisition. Acquiring changed data from the transactional repositories; the data integration services extract, discover, cleanse, transform, and deliver data to multiple subscribers.
Decision repositories are the enterprise data warehouses, data marts, and operational data stores. They ingest and persist the results of data integration services and provide high-speed access to a wide variety of data content.
Decision services are used to analyze facts, patterns, and relationships in enterprise data repositories and deliver relevant information. This part of the architecture focuses on BI and applications accessing the data warehouse. This includes reporting, data mining, dashboarding, tactical applications, operational applications, and strategic applications, such as market segmentation, risk analysis, category management, profitability analysis, user satisfaction analysis, financial planning, and business performance management.
Enterprise application integration is largely achieved using an Enterprise Service Bus (ESB), messaging middleware, J2EE and .NET developer tools, and service-oriented architecture (SOA). Included here are numerous middleware services, such as adapters, transforms, agents, publish and subscribe, and information routing.
Business process automation is a collection of capabilities to oversee and orchestrate processes. This includes Business Process Management (BPM), Business Activity Monitoring (BAM), and Business Rules Engines (BRE). These systems manage SOA workflow, detect events, send alerts and alarms, and allow business users to dynamically change business rules in real time.

Brief Biography of the Speaker:
Zeljko Panian is full professor of business informatics at The Faculty of Economics and Business, University of Zagreb, Croatia. He received his master degree in 1978 and Ph. D. in 1981 at the University of Zagreb. His scientific interests are primarily focused on Enterprise Information Systems, e-Business and Business Intelligence.
He wrote 32 books and more than 150 scientific and professional papers, and lectured as a visiting professor at the People's University of China at Beijing, Florida State University in Tellahassee (USA), University of Maribor (Slovenia) and University of Sarajevo and Mostar (Bosnia and Herzegovina), as well as nearly all universities in Croatia.
For several times, he delivered invited, keynote and plenary speeches at WSEAS and other international conferences and symposiums.

Plenary Lecture 4

Black Holes Nonholonomic Thermodynamics

Professor Constantin Udriste
Department of Mathematics
University Politehnica of Bucharest
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Abstract: This Lecture presents the geometry and the interaction of nonholonomic black hole systems using a specialized MAPLE soft for computing. Our point of view is strongly connected to the possibility of describing a nonholonomic black hole system via a Gibbs-Pfaff equation, or to the possibility of having extremum problems with nonholonomic constraints.
Section 1 introduces a nonholonomic black hole system and proves that the existence of an integral surface of the Gibbs-Pfaff equation implies the second area condition (the equality of two elements of area). Section 2 shows that the equilibrium after interaction of two nonholonomic black hole systems is realized at equal temperatures and equal angular velocities. Section 3 uses the nonholonomic theory of Vranceanu to build the subriemannian geometry of black holes. Section 4 computes the coefficients of the bilinear covariants of the Gibbs-Vranceanu co-framed nonholonomic space. The geometry of the Gibbs-Vranceanu-Riemann nonholonomic space is represented by the Ricci rotation coefficients (Section 5), the geodesics (Section 6), the Ricci coefficients with four indexes (Section 7), the Ricci tensor and the scalar curvature (Section 8). We introduce also some interesting submanifolds: the submanifold of the coefficients of bilinear covariants (Section 9), the submanifold of Ricci rotation coefficients (Section 10), the submanifold of Ricci coefficients with four indexes (Section 11). Section 12 underlines that some properties of black holes can be obtained using geometric tools in MAPLE version.

Brief Biography of the Speaker:
Important Career Positions: Dean, Director, Chair, Full Professor 1990-, University Politehnica of Bucharest, Department of Mathematics-Informatics I.
Number of PhD Students: 25 in due time and 14 Doctors in Mathematics.
Membership of Associations: AMS, 1987; Tensor Society, 1985; Balkan Society of Geometers, President, 1994;
Publications: over 40 books; 230 papers; 230 communications.
Honours: D. Hurmuzescu Prize, Romanian Academy, 1985; Award MEI, 1988; Correspondent Member, Academia Peloritana, Messina, 1997; Titular Member, Academy of Romanian Scientists, 2007; Honorary Member, World Scientific and Engineering Academy and Society, 2008-;
Main Organizer: The International Conference of Differential Geometry and Dynamical Systems, University Politehnica of Bucharest, October 5-7, 2007; The International Conference of Differential Geometry and Dynamical Systems, The V-th International Colloquium of Mathematics in Engineering and Numerical Physics, August 29-September 02, 2008; The International Conference of Differential Geometry and Dynamical Systems, University Politehnica of Bucharest, October 7-11, 2009.
Chair Committee or Member of the International Advisory Committee: 7th WSEAS International Conference on Systems Theory and Scientific Computation (ISTASC-07), Vouliagmeni Beach, Athens, Greece, August 24-26 (2007); European Computing Conference, Vouliagmeni Beach, Athens, Greece, September 24-26, 2007; 12th WSEAS International Conference on Applied Mathematics, Cairo, Egypt, Dec. 29-31, 2007; 7th WSEAS International Conference on Circuits, Systems, Electronics, Control and Signal Processing, Cairo, Egypt, Dec. 29-31, 2007; Chair-Committee: American Conference on Applied Mathematics (Math-08) and Management, Marketing and Finances (MMF-08), Cambridge, Massachusetts, USA, March 24-26, 2008; International Program Committee: The Applied Computing Conference (ACC-08), Istanbul, Turkey, May 27-30, 2008; European Computing Conference (ECC-09), Tbilisi, Georgia, June 26-28, 2009; The 9th WSEAS International Conference on Applied Informatics and Communications (AIC-09), Moscow, Russia, August 20-22, 2009; The 10th International Conference on Applied Computer Science (ACS-10), Iwate, Japan, October 4-6, 2010.
Fields of Interest: Differential Geometry, Optimizations on Riemannian Manifolds, Magnetic Dynamical Systems, Geometric Dynamics, Multitime Optimal Control.

Plenary Lecture 5

Multiple Latticed Cellular Automata: HIV Dynamics in Coupled Lymph Node and Peripheral Blood Compartments

Professor Yongwimon Lenbury
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Dept of Mathematics, Faculty of Science, Mahidol University, THAILAND
Centre of Excellence in Mathematics, PERDO, CHE, THAILAND
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Abstract: Cellular automata simulation approach has become well known as a useful technique to investigate complex biomedical systems in situations where traditional methodologies are difficult or too costly to employ. In certain applications, multiple lattices are needed to simulate parallel multi-compartmental systems. So far, relatively simple cellular automata models have been proposed to simulate the dynamics of HIV infection in human. Most cellular automata models only considered viral proliferation in the lymph node. However, most clinical indications of AIDS progression are based on blood data, because these data are most easily obtained. Since viral population circulates between lymph node and plasma, viral load in the two compartments are important for the description of HIV infection dynamics. We present here cellular automata simulations of a two-compartment model of HIV proliferation with delay.

Plenary Lecture 6

Facial Expression Recognition for Speaker Using Thermal Image Processing and Speech Recognition System

Professor Yasunari Yoshitomi
Information Communication System Lab.
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Abstract: The goal of our research is to develop a robot which can perceive human feelings or mental states. The robot should be able to interact in a friendly manner with a human. For example, it could perhaps encourage a human who looks sad. Moreover, it could advise a person to stop working and rest for a while when the individual looks tired. Moreover, it could take care of a person advanced in years.
The presented investigation concerns the first stage of development wherein a robot acquires vision with the ability to detect human feeling or inner mental states. Although the mechanism for recognizing facial expressions as one of the main, visible expressions of feeling has been received considerable attention in the course of computer vision research, its present stage still falls far short of human capability, especially from the viewpoint of robustness under widely ranging lighting conditions. One of the reasons is that nuances of shade, reflection, and local darkness influence the accuracy of facial expression recognition through the inevitable change of gray levels. In order to avoid the problem and to develop a robust method for facial expression recognition applicable under widely varied lighting condition, we have used an image registered by infrared rays (IR) which describes the thermal distribution of the face. Although a human can not detect IR, it is possible for a robot to process the information around it using thermal images created by IR. Therefore, as a new mode of robot-vision, thermal image processing is a practical method viable under natural conditions.
The timing of recognizing facial expressions is also important for a robot because the processing for doing it might be time-consuming. We have adopted an utterance as the key of expressing human feelings or mental states because humans tend to say something to express feelings.
In this talk, I lecture on our method for facial expression recognition for a speaker by exploiting a new technique for deciding the timing positions of extracting the frames from the thermal dynamic image at an utterance, using a speech recognition system. For facial expression recognition, we pick up three images (i) just before speaking, in speaking (ii) the first and (iii) last vowels at an utterance. The face direction is also estimated for selecting front-view faces as targets of facial expression recognition using thermal image processing. A two-dimensional discrete cosine transformation is performed for transforming gray-scale values on each block in focused face-parts of image into their frequency-components, which are used for generating feature vectors. In this method, the facial expressions are discriminable with the good recognition accuracy, when he or she exhibits one of the intentional facial expressions of "angry", "happy", "neutral", "sad", and "surprise".

Brief Biography of the Speaker:
Yasunari Yoshitomi received his B.E., M.E. and Dr. Eng. degrees in Applied Mathematics and Physics from Kyoto University in 1980, 1982, and 1991, respectively. He had worked in Nippon Steel Corporation from 1982 to 1995 and had been engaged in image analysis application and development of soft magnetic materials. From 1995 to 2001, he had been in Miyazaki University as an associate professor at the Department of Computer Science and Systems Engineering. From 2001 to 2008, he had been in Kyoto Prefectural University as a professor at the Department of Environmental Informatics. Since 2008, he has been in Kyoto Prefectural University as a professor at the Environmental Information System Subdivision, Division of Environmental Sciences, Graduate School of Life and Environmental Sciences. He is a member of IEEE, IPSJ, IEICE, JSIAM, ORSJ, HIS, SSJ and IIEEJ. He received a Best Paper Award from IEEE International Workshop on Robot and Human Communication in 1998, and a Best Paper Award from IEEE International Workshop on Robot and Human Interactive Communication in 2000. He has published more than 100 papers, two reviews, two books, and more than 200 patents. He has been listed in the 2010 Edition of Marquis Who's Who in the World. His current research interests are communication between human and computer, media information processing, watermarking and biometric authentication on digital content, stochastic programming problem and simulation on emission trading of greenhouse effect gas.

Plenary Lecture 7

Genetic Search Algorithms to Fuzzy Multiobjective Games: A Mathematica Implementation

Professor Andre A. Keller
Universite de Lille 1 Sciences et Technologies
Cite Scientifique 59655 Villeneuve d'Ascq Cedex FRANCE
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Abstract: Genetic stochastic search algorithms (GAs) have soon demonstrated their helpful contribution in finding solutions to the complex real-life optimization problems. In 2005, Mastorakis' method successfully combines the GAs with the Nelder-Mead (NM) simplex optimization technique: the GAs are used first to reach the neighborhood of some global extremum, and the NM algorithm then finds it exactly. Playing games with genetic algorithms has been already proposed: it is a means of seeking better strategies in playing repeated games. These algorithms have been applied extensively for solving Nash equilibria of fuzzy bimatrix games with single objective. The experience shows the ability of the GAs to find solutions to equivalent quadratic programming problems without an exhaustive search. In 2002, Chen extends the applications to multiple objective programming problems, without weighting the desired objectives contrary to the Nishizaki-Sakawa models. This lecture is an attempt to consider the complexity of the real situations, when the decision makers are facing to multiple simultaneous objectives in a fuzzy environment. The software MATHEMATICA 7.0.1 is used to implement these techniques in a high-performance computing environment.

Brief Biography of the Speaker:
Professor Andre A. Keller is an associate researcher in mathematical economics at CLERSE - Centre Lillois d'Etudes et de Recherches Sociologiques et Economiques - a research unit UMR/CNRS 8019 of the French 'Centre National de la Recherche Scientifique (CNRS)' from the University Lille 1, Sciences et Technologies. Prof. Keller is graduated in econometrics and operations research, and received his PhD in Economics in 1977 from the Universite de Paris I. Prof. Keller taught applied mathematics (optimization techniques), econometrics, microeconomics, theory of games and macrodynamics. His experience centers are on discrete mathematics (graph theory), building and simulating large scale macro-econometric models. Since 1985, his research interest has concentrated on modeling high frequency time-series: spectral properties of usual filters, automatic selection of ARIMA models, efficiency tests. Since 1990, Prof. Keller's research is centered on discrete mathematics (graph theory), stochastic differential games and tournaments, circuit theory of environmental systems, dynamics and optimal control under uncertainties, as in a fuzzy environment. Prof. Keller's publications in journals and proceedings are on model building and game theory, with application to macroeconomics and international finance. Books chapters are on semi-reduced forms of econometric models (Martinus Nijhoff, 1984), econometrics of technical change (Springer and IIASA, 1989), advanced time-series analysis (Woodhead-Faulkner), circuits enumeration in digraphs (Springer, 2008), stochastic differential games (Nova Science, 2009), optimal fuzzy control (InTech, 2009), circuit analysis (Nova Science, forthcoming 2010).

Plenary Lecture 8

Magic Wand Approach to Representation of Personal Technologies

Professor Victor Malyshkin
Supercomputer Software Department (SSD)
Institute of Computational Mathematics and Mathematical Geophysics
Russian Academy of Sciences
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Abstract: In this talk I will highlight and present the idea of magic wand as approach to representation new technologies, their implementability, application and use in different object domain. Magic wand approach in its currently implementable form is suggested to be the standard for any new technology representation. How to describe a new technology, how to accumulate and control the active knowledge base constitute the main subject of this talk. It will be a collected view on my past experience reflected in new innovative challenges.

Plenary Lecture 9

Formal and Automatic Enforcement of Security by Rewriting

Professor Mohamed Mejri
Departement d'Informatique et de Genie Logiciel
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Abstract: The literature records various formal and automatic techniques allowing to ensure that a system never violate some given requirements ans in particular some security policies. Mainly, we distinguish two groups of approaches: static analysis and dynamic analysis. Static analysis aims to verify software before running them while dynamic analysis techniques check them during their executions. Generally, both of these techniques are needed since they complement each other: There are some properties that could not be verified dynamically and vice-versa. For instance, liveness properties (something good will happen) could not be ensured dynamically. Other properties that depend on some values known only at execution time could not be verified statically. However, static analysis are in most all cases preferable when the problem can be resolved before the execution.
Recently, many researchers have been interested by rewriting techniques in order to gather advantages of both static and dynamic methods. The idea consists in modifying statically a software, so that the new version respects the requested requirements. The rewritten software is generated from the original one by adding, when necessary, some tests at some critical points so that it behaves like requested.

Brief Biography of the Speaker:
He received a Ph.D. in Computer Science with General Honors, Computer Science Department, Laval University, Canada.
Currently he is a Full Professor in Computer Science. Computer Science Department, Laval University, Quebec, Canada, he works on computer Security, and contributed in many project worldwide.
He received CIPA Awards/Canadian Information Productivity Awards/2001: MaliCots project (LSFM research group). CIPA'2001. He received Star Professor/Laval University, Canada 2002/ 2003/ 2005/ 2006/ 2008: For the excellent quality of teaching. He was a visiting professor at Fujita's Laboratory Iwate Prefectural University, Iwate, Japan on 2008, for six months doing a joint work with Prof. Hamido Fujita, He got a joint patent on software methodology.

Plenary Lecture 10

PLAYWARE: Intelligent Hardware and Software that Creates Playful Experiences

Professor Henrik Hautop Lund
Center for Playware
Technical University of Denmark
DENMARK
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Abstract: This talk will present the design approach for technological tools that may enhance playful interaction for a vast variety of people, e.g. for play, education, cardiac patients, stroke patients, hospitalised children, home care, autistic children, dementia patients, and handicapped. The approach builds upon the development of modular robotics to create a kind of playware, which is flexible in both set-up and activity building for anybody and anywhere. Key features of this design approach are modularity, flexibility, and construction, immediate feedback to stimulate engagement, activity design by end-users, and creative exploration of play activities. These features permit the use of such modular playware by a vast array of users, including elderly and disabled who often could be prevented from using and taking benefits from modern technologies. For instance, the creative play activities with modular playware helps confidence and self-esteem blossom as young children meet success in activities that are fun. The objective is to get any person moving, exchanging, experimenting and having fun, regardless of their cognitive or physical ability levels. By offering exciting activities that entice users to participate, the interactive playware technologies can not only help them reap the physical benefits of exercise, but also provide opportunities for them to learn, share, express feelings, set goals, and function independently.
I will illustrate the design approach by a system composed of different modular robotic devices that by its modularity is used for creating playful experiences in a vast variety of application areas, e.g. music, sport, play and rehabilitation, e.g. most recently for the FIFA World Cup 2010 in South Africa. The system composed of the modular robotic devices engages the user in physical activities, and I will show how it motivates to perform physical activities by providing immediate feedback based upon playful physical interaction with the system. The modularity, ease of use and the functionality of the devices such as modular robotic tiles and cubic I-BLOCKS suit well into these kinds of scenarios, because they can provide feedback in a generic way. It is therefore possible to create applications with different stimuli and to dynamically change parameters to provide immediate feedback to the users. The modularity allows to investigate adaptivity both as changes in the physical structure and in the processing of the modules (e.g. by neural networks).
This gives ample room for the development of playware, i.e. intelligent hardware and software that creates play and playful experiences amongst users of all ages. Indeed, design principles from modular robotics, embodied AI, interaction design and cultural studies allow us to create playware for diverse application fields such as welfare robotics (e.g. home care, physiotherapy, autism therapy, dementia therapy), sport, music, playground play and fitness training. In the presentation, I will show numerous examples from DJ remix music, rock music, physical rehabilitation, playgrounds, soccer, and use in Africa.

Brief Biography of the Speaker:
Professor Henrik Hautop Lund, Center for Playware at Technical University of Denmark, is known internationally for his work in bringing robotics to use in novel ways. His approach is to combine modular robotics and modern artificial intelligence to create novel solutions to problems that occupy the citizens of the World, e.g. obesity, rehabilitation, and 3rd World development. He has recently founded the Center for Playware to focus even further on how playful aspects of robotics may provide motivation for any citizen to perform different kinds of interaction with the robots of our future daily life. He chaired the Robots at Play festivals in the open city areas where researchers, artists, entertainers, and citizens meet through playful hands-on experience with robotics in the daily life of the citizens. In all cases, Lund has shown how the combination of a modern artificial intelligence, modular robotics and entertainment may provide novel opportunities in play, rehabilitation, sport, music, teaching, third World development, etc., because the approach provides non-expert users easy access to the technology in a playful and motivating way.
Professor Henrik Hautop Lund has published more than 135 scientific articles in the field of robotics, he has been a member of the Danish Research Council, and he has been invited to present his robotic work in numerous occasions, for instance for the Emperor of Japan at Akasaka Palace in Tokyo. He has been keynote speaker at the major conferences in the field, such as IROS and Ro-Man. He founded and headed the LEGO Lab in 1997-2000. He

founded the RoboCluster industrial promotion organization. He invented the RoboCup Junior robot football game for children, and his Adaptronics group won the RoboCup Humanoids Free Style World Championship 2002 in front of 120.000 spectators. Also, he developed the Laudrup, Hogh & Lund RoboSoccer, which was used at the FIFA World Cup 2010 in South Africa. Further, he developed the RoboMusic in collaboration with World Music Award winner, remix musician Funkstar De Luxe. Professor Lund's work has received world-wide interest from news media, e.g. CNN, BBC and WIRED to name a few, and he was nominated for the award for the best entertainment robots and systems research over the last 20 years at the IEEE International Conference on Intelligent Robots and Systems (IROS).

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