Dear Participants,

After a long way through various European cities including Innsbruck, Ales, Norwich, Portoroz, Prague, Roanne, Coimbra, the ICANNGA conference finally came to our city. Warsaw University of Technology, the largest technological University in Poland is the hosting institution. Benefiting from ICANNGA past experience and achievements, supported by Authors and Participants we wish to cultivate the ICANNGA tradition and its distinctive quality.

On behalf of the Organizing Committee of ICANNGA'07, I extend a warm welcome to all of you. We hope that you will enjoy participation in the conference and the stay in Warsaw.

Bartlomiej Beliczynski
ICANNGA'07 Chair

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Local information

Conference organization

Registration

Most of the conference events take place at the Central University Campus, in the Main Building of the University. The Registration Desk is located in room 206. It is open from 9.00 to 18:00 on Wednesday, 8.00 to 18.10 on Thursday and Friday, 8.00 to 16.35 on Saturday. Should you have any questions please do not hesitate to ask our staff there. The conference participants are encouraged to use the cloak-room that is reserved in the Lobby. However if you have bags or packages they will not be accepted there. You are advised to use room 206 for that purpose.

Tutorials, plenary lectures and oral sessions

All the sessions are held in the Main Building in Lecture Theatres 123 and 134 on the first floor and the Audience Hall (room 237) on the second floor. All the plenary lectures are given at the Audience Hall (room 237). Rooms for tutorials on the first day of the conference will be announced at the Registration Desk (room 206). The total number of 18 oral sessions is organized. Oral presentations are planned for 20 minutes, including 15 minutes for the presenter plus 5 minutes for discussion. The lecture theatres are equipped with overhead projectors and computers with CD-drives and USB ports, with Windows system and appropriate software i.e. Power Point and Acrobat Reader. Presenters are kindly requested to show up in the lecture theatre 10 min before the session starts in order to introduce themselves to the Session Chair and to check the technical facilities.

Poster sessions

The two poster sessions are taking place on the second floor as indicated on the floor plan (Poster Area). Presenters are kindly requested to arrange their posters during the lunch break and follow the poster numbers according to the conference programme when

attaching posters to the poster board. The poster board area for each presentation is 2 m high by 0.98 m wide. You may use the whole or a part of the area. Adhesive tape and scissors will be provided by organisers. At least one author must be present during the session which is one hour long. All poster material should be removed promptly at the end of the session.

Computer Room

Our computer lab on the forth floor in room 443 is used as a Communication Centre for the conference participants. There is a computer network with WiFi access there (the connection details will be provided by our staff there). The Communication Centre is open for the conference participants from 11.00 through 15.00 on Wednesday and Saturday and from 9.30 through 17.00 on Thursday and Friday.

Coffee-breaks

There are free coffee-breaks for the conference participants - they will take place in the Audience Hall (room 237). Nevertheless one may want to pay a visit to the University Cafe located in room 147 on the first floor (at your own expense, Polish currency only).

Lunches

Just across Nowowiejska Street, ca. 150 meters from the Main Building there is the University Dining Hall where buffet lunches are served (self service). There is a buffet lunch provided with variety of food including soup, second course, cake and drink (water, juice, tea, coffee). Lunch coupons are included in the conference materials.

Conference events

Concert in St. Saviour's Church (kosciol sw. Zbawiciela) under auspices of Professor Stanislaw Wincenciak, Dean of the Electrical Engineering Departament (Organ and choral music) Thursday, 12 April, 19.30-20.15

St. Saviour's Church (kosciol sw. Zbawiciela) is located within 5 minutes walking distance from Warsaw University of Technology. Remark: Between 18.30 and 19.15 the daily service will be held in the St. Saviour's Church. The concert will be performed about 15 min. after the service at 19.30. Performers:

- **Piotr Rachon** was born in Krasnik in 1970. He graduated with distinction from the College of Music in Lublin where he studied under Teresa Ksieska-Falger. He studied at the Fryderyk-Chopin-Academy of Music in Warsaw under Alicja Paleta-Bugaj and in Krystyna Borucinska's class for chamber music. Piotr Rachon finished his studies with distinction. Already at an early age, he received a scholarship from the Fryderyk-Chopin-Society in Warsaw and from the Ministry of Culture and Arts. Piotr Rachon attended a course at the Academia Chigiana in Siena, Italy. Being one of the best young musicians of his country, he was invited by the Ministry of Culture to participate in the "Concert of the Year". He is laureate of the Karol Szymanowski Music Competition.
- **The Song and Dance Ensemble of Warsaw University of Technology** celebrated its 55th anniversary last year. The history of the group started in 1951 when a few young people decided to set up an ensemble referring to the tradition of Polish folklore. The singing and dancing group grew over the years to reach its present membership of 100. Numerous awards granted to the ensemble at domestic and international festivals and competitions attest to the high artistic level of the ensemble.

Detailed concert programme is attached to the conference materials.

Welcome Reception in The Building of Physics Thursday, 12 April, 20.30-22.00

The Building of Physics - located in the heart of the Central Campus - is one of the historical buildings of Warsaw University

of Technology. It is one of the oldest edifices of the University - it was designed, along with the Main Building, by Stefan Szyller and erected at the turn of the 19th century. The first inauguration of the academic year at the University was celebrated on 18th November 1915 in the Hall of the Building of Physics. A hundred years after the construction, the Hall of the Building of Physics was renovated and - on 9th November 2001 - reopened for the public. Since then it has been used for scientific and educational purposes (organization of conferences, seminars and exhibitions) as well as for representation (organization of inaugurations of the academic year, balls, assemblies etc.).

Conference Dinner in Jablonna Palace Friday, 13 April, 18.30(assembly time)-22.00.

The conference participants will be taken by busses from Plac Politechniki (Polytechnic Square - at the front of the main entrance of the University) at 18.30. Depending on the road traffic the trip will take about 45-60 min. Jablonna Palace is a part of an 18th century elegant palace-and-park complex situated on the outskirts of Warsaw, 20 km from the centre of the city. Its representative rooms, stylish guestrooms, conference halls and a restaurant decorated with 18th century frescoes serving excellent Polish cuisine together with a beautiful English-style park make it a perfect conference and recreational centre. Formally, since 1953, Jablonna has been owned by the Polish Academy of Sciences (PAN), but its history dates back to the beginning of the Middle Ages, when bishops of Plock built a summer residence in the 15th century. Just over two centuries later, Michal Poniatowski, the bishop of Plock and brother of the last Polish King Stanislaw August purchased Jablonna from the Plock chapter and in 1774 had it completely redesigned by the royal architect Dominik Merlini. The complex consisted of three buildings - a one-storey palace in the center of the park and two three-storey side pavilions one of them became known as royal since King Stanislaw August Poniatowski resided there. Kings nephew and later on Napoleon Bonapartes friend and hero of Napoleonic wars, Prince Jozef Poniatowski, inherited Jablonna in 1794 and stayed there frequently in his private suite on the ground floor of one of the pavilions. After Prince Jozef was killed in the battle of Leipzig in 1813, Jablonna was owned by the Potocki family until the end of the World War II. During that time the entire complex was transformed into a centre memorialising the Prince Jozef Poniatowski and later it was redesigned and redecorated many times by its owners. In recent years the role and the character of the complex

has changed slightly. The palace has served not just as a museum and a conference centre, but it became one of the best known and frequently visited cultural and tourist centres in Mazovia.

Conference Schedule: 11-12 April 2007

First day (Tutorials)
Wednesday, 11 April 2007

9:00-18:00	Registration Desk (Room 206)	
9:30-12:15	Tutorial I Tadeusz Kaczorek	Tutorial III Sarunas Raudys
12:15-13:30	Lunch (Dining Hall)	
13:30-16:15	Tutorial II Vera Kurkova	Tutorial IV Stanislaw Zak

Second day
Thursday, 12 April 2007

8:00-18:10	Registration Desk (Room 206)		
9:00-9:20	Opening Ceremony (Room 237)		
9:30-10:20	Plenary Lecture 1 - Sun-ichi Amari (Room 237)		
10:20-10:40	Coffee Break		
10:40-12:40	Neural Networks I (Room 237)	Evolutionary Computation I (Room 134)	Computer Vision I (Room 123)
12:40-14:00	Lunch (Dining Hall)		
14:00-14:50	Plenary Lecture II - Ryszard Tadeusiewicz (Room 237)		
14:50-15:10	Coffee Break		
15:10-17:10	Neural Networks II (Room 237)	Evolutionary Computation II (Room 134)	Computer Vision II (Room 123)
17:10-18:10	Poster Session I (Poster Area)		
19:30-20:15	Concert		
20:30-22:00	Welcome Reception		

Conference Schedule: 13-14 April 2007

Third day
Friday, 13 April 2007

9:00-18:10	Registration Desk (Room 206)		
9:30-10:20	Plenary Lecture III - Kevin Warwick (Room 237)		
10:20-10:40	Coffee Break		
10:40-12:40	Classification and Clustering I (Room 237)	Genetic Algorithms I (Room 134)	Biomedical Signal and Image Processing (Room 123)
12:40-14:00	Lunch (Dining Hall)		
14:00-14:50	Plenary Lecture IV - Rafal Zbikowski (Room 237)		
14:50-15:10	Coffee Break		
15:10-17:10	Classification and Clustering II (Room 237)	Genetic Algorithms II (Room 134)	Biometrics (Room 123)
17:10-18:10	Poster Session II (Poster Area)		
19:30-22:00	Conference Dinner		

Fourth day
Saturday, 14 April 2007

9:00-16:35	Registration Desk (Room 206)		
9:30-10:20	Plenary Lecture V - Janusz Kacprzyk (Room 237)		
10:20-10:40	Coffee Break		
10:40-13:00	Fuzzy and Rough Systems (Room 237)	Learning and Optimisation (Room 134)	Neural Networks III (Room 123)
13:00-14:15	Lunch (Dining Hall)		
14:15-16:35	Particle Swarm Optimisation (Room 237)	Linguistics and Games (Room 134)	Robotics (Room 123)

Tutorials

Tutorial I - Tadeusz Kaczorek

Title:	**Selected Mathematical Equations of Contemporary Technology**
Presenter:	***Tadeusz Kaczorek***
	Institute of Control and Industrial Electronics,
	Warsaw University of Technology, Warsaw, Poland
Date&Time:	11 April 2007, 9:30
Room:	Info will be provided during the registration

The talk will be consisting of two parts. The first part will be devoted to some recent developments of selected mathematical matrix equations. A special attention will be focused on the matrix Sylvester equation, the matrix Lyapunov equation and the matrix Riccati equation. The polynomial matrix equations will be also discussed. The numerical aspects of solutions to the equations will be considered and illustrated by numerical examples. Some applications of the equations in engineering problems will be also demonstrated. The second part will be devoted to some new extensions of the classical Cayley-Hamilton theorem for n-D polynomial matrices, the block matrices, the coefficients matrices of the impulse response matrices, the right and left inverse matrices and for time-varying and nonlinear systems. It will be shown that the extensions are useful not only in systems and control systems theory but they can be also applied in solving many engineering problems.

Tutorial II - Vera Kurkova

Title:	**Learning from Data with Generalization as an Inverse Problem**
Presenter:	***Vera Kurkova***
	Institute of Computer Science,
	Academy of Sciences of the Czech Republic
Date&Time:	11 April 2007, 13:30
Room:	Info will be provided during the registration

Generalization capability in learning from data can be investigated in terms of regularization, which has been used in many branches of applied mathematics to obtain stable solutions of inverse problems, i.e., problems of finding unknown causes (such as shapes of functions) of known consequences (such

as measured data). It will be shown that supervised learning modeled as minimization of error functionals, the expected and the empirical one, can be reformulated in terms of inverse problems with solutions in spaces of functions defined by kernels. Mathematical results from theory of inverse problems applied to construction of optimal solutions of learning tasks can be used to design learning algorithms based on solutions of systems of linear equations.

Tutorial III - Sarunas Raudys

Title:	**Integration of Statistical and Neural Approaches to Train Classification and Prediction Algorithm**
Presenter:	***Sarunas Raudys*** Institute of Mathematics and Informatics, Vilnius, Lithuania
Date&Time:	11 April 2007, 9:30
Room:	Info will be provided during the registration

Classification and prediction algorithms are among major topics in Machine Learning and Data Mining applications. Very often training of the algorithms is performed by statistical methods or by neural network based methods. In spite of similarity between both approaches there is a certain confrontation between followers of both of them. An objective of the tutorial is to explain how both approaches can be utilized simultaneously in order to use positive features of each of them, consider sample size, the algorithm complexity and performance relationships. We explain that when training SLP under special conditions, we may obtain seven well known in statistical data analysis linear classification algorithms (Euclidean distance classifier, regularized discriminant analysis, standard Fisher classifier or —fisher with matrix pseudo-inversion, robust, minimum empirical error, and support vector (SV) classifiers) or six regressions (naive, regularized, two types of mean square, robust, minimax, or SV regressions). Evolution of the SLP during its iterative training process opens the possibility to integrate statistical and neural approaches for designing classification and prediction algorithms. For this purpose we should use all our knowledge about the real-world problem at hand, and apply one of the known statistical models to estimate the inputs covariance matrix, described by a small number of parameters. Then, instead of using the original covariance matrix to construct the classification or prediction algorithm directly, we decorrelate and scale the multivariate data and obtain this statistical algorithm just after the first iteration. Such an approach provides a two-fold benefit: first, it utilizes the researchers a priori statistical knowledge about the data, helping to reduce the generalization error, and second, it decorrelates the multivariate data and equates its variances, speeding up the iterative training process. In comparison of earlier authors tutorials on the subject, cases of a) unequal covariance matrices and b) many pattern classes are considered. Last part of the tutorial is devoted to explain relationships between complexity, learning set size and generalization error

of statistical classifiers. In contrast to complexity and sample size relation reviews based on analysis of empirical risk minimization algorithms and classification error bounds, the present survey considers generalization errors of variety of statistical pattern classification algorithms, mostly these that could be obtained while training the non-linear single layer perceptron and multinomial classifier used when features assume categorical values (this method is strongly related with popular decision tree classifiers). Use of methods of multivariate statistical analysis to examine statistical classification rules sometimes allow obtaining exact analytical expressions for generalization error provided true models of the data are known. The survey also contains two new still unpublished results: a) unequal learning set sizes of distinct pattern classes and b) examination of loses that arise due to sample based feature selection used in order to reduce input feature space and the loses that arise due to estimation of distinct parameters of the classifiers in original high dimensional spaces. It is shown that for some non-optimal (in Bayes sense), however, popular statistical classification algorithms (the standard multivariate Gaussian density based quadratic classifier and the multinomial classifier used when features assume categorical values) for some data models expected generalization error unexpectedly starts increasing if a number of learning vectors of minority class is increasing.

Tutorial IV - Stanislaw Zak

Title:	**Intelligent Control Systems: An Engineering Approach**
Presenter:	***Stanislaw Zak*** School of Electrical and Computer Engineering, Purdue University, West Lafayette, IN, USA
Date&Time:	11 April 2007, 13:30
Room:	Info will be provided during the registration

A major problem that has been facing control engineers is the growing gap between real world control problems and the theory for analysis and design of linear control systems. Design techniques based on the linear system theory have difficulties with accommodating nonlinear effects and modeling uncertainties. The objective of this tutorial is to present the theory and design of intelligent controllers and observers. The emphasis will be on design in order to show how intelligent control system theory fits into practical applications. Participants will learn first the ingredients of intelligent controllers that include adaptation, learning, fuzzy logic, neural networks, and genetic algorithms. Then, participants will learn how to combine these ingredients to obtain sensory interactive control structures incorporating cognitive characteristics to emulate learning behavior with a capacity for performance or parameter adaptation.

Plenary Lectures

Plenary Lecture I - Shun-ichi Amari

Title:	**Dynamics of Learning in Neural Networks: Supervised and Unsupervised**
Presenter:	***Shun-ichi Amari***
	RIKEN Brain Science Institute,
	Japan
Date&Time:	12 April 2007, 9:30
Room:	237 (Audience Hall)

Neural networks have ability to modify its behavior by learning. This makes neural networks to have powerful information-processing capability. There are two types of learning, supervised (with teacher) and unsupervised (without teacher). The present talk focuses on fundamental mathematical aspects of learning of neural networks. We begin with a general theory of learning of a neuron, followed by the mechanism of unsupervised learning of feature extractors and self-organization maps. The MLP (multilayer perceptron) is a model of supervised learning, which has a universal power of approximating any functions. Backpropagation is a well-known method of learning. However, its learning behavior is known to be very slow, being trapped in plateaus and taking long time before getting rid of them. The present talk uses information geometry to understand the dynamical behavior of learning in MLP. The set of MLPs forms a Riemannian manifold, in which the trajectories of learning are described. The manifold includes continua of singular points, which cause the plateau phenomena. Such strange geometrical structure is ubiquitous in hierarchical systems. We analyze the dynamics of learning near singularities explicitly, and propose a modified method of learning called the natural gradient method, which is free of the plateau phenomenon.

Plenary Lecture II - Ryszard Tadeusiewicz

Title:	**Why Automatic Understanding?**
Presenter:	***Ryszard Tadeusiewicz***
	Academy of Mining and Metallurgy,
	Cracow, Poland
Date&Time:	12 April 2007, 14:00
Room:	237 (Audience Hall)

Typical applications of Artificial Intelligence (AI) methods in biomedicine (e.g. medical diagnostics), in the area of engineering problems (e.g. control systems) and also in intelligent economical information systems includes some traditional techniques: intelligent data processing and analysis, pattern recognition, neural networks, genetic algorithms and expert systems. Data processing and analysis give us better description of the objects or processes under consideration. Pattern recognition give us possibilities of its classification for example in case of automatic diagnostics. Neural network helps us to build behavioral models for control or forecasting. Genetic algorithms can solve optimization problems. Expert systems can advise us, what we ought to do in particular situations. This short outlook presents general view over the typical AI landscape.

In many biomedical, economical, and engineering problems it is enough. If we can solve presented problems and if we can build AI tools for intelligent data analysis, recognition and modeling we are happy. This is true, but definitely not in all situations. Sometimes solving of complex problems leads to the necessity of understanding some signals, patterns and situations instead of simple processing, classification and interpretation. In fact understanding of the problem is first necessary step for intelligent solving of the problem, when we use natural (not artificial) intelligence. Understanding of the problem is not special case of signal processing it needs also some knowledge and demands special type of data processing. Details of natural understanding are very complicated and obscure, therefore we can talking about understanding in terms of psychology and in frames of cognitive science, although in fact we can not understood the natural understanding process!

Nevertheless we can propose effective methods of artificial imitation of understanding. Although it sounds strange - in fact it is definitely possible to build up the system for automatic understanding of selected data, signals and situations. This fact was proven by the authors in many previous papers and books on the base of many examples of medical images. If computer powered by special AI programs can understood the nature of disease on the base of analysis of features of some medical images it can be applied also to the solving of other complex problems, demanding automatic understanding as a part of its automatic solving. In the paper we describe the general methodology of the automatic understanding and we show how to use this methodology for solving selected biomedical, economical and also engineering problems.

Plenary Lecture III - Kevin Warwick

Title:	**The Evolution of Artificial Intelligence: From the Slow Death of Traditional AI to Truly Intelligent Machines and Cyborgs**
Presenter:	***Kevin Warwick***
	University of Reading,
	Great Britain
Date&Time:	13 April 2007, 9:30
Room:	237 (Audience Hall)

A modern perspective will be given to the status of traditional AI via up to date results from such as the Turing Immitation Game and an assessment of how traditional AI relates to artificial Life. A look will then be taken at some of the exciting projects presently ongoing which involve the direct connection between artificial and real neural networks. This will include biological neural tissue being grown in order to control robot technology, the use of artificial neural nets to predict the behaviour of human neural nets for medical/corrective purposes and finally the possibilities inherent with human enhancements.

Plenary Lecture IV - Rafal Zbikowski

Title:	**Reverse Engineering of Insect Flight Control**
Presenter:	***Rafal Zbikowski***
	Cranfield Univ. (Defence Academy Shrivenham),
	Great Britain
Date&Time:	13 April 2007, 14:00
Room:	237 (Audience Hall)

Micro air vehicles (MAVs) are small flying vehicles developed to reconnoitre in confined spaces. This requires power-efficient, highly-manoeuvrable, low-speed flight with stable hover. All of these attributes are present in insect flight and hence the focus on reproducing the functionality of insect flight by engineering means. One key aspect is the excellent manoeuvrability of insects which calls for examination of their flight control. Both modern aircraft and flying insects exhibit complex flight dynamics, whose handling requires generating much information in real time. In conventional control little measurement is made, so that the required information is recovered by involved calculations. I believe that insects do the converse: they measure much and compute little. This sensor-rich feedback control is a new approach to tackle complexity of animal/vehicle motion, a particularly challenging problem in

the context of manoeuvrable flight. Insect vision seems to be the key sensor system, as not only does it recognise patterns (objects), but can perceive motion. The compound eyes, composed of up to 6,000 ommatidia, are a rich sensor system, each ommatidium measuring light intensities within a small solid angle, but with a high temporal resolution. Neural processing of the compound eyes produces a global, detailed view of the relative motion of the insect with respect to its surroundings. This sensor-rich feedback control paradigm relies on extensive, distributed measurement of the quantities of interest in space and time. In insects motion representation covers the whole of space, and involves several overlapping patches of the space. It seems that the complex underlying differential equations of motion need not be integrated numerically, as their solutions are readily available through interpolation of the detailed measurements. Also, this redundant representation may allow fine control of high agility manoeuvres with little computation. This new paradigm will have a large impact not only on the vast applications of automatic control, but also on the sensor, instrumentation, and measurement communities. Further, detailed and multidisciplinary research is needed to reverse engineer insect flight control completely.

Plenary Lecture V - Janusz Kacprzyk

Title:	**Intelligence, intelligent systems, soft computing and decision support**
Presenter:	***Janusz Kacprzyk*** Polish Academy of Sciences, Warsaw, Poland
Date&Time:	14 April 2007, 9:30
Room:	237 (Audience Hall)

First, we present a brief account of modern approaches to real world decision making, emphasize the concept of a decision making process that involves more factors and aspects like: the use of own and external knowledge, involvement of various "actors", aspects, etc., individual habitual domains, non-trivial rationality, different paradigms. As an example we mention Checkland's deliberative decision making (which is an important elements of his soft approach to systems analysis).

We strongly advocate the use of computer based decision support systems. First, we briefly review their history of decision support systems, and then present a popular classification, starting from data driven to Web based and interorganizational. We indicate that decision support systems should incorporate some sort of "intelligence", and we first briefly mention some views of what intelligence may mean in this concept, both in an individual and collective perspective, and then assume some more pragmatic, though limited, view of intelligent decision support systems.

We indicate possible advantages of using elements of fuzzy logic and soft computing, notably, Zadeh's computing with words to be able to somehow

merge the ideas presented like: human centric computing, decision making processes, intelligent decision support, etc.

Finally, we present some example of our own implementations that concern a data and document driven decision support system for a small to medium company in which, first, Zadeh's computing with words and perceptions paradigm is employed via linguistic database summaries, elements of business intelligence and Web intelligence are used to derive additional information, and the ideas of an intelligent decision support and human centric computing are shown to be synergistically combined.

Sessions on 12th April

Neural Networks I, Room 237 - Audience Hall

1. **10:40** Evolution of Multi-class Single Layer Perceptron *Sarunas Raudys* LNCS 4432 p.1
   While training single layer perceptron (SLP) in two-class situation, one may obtain seven types of statistical classifiers including minimum empirical error and support vector (SV) classifiers. Unfortunately, both classifiers cannot be obtained automatically in multi-category case. We suggest designing K(K-1)/2 pair-wise SLPs and combine them in a special way. Experiments using K=24 class chromosome and K=10 class yeast infection data illustrate effectiveness of new multi-class network of the single layer perceptrons.
2. **11:00** Estimates of Approximation Rates by Gaussian Radial-Basis Functions *Paul C. Kainen, Vera Kurkova, Marcello Sanguineti* LNCS 4432 p.11
   Rates of approximation by networks with Gaussian RBFs with varying widths are investigated. For certain smooth functions, upper bounds are derived in terms of a Sobolev-equivalent norm. Coefficients involved are exponentially decreasing in the dimension. The estimates are proven using Bessel potentials as auxiliary approximating functions.
3. **11:20** Least Mean Square vs. Outer Bounding Ellipsoid Algorithm in Confidence Estimation of the GMDH Neural Networks *Marcin Mrugalski, Jozef Korbicz* LNCS 4432 p.19
   The paper deals with the problem of determination of the model uncertainty during the system identification with the application of the Group Method of Data Handling (GMDH) neural network. The main objective is to show how to employ the Least Mean Square (LMS) and the Outer Bounding Ellipsoid (OBE) algorithm to obtain the corresponding model uncertainty.
4. **11:40** Neural Computations by Asymmetric Networks with Nonlinearities *Naohiro Ishii, Toshinori Deguchi, Masashi Kawaguchi* LNCS 4432 p.37
   Nonlinearity is an important factor in the biological visual neural networks. Among prominent features of the visual networks, movement detections are carried out in the visual cortex. The visual cortex for the movement detection, consist of two layered networks, called the primary visual cortex (V1),followed by the middle temporal area (MT), in which nonlinear functions will play important roles in the visual systems. These networks will be decomposed to asymmetric sub-networks with nonlinearities. In this paper, the fundamental

characteristics in asymmetric neural networks with nonlinearities, are discussed for the detection of the changing stimulus or the movement detection in these neural networks. By the optimization of the asymmetric networks, movement detection equations are derived. Then, it was clarified that the even-odd nonlinearity combined asymmetric networks, has the ability in the stimulus change detection and the direction of movement or stimulus, while symmetric networks need the time memory to have the same ability. These facts are applied to two layered networks, V1 and MT.

5. **12:00** Properties of the Hermite Activation Functions in a Neural Approximation Scheme *Bartlomiej Beliczynski* LNCS 4432 p.46

   The main advantage to use Hermite functions as activation functions is that they offer a chance to control high frequency components in the approximation scheme. We prove that each subsequent Hermite function extends frequency bandwidth of the approximator within limited range of well concentrated energy. By introducing a scalling parameter we may control that bandwidth.

6. **12:20** On Feature Extraction Capabilities of Fast Orthogonal Neural Networks *Bartlomiej Stasiak, Mykhaylo Yatsymirskyy* LNCS 4432 p.27

   The paper investigates capabilities of fast orthogonal neural networks in a feature extraction task for classification problems. Neural networks with an architecture based on the fast cosine transform, type II and IV are built and applied for extraction of features used as a classification base for a multilayer perceptron. The results of the tests show that adaptation of the neural network allows to obtain a better transform in the feature extraction sense as compared to the fast cosine transform. The neural implementation of both the feature extractor and the classifier enables integration and joint learning of both blocks.

Evolutionary Computation I, Room 134

1. **10:40** A New Self-Adaptative Crossover Operator for Real-Coded Evolutionary Algorithms *Manuel E. Gegundez, Pablo Palacios, Jose L. Alvarez* LNCS 4431 p.39

   In this paper we propose a new self-adaptative crossover operator for real coded evolutionary algorithms. This operator has the capacity to simulate other real-coded crossover operators dynamically and, therefore, it has the capacity to achieve exploration and exploitation dynamically during the evolutionary process according to the best individuals. In other words, the proposed crossover operator may handle the generational diversity of the population in such a way that it may either generate additional population diversity from the current one, allowing exploration to take effect, or use the diversity previously generated to

exploit the better solutions. In order to test the performance of this crossover, we have used a set of test functions and have made a comparative study of the proposed crossover against other classic crossover operators. The analysis of the results allows us to affirm that the proposed operator has a very suitable behavior; although, it should be noted that it offers a better behavior applied to complex search spaces than simple ones.

2. **11:00** Evolutionary Induction of Decision Trees for Misclassification Cost Minimization *Marek Kretowski, Marek Grzes* LNCS 4431 p.1

   In the paper, a new method of decision tree learning for cost sensitive classification is presented. In contrast to the traditional greedy top down inducer in the proposed approach optimal trees are searched in a global manner by using an evolutionary algorithm (EA). Specialized ge netic operators are applied to modify both the tree structure and tests in non terminal nodes. A suitably defined fitness function enables the algo rithm to minimize the misclassification cost instead of the number of clas sification errors. The performance of the EA based method is compared to three well recognized algorithms on real life problems with known and randomly generated cost matrices. Obtained results show that the pro posed approach is competitive both in terms of misclassification cost and compactness of the classifier at least for some datasets.

3. **11:20** Multiple Sequence Alignment with Evolutionary--Progressive Method *Pawel Kupis, Jacek Mandziuk* LNCS 4431 p.23

   A new evolutionary-progressive method for Multiple Sequence Alignment problem is proposed. The method efficiently combines flexibility of evolutionary approach with speed and accuracy of progressive technique. The results show that the hybrid method is an interesting alternative for purely genetic or purely progressive approaches.

4. **11:40** DNA Based Evolutionary Approach for Microprocessor Design Automation *Nagarajan Venkateswaran, Arjun Kumeresh, Harish Chandran* LNCS 4431 p.11

   In a paper presented to BICS 2006, a basic methodology for microprocessor design automation using DNA sequences was proposed. A refined methodology with new schemes for traversal, encoding, recombination, and processor evaluation are proposed in this paper. Moreover concepts such as mutation, graphical decoding and environment simulation are introduced and a new technique for creating DNA based algorithms used in the mutation process is also presented. The proposed methodology is then generalized to extend its application to other domains. This paper presents a conceptual framework whose implementation aspects are still under investigation.

5. **12:00** Optimal Design Centring through a Hybrid Approach Based on Evolutionary Algorithms and Monte Carlo Simulation *Luis Pierluissi, Claudio M. Rocco S.* LNCS 4431 p.31
   In many situations a robust design could be expensive and decisionmakers need to evaluate a design that is not robust, that is, a design with a probability of satisfying the design specifications (or yield) less than 100 %. In this paper we propose a procedure for centring a design that maximises the yield, given predefined component tolerances. The hybrid approach is based on the use of Evolutionary Algorithms, Interval Arithmetic and procedures to estimate the yield percentage. The effectiveness of the method is tested on a literature case. We compare the special evolutionary strategy (1+1) with a genetic algorithm and deterministic, statistical and interval-based procedures for yield estimation.
6. **12:20** Wavelet Enhanced Analytical and Evolutionary Approaches to Time Series Forecasting *Bartosz Kozlowski* LNCS 4431 p.49
   This paper provides two methodologies for forecasting time series. One of them is based on the Wavelet Analysis and the other one on the Genetic Programming. Two examples from finance domain are used to illustrate how given methodologies perform in real-life applications. Additionally application to specific classes of time series, seasonal, is discussed.

Computer Vision I, Room 123

1. **10:40** A Segmentation Method for Digital Images Based on Cluster Analysis *Hector Allende, Carlos Becerra, Jorge Galbiati* LNCS 4432 p.554
   We present a method for image segmentation, that is, to identify image points with an indication of the region or class they belong to. The proposed algorithm basically consists of two stages. First it starts by restoring the image from possible contamination. In the second stage it analyzes each pixel using a 3x3 sliding window. For the first pixel, it creates an objets consisting of that same pixel, and registers this object in an array. In the subsequent steps, a cluster analysis is applied to the surrounding eight pixels, an determines whether the central pixel belongs to one of the existing objects, or a new object has to be created, and registered in the array of objects.
2. **11:00** A Context-Driven Bayesian Classification Method for Eye Location *Eun Jin Koh, Mi Young Nam, Phill Kyu Rhee* LNCS 4432 p.517
   In this paper, we present a novel classification method for eye location. It is based on image context analysis. There is general accord that context can be affluent derivation of information about an illumination, character and diversity

of object. However, the problem of how to customize contextual influence is not yet solved clearly. Here we describe a nave probabilistic method for modeling and testing the images of eye patterns. The proposed eye location method employs context-driven adaptive Bayesian framework to relive the effect due to uneven condition of face image. Based on an easy holistic analysis of face images, the proposed method is able to exactly locate eye position. The experimental results show that the proposed approach can achieve superior performance using various data sets to previously proposed methods.

3. **11:20** Automatic Target Recognition in SAR Images Based on a SVM Classification Scheme *Wolfgang Middelmann, Alfons Ebert, Ulrich Thoennessen* LNCS 4432 p.492
   The performance of classifiers is commonly evaluated by classification rate and false alarm rate (FAR). Many applications like traffic monitoring, surveillance and other security relevant tasks suffer from the problem balancing the performance criteria in an appropriate way. In this contribution, we propose a kernel classification scheme with high performance in discriminating classes and rejecting clutter objects. Especially, it determines a class membership assessment. The classification scheme consists of two kernel classification stages and a maximum decision module as combiner. For tests, we use targets taken from the MSTAR synthetic aperture radar (SAR) dataset and clutter objects extracted from SAR scenes by a screening process. The dependency on parameter variations is shown and receiver operator characteristic (ROC) curves are given. The results confirm the high classification performance at low FARs. The integration into an operational demonstration system is in progress.
4. **11:40** Adaptive Mosaicing: Principle and Application to the Mosaicing of Large Image Data Sets *Conrad Bielski, Pierre Soille* LNCS 4432 p.500
   Automatic image compositing of very large data sets is necessary for the creation of extensive mosaics based on high spatial resolution remotely sensed imagery. A novel morphological image compositing algorithm has been developed which adapts to salient images edges. This technique produces seam lines that are difficult to identify by the naked eye which is also a characteristic to measure the quality of the resulting seam line. This paper begins with a description of the methodology and results based on Landsat 7 ETM+ imagery. It is also shown how updates to an already composited image data set can be easily made without having to reprocess the entire data set. Finally, ways of quantifying the quality of an automatically delineated cut line and future research directions are discussed.
5. **12:00** Circular Road Signs Recognition with Affine Moment Invariants and the Probabilistic Neural Classifier *Boguslaw Cyganek* LNCS 4432 p.508
   In this paper the neural classifier for recognition of the circular shaped road signs is presented. This classifier belongs to the road signs recognition module, which

in turn is a part of a driver assisting system. The circular shaped prohibition and obligation signs constitute the very important groups within the set of road signs. In this case however, it is not possible for a detector to determine rotation of the shapes that would allow dimension reduction of the search space. Thus the classifier has to be able to properly work with all possible affine deformations. To alleviate this problem we propose to use as features the statistical moments which were shown to be invariant within an affine group of transformations. The classification is performed by the probabilistic neural network which is trained with sign examples extracted from the real traffic scenes. The obtained results show good accuracy of classification and fast operation time.

6. **12:20** Computer-Aided Vision System for Surface Blemish Detection of LED Chips *Hong-Dar Lin, Chung-Yu Chung, Singa Wang Chiu* LNCS 4432 p.525

   This research explores the automated detection of surface blemishes in light-emitting diode (LED) chips. An LED is a semiconductor device that emits visible light when an electric current passes through the semiconductor chip. Water-drop blemishes, commonly appearing on the surfaces of chips, impair the appearance of LEDs as well as their functionality and security. Consequently, detecting water-drop blemishes becomes crucial for the quality control of LED products. We first use the one-level Haar wavelet transform to decompose a chip image and extract four wavelet characteristics. Then, the T2 statistic of multivariate statistical analysis is applied to integrate the multiple wavelet characteristics. Finally, the wavelet based multivariate statistical approach judges the existence of water-drop blemishes. Experimental results show that the proposed method achieves an above 95

Neural Networks II, Room 237 - Audience Hall

1. **15:10** Study of the Influence of Noise in the Values of a Median Associative Memory *Humberto Sossa, Ricardo Barron, Roberto A. Vazquez* LNCS 4432 p.55

   In this paper we study how the performance of a median associative memory is influenced when the values of its elements are altered by noise. To our knowledge this kind of research has not been reported until know. We give formal conditions under which the memory is still able to correctly recall a pattern of the fundamental set of patterns either from a non-altered or a noisy version of it. Experiments are also given to show the efficiency of the proposal.

2. **15:30** Learning Using a Self-building Associative Frequent Network *Jin-Guk Jung, Mohammed Nazim Uddin, Geun-Sik Jo* LNCS 4432 p.71

   In this paper, we propose a novel framework, called a frequent network, to discover frequent itemsets and potentially frequent patterns by logical inference. We also introduce some new terms and concepts to define the frequent network, and we show the procedure of constructing the frequent network. We then describe a new method LAFN (Learning based on Associative Frequent Network) for mining frequent itemsets and potentially patterns, which are considered as a useful pattern logically over the frequent network. Finally, we present a useful application, classification with these discovered patterns from the proposed framework, and report the results of the experiment to evaluate our classifier on some data sets.

3. **15:50** A Study into the Improvement of Binary Hopfield Networks for Map Coloring *Gloria Galan-Marin, Enrique Merida-Casermeiro, Domingo Lopez-Rodriguez, Juan M. Ortiz-de-Lazcano-Lobato* LNCS 4432 p.98

   The map-coloring problem is a well known combinatorial optimization problem which frequently appears in mathematics, graph theory and artificial intelligence. This paper presents a study into the performance of some binary Hopfield networks with discrete dynamics for this classic problem. A number of instances have been simulated to demonstrate that only the proposed binary model provides optimal solutions. In addition, for large-scale maps an algorithm is presented to improve the local minima of the network by solving gradually growing submaps of the considered map. Simulation results for several n-region 4-color maps showed that the proposed neural algorithm converged to a correct colouring from at least 90% of initial states without the finetuning of parameters required in another Hopfield models.

4. **16:10** Robust Stability Analysis for Delayed BAM Neural Networks *Yijing Wang, Zhiqiang Zuo* LNCS 4432 p.88

   The problem of robust stability for a class of uncertain bidirectional associative memory neural networks with time delays is investigated in this paper. A more general Lyapunov-Krasovskii functional is proposed to derive a less conservative robust stability condition within the framework of linear matrix inequalities. A numerical example is given to illustrate the effectiveness of the proposed method.

5. **16:30** Impact of Learning on the Structural Properties of Neural Networks *Branko Ster, Ivan Gabrijel, Andrej Dobnikar* LNCS 4432 p.63

   We research the impact of the learning process of neural networks (NN) on the structural properties of the derived graphs. A type of recurrent neural network is used (GARNN). A graph is derived from a NN by defining a connection between any pair od nodes having weights in both directions above a certain threshold. We measured structural properties of graphs such as characteristic path lengths

(L), clustering coefficients (C) and degree distributions (P). We found that well trained networks differ from badly trained ones in both L and C.

6. **16:50** Proposal of a New Conception of an Elastic Neural Network and its Application to the Solution of a Two-Dimensional Travelling Salesman Problem *Tomasz Szatkiewicz* LNCS 4432 p.80

   In this publication, a new conception of a neural network proposed by the author was described. It belongs to the class of self-organizing networks. The theory, structure and learning principles of the network proposed were all described. Further chapters include the application of a system of two proposed neural networks for the solution of a two-dimensional Euclides' travelling salesman problem. The feature of the neural network system proposed is an ability to avoid unfavourable local minima. The article presents graphical results of the evaluation of the neural network system from the initialization point to the determination of the selected TSP instance.

Evolutionary Computation II, Room 134

1. **15:10** Gradient Based Stochastic Mutation Operators in Evolutionary Multi-objective Optimization *Pradyumn Kumar Shukla* LNCS 4431 p.58

   Evolutionary algorithms have been adequately applied in solving single and multi-objective optimization problems. In the singleobjective case various studies have shown the usefulness of combining gradient based classical search principles with evolutionary algorithms. However there seems to be a dearth of such studies for the multi-objective case. In this paper, we take two classical search operators and discuss their use as a local search operator in a state-of-the-art evolutionary algorithm. These operators require gradient information which is obtained using a stochastic perturbation technique requiring only two function evaluations. Computational studies on a number of test problems of varying complexity demonstrate the efficiency of hybrid algorithms in solving a large class of complex multi-objective optimization problems.

2. **15:30** Co-evolutionary Multi-agent System with Predator-Prey Mechanism for Multi-objective Optimization *Rafal Drezewski, Leszek Siwik* LNCS 4431 p.67

   Co-evolutionary techniques for evolutionary algorithms allow for the application of such algorithms to problems for which it is difficult or even impossible to formulate explicit fitness function. These techniques also maintain population diversity, allows for speciation and help overcoming limited adaptive capabilities of evolutionary algorithms. In this paper the idea of co-evolutionary multi-agent

system with predator-prey mechanism for multi-objective optimization is introduced. In presented system the Pareto frontier is located by the population of agents as a result of co-evolutionary interactions between two species: predators and prey. Results from runs of presented system against test problem and comparison to classical multi-objective evolutionary algorithms conclude the paper.

3. **15:50** Optical Design with Epsilon-Dominated Multi-objective Evolutionary Algorithm *Shaine Joseph, Hyung W. Kang, Uday K. Chakraborty* LNCS 4431 p.77
   Significant improvement over a patented lens design is achieved using multi-objective evolutionary optimization. A comparison of the results obtained from NSGA2 and ε-MOEA is done. In our current study, ε-MOEA converged to essentially the same Pareto-optimal solutions as the one with NSGA2, but ε-MOEA proved to be better in providing reasonably good solutions, comparable to the patented design, with lower number of lens evaluations. ε-MOEA is shown to be computationally more efficient and practical than NSGA2 to obtain the required initial insight into the objective function trade-offs while optimizing large and complex optical systems.
4. **16:10** Immune Algorithm versus Differential Evolution: a Comparative Case Study Using High Dimensional Function Optimization *Vincenzo Cutello, Natalio Krasnogor, Giuseppe Nicosia, Mario Pavone* LNCS 4431 p.93
   In this paper we propose an immune algorithm (IA) to solve high dimensional global optimization problems. To evaluate the effectiveness and quality of the IA we performed a large set of unconstrained numerical optimisation experiments, which is a crucial component of many real-world problem-solving settings. We extensively compare the IA against several Differential Evolution (DE) algorithms as these have been shown to perform better than many other Evolutionary Algorithms on similar problems. The DE algorithms were implemented using a range of recombination and mutation operators combinations. The algorithms were tested on 13 well known benchmark problems. Our results show that the proposed IA is effective, in terms of accuracy, and capable of solving large-scale instances of our benchmarks. We also show that the IA is comparable, and often outperforms, all the DE variants, including two Memetic algorithms.
5. **16:30** Boosting the Performance of a Multiobjective Algorithm to Design RBFNNs Through Parallelization *Alberto Guillen, Ignacio Rojas, Jesus Gonzalez, Hector Pomares, Luis J. Herrera, Ben Paechter* LNCS 4431 p.85
   Radial Basis Function Neural Networks (RBFNNs) have been widely used to solve classification and regression tasks providing satisfactory results. The main issue when working with RBFNNs is how to design them because this task requires the optimization of several parameters such as the number of RBFs, the position of their centers, and their radii. The problem of setting all the previous values presents many local minima so Evolutionary Algorithms (EAs) are

a common solution because of their capability of finding global minima. Two of the most important elements in an EAs are the crossover and the mutation operators. This paper presents a comparison between a non distributed multi-objective algorithm against several parallel approaches that are obtained by the specialisation of the crossover and mutation operators in different islands. The results show how the creation of specialised islands that use different combinations of crossover and mutation operators could lead to a better performance of the algorithm by obtaining better solutions.

6. **16:50** Self-adaptive Evolutionary Methods in Designing Skeletal Structures *Adam Borkowski, Piotr Nikodem* LNCS 4431 p.102
   This paper focuses on modified genetic algorithm based on the graph representation and specialized genetic operators. Advantages of changed representation, multi-level organization as well as self-adaptive aspects of the proposed method are described. The results of algorithm usage in optimising skeletal structures are also presented.

Computer Vision II, Room 123

1. **15:10** Dimensionality Problem in the Visualization of Correlation-Based Data *Gintautas Dzemyda, Olga Kurasova* LNCS 4432 p.544
   A method for visualization the correlation-based data has been investigated. The advantage of this method lies in the possibility to restore the system of multidimensional vectors describing parameters from their correlation matrix (one vector for one parameter) and to visualise these vectors for the visual decision making on the similarity of the parameters. The goal of this research is to investigate the possibility to reduce the dimensionality of the vectors from the restored system and to evaluate the visualization quality in dependence on the reduction level.
2. **15:30** Reflective Symmetry Detection Based on Parallel Projection *Ju-Whan Song , Ou-Bong Gwun* LNCS 4432 p.590
   Reflective symmetry is useful for various areas such as computer vision, medical imaging, and 3D model retrieval system. This paper presents an intuitive reflective symmetry detection method for 3D polygon objects. Without any mapping process the method detects the reflective symmetry plane by parallel projection. This paper defines a continuous measure to estimate how much an object is reflective symmetrical for a projection plane through the center of the object. Also it explores the method to detect the reflective symmetry plane with the measure. The proposed method can detect up to 99% reflective symmetry plane not exceeding 4 degree angle for perfect symmetry objects and detect

up to 85% reflective symmetry plane not exceeding 10 degree angle for near symmetry objects using Princeton Shape Benchmark.

3. **15:50** Active Shape Models and Evolution Strategies to Automatic Face Morphing *Vittorio Zanella, Hector Vargas, Lorna V. Rosas* LNCS 4432 p.564

   Image metamorphosis, commonly known as morphing, is a powerful tool for visual effects that consists of the fluid transformation of one digital image into another. There are many techniques for image metamorphosis, but in all of them there is a need for a person to supply the correspondence between the features in the source image and target image. In this paper we use the Active Shape Models and Evolution Strategies to perform the metamorphosis of face images in frontal view automatically.

4. **16:10** A Local-Information-based Blind Image Restoration Algorithm Using a MLP *Hui Wang, Nian Cai, Ming Li, Jie Yang* LNCS 4432 p.582

   Based on a multilayer perceptron (MLP), a blind image restoration method is presented. The algorithm considers both local region information and edge information of an image. To reduce the dimension of the network's input, a sliding window approach is employed to extract the features of the blurred image, which makes use of local region information. For the purpose of accelerating training and improving the restoration performance, the edge part and the smooth part in an image are separated and then used as training sets, respectively. A mapping model between the blurred image and the clear one is established through training the MLP with LM algorithm and then it is utilized to restore the blurred image. The simulation results demonstrate the proposed method feasible for image restoration.

5. **16:30** Recognition of Shipping Container Identifiers Using ART2-Based Quantization and a Refined RBF Network *Kwang-Baek Kim, Minhwan Kim, Young Woon Woo* LNCS 4432 p.572

   Generally, it is difficult to find constant patterns on identifiers in a container image, since the identifiers are not normalized in color, size, and position, etc. and their shapes are damaged by external environmental factors. This paper distinguishes identifier areas from background noises and removes noises by using an ART2-based quantization method and general morphological information on the identifiers such as color, size, ratio of height to width, and a distance from other identifiers. Individual identifier is extracted by applying the 8-directional contour tracking method to each identifier area. This paper proposes a refined ART2-based RBF network and applies it to the recognition of identifiers. Through experiments with 300 container images, the proposed algorithm showed more improved accuracy of recognizing container identifiers than the others proposed previously, in spite of using shorter training time.

6. **16:50** A Novel Architecture for the Classification and Visualization of Sequential Data *Jorge Couchet, Enrique Ferreira, Andre Fonseca, Daniel Manrique* LNCS 4431 p.730
   This paper1 introduces a novel architecture to efficiently code in a self-organized manner, data from sequences or a hierarchy of sequences. The main objective of the architecture proposed is to achieve an inductive model of the sequential data through a learning algorithm in a finite vector space with generalization and prediction properties improved by the compression process. The architecture consists of a hierarchy of recurrent self-organized maps with emergence which performs a fractal codification of the sequences. An adaptive outlier detection algorithm is used to automatically extract the emergent properties of the maps. A visualization technique to help the analysis and interpretation of data is also developed. Experiments and results for the architecture are shown for an anomaly intrusion detection problem.

Poster Session I, Poster Area

1. An Evolutionary Approach to Task Graph Scheduling *Saeed Parsa, Shahriar Lotfi, Naser Lotfi* LNCS 4431 p.110
   Effective scheduling is of great importance to parallel programming environments. The aim is to minimize the completion time of task graphs. The completion time of a task graph is directly affected by the length of its critical path. Hence, the trend of an evolutionary approach for task graph scheduling can be biased towards reduction of the critical path. In this paper, a new genetic scheduling algorithm is presented. The algorithm, in the first priority, minimizes the critical path length of the parallel program task graph and in the second priority minimizes the inter-processor communication time. Thereby, it achieves a better scheduling in comparison with the existing approaches.
2. Universal Quantum Gates via Yang-Baxterization of Dihedral Quantum Double *Mario Velez, Juan Ospina* LNCS 4431 p.120
   The recently discovered Yang-Baxterization process for the quantum double of the dihedral group algebra, is presented keeping on mind the quantum computation. The products resultant from YangBaxterization process are interpreted as universal quantum gates using the Bryslinski's theorem. Results are obtained for two-qubits and two-qutrits gates. Using the Zhang-Kauffman-Ge method (ZKGM), certain Hamiltonians responsible for the quantum evolution of the quantum gates are obtained. Possible physical systems such as anyons systems are mentioned as referents for practical implementation.

3. Evolutionary Bi-objective Learning with Lowest Complexity in Neural Networks: Empirical Comparisons *Yamina Mohamed Ben Ali* LNCS 4431 p.128

   This paper introduces a new study in evolutionary computation technique in order to learn optimal configuration of a multilayer neural network. Inspired from thermodynamic perception, the used evolutionary framework undertakes the optimal configuration problem as a Bi-objective optimization problem. The first objective aims to learn optimal layer topology by considering optimal nodes and optimal connections by nodes. Second objective aims to learn optimal weights setting. The evaluation function of both concurrent objectives is founded on an entropy function which leads the global system to optimal generalization point. Thus, the evolutionary framework shows salient improvements in both modeling and results. The performance of the required algorithms was compared to estimations distribution algorithms in addition to the Backpropagation training algorithm.

4. Improving the Quality of the Pareto Frontier Approximation Obtained by Semi-elitist Evolutionary Multi-agent System Using Distributed and Decentralized Frontier Crowding Mechanism *Leszek Siwik, Marek Kisiel-Dorohinicki* LNCS 4431 p.138

   The paper presents one of additional mechanisms called distributed frontier crowding which can be introduced to the Semi-Elitist Evolutionary Multi Agent System–selEMAS and which can significantly improve the quality of obtained Pareto frontier approximation. The preliminary experimental comparative studies are based on a typical multi-objective problem presenting the most important features of the proposed approach.

5. On Semantic Properties of Interestingness Measures for Extracting Rules from Data *Mondher Maddouri, Jamil Gammoudi* LNCS 4431 p.148

   The extraction of IF-THEN rules from data is a promising task of data mining including both Artificial Intelligence and Statistics. One of the difficulties encountered is how to evaluate the relevance of the extracted rules? Many authors use statistical interestingness measures to evaluate the relevance of each rule (taken alone). Recently, few research works have done a synthesis study of the existing interestingness measures but their study presents some limits. In this paper, firstly, we present an overview of related works studying more than forty interestingness measures. Secondly, we establish a list of nineteen other interestingness measures not referenced by the related works. Then, we identify twelve semantic properties characterizing the behavior of interestingness measures. Finally, we did a theoretical study of sixty two interestingness measures by outlining their semantic properties. The results of this study are useful to the users of a data-mining system in order to help them to choose an appropriate measure.

6. A Hybrid Genetic Algorithm with Simulated Annealing for Nonlinear Blind Equalization Using RBF Networks *Soowhan Han, Imgeun Lee, Changwook Han* LNCS 4431 p.257
   In this study, a hybrid genetic algorithm, which merges a genetic algorithm with simulated annealing, is derived for nonlinear channel blind equalization using RBF networks. The proposed hybrid genetic algorithm is used to estimate the output states of a nonlinear channel, based on the Bayesian likelihood fitness function, instead of the channel parameters. From these estimated output states, the desired channel states of the nonlinear channel are derived and placed at the center of a RBF equalizer to reconstruct transmitted symbols. In the simulations, binary signals are generated at random with Gaussian noise. The performance of the proposed method is compared with those of a conventional genetic algorithm (GA) and a simplex GA. It is shown that the relatively high accuracy and fast convergence speed have been achieved.
7. Feature Extraction of Speech Signal by Genetic Algorithms-Simulated Annealing and Comparison with Linear Predictive Coding Based Methods *Melih Inal* LNCS 4431 p.266
   This paper presents Genetic Algorithms and Simulated Annealing (GASA) based on feature extraction of speech signal and comparison with traditional Linear Predictive Coding (LPC) methods. The performance of each method is analyzed for ten speakers with independent text speaker verification database from Center for Spoken Language Understanding (CSLU) which was developed by Oregon Graduate Institute (OGI). The GASA algorithm is also analyzed with constant population size for different generation numbers, crossover and mutation probabilities. When compared with the Mean Squared Error (MSE) of the each speech signal for each method, all simulation results of the GASA algorithm are more effective than LPC methods.
8. Automatic Design of ANNs by Means of GP for Data Mining Tasks: Iris Flower Classification Problem *Daniel Rivero, Juan Rabunal, Julian Dorado, Alejandro Pazos* LNCS 4431 p.276
   This paper describes a new technique for automatically developing Artificial Neural Networks (ANNs) by means of an Evolutionary Computation (EC) tool, called Genetic Programming (GP). This paper also describes a practical application in the field of Data Mining. This application is the Iris flower classification problem. This problem has already been extensively studied with other techniques, and therefore this allows the comparison with other tools. Results show how this technique improves the results obtained with other techniques. Moreover, the obtained networks are simpler than the existing ones, with a lower number of hidden neurons and connections, and the additional advantage that there has been a discrimination of the input variables. As it is explained in the text, this variable discrimination gives new knowledge to the problem, since now it is possible to know which variables are important to achieve good results.

9. FPGA Implementation of Evolvable Characters Recognizer with Self-Adaptive Mutation Rates *Jin Wang, Chang Hao Piao, Chong Ho Lee* LNCS 4431 p.286

   As an alternative to traditional artificial neural network approaches to pattern recognition, a hardware-implemented evolvable characters recognizer is presented in this paper. The main feature of the proposed evolvable system is that all the components including the evolutionary algorithm (EA), fitness calculation, and virtual reconfigurable circuit are implemented in a Xilinx Virtex xcv2000E FPGA. This allows for a completely pipelined hardware implementation and yields a significant speedup in the system evolution. In order to optimize the performance of the evolutionary algorithm and release the users from the time-consuming process of mutation parameters tuning, a selfadaptive mutation rate control scheme is also introduced. An analysis of experimental results demonstrates that the proposed evolvable system using self-adaptive mutation rates is superior to traditional fixed mutation rate-based approaches.

10. A Multi-gene-feature-based Genetic Algorithm for Prediction of Operon *Shuqin Wang, Yan Wang, Wei Du, Fangxun Sun, Xiumei Wang, Yanchun Liang, Chunguang Zhou* LNCS 4431 p.296

    The prediction of operons is critical to reconstruction of regulatory networks at the whole genome level. In this paper, a multi-approach guided genetic algorithm is developed to prediction of operon. The fitness function is created by using intergenic distance of local entropy-minimization, participation of the same metabolic pathway, log-likelihood of COG gene functions and correlation coefficient of microarray expression data, which have been used individually for predicting operons. The gene pairs within operons have high fitness value by using these four scoring criteria, whereas those across transcription unit borders have low fitness value. On the other hand, it is easy to predict operons and makes the prediction ability stronger by using these four scoring criteria. The proposed method is examined on 683 known operons of Escherichia coli K12 and an accuracy of 85.9987% is obtained.

11. Application of Micro-GA for an Optimal Direct Design Method of Steel Frame *Se-Hyu Choi* LNCS 4431 p.306

    In this paper, an optimal direct design method of steel frame using advanced analysis and genetic algorithm is presented. The advanced analysis realistically assesses both strength and behavior of a structural system and its component members in a direct manner. The micro-GA is used for minimum weight optimization of steel frames. Constraint functions are load-carrying capacities and serviceability. The optimum designs determined by the proposed method are lighter than those given by other approaches.

12. Multi-Objective Optimal Public Investment: An Extended Model and Genetic Algorithm-Based Case Study *Lei Tian, Liyan Han, Hai Huang* LNCS 4431 p.314
    Under the multi-region and multi-sector consideration, the previous double-objective optimal public investment model is extended to involve optimal employment rate objective and time-flow total income maximization objective first. Then genetic algorithm is applied to solve the multi-objective model. Finally a case study is carried out to verify the superiority of the genetic algorithm-based solution to traditional public investment distribution approach.
13. Recognition of Patterns without Feature Extraction by GRNN *Ovunc Polat, Tulay Yildirim* LNCS 4432 p.161
    Automatic pattern recognition is a very important task in many applications such as image segmentation, object detection, etc. This work aims to find a new approach to automatically recognize patterns such as 3D objects and handwritten digits based on a database using General Regression Neural Networks (GRNN). The designed system can be used for both 3D object recognition from 2D poses of the object and handwritten digit recognition applications. The system does not require any preprocessing and feature extraction stage before the recognition. Simulation results show that pattern recognition by GRNN improves the recognition rate considerably in comparison to other neural network structures and has shown better recognition rates and much faster training times than that of Radial Basis Function and Multilayer Perceptron networks for the same applications.
14. Parallel Realizations of the SAMANN Algorithm *Sergejus Ivanikovas, Viktor Medvedev, Gintautas Dzemyda* LNCS 4432 p.179
    Sammon's mapping is a well-known procedure for mapping data from a higher-dimensional space onto a lower-dimensional one. But the original algorithm has a disadvantage. It lacks generalization, which means that new points cannot be added to the obtained map without recalculating it. The SAMANN neural network, that realizes Sammon's algorithm, provides a generalization capability of projecting new data. A drawback of using SAMANN is that the training process is extremely slow. One of the ways of speeding up the neural network training process is to use parallel computing. In this paper, we proposed some parallel realizations of the SAMANN.
15. A POD-based Center Selection for RBF Neural Network in Time Series Prediction Problems *Wenbo Zhang, Xinchen Guo, Chaoyong Wang, Chunguo Wu* LNCS 4432 p.189
    Center selection based on proper orthogonal decomposition (POD) is presented to select centers for the radial basis function (RBF) neural network in prediction of nonlinear time series. The proposed method takes advantages of the time-sequence feature in time series data and enables the center selection to be implemented in a parallel manner. Simulations on a benchmark problem and on

two predictions of stock prices show that the presented method can be applied effectively to the prediction of nonlinear time series. Besides possessing higher precisions in training and testing, the proposed method has stronger generalization and noise resistance abilities, compared to several other popular center selection methods.

16. Real-Time String Filtering of Large Databases Implemented via a Combination of Artificial Neural Networks *Tatiana Tambouratzis* LNCS 4432 p.169

    A novel approach to real-time string filtering of large databases is presented. The proposed approach is based on a combination of artificial neural networks and operates in two stages. The first stage employs a self-organizing map for performing approximate string matching and retrieving those strings of the database which are similar to (i.e. assigned to the same SOM node as) the query string. The second stage employs a harmony theory network for comparing the previously retrieved strings in parallel with the query string and determining whether an exact match exists. The experimental results demonstrate accurate, fast and database-size independent string filtering which is robust to database modifications. The proposed approach is put forward for general-purpose (directory, catalogue and glossary search) and Internet (e-mail blocking, intrusion detection systems, URL and username classification) applications.

17. GA-Based Iris/Sclera Boundary Detection for Biometric Iris Identification *Tatiana Tambouratzis, Michael Masouris* LNCS 4432 p.457

    Iris identification (IRI) constitutes an increasingly accepted methodology of biometrics. IRI is based on the successful encoding and matching of distinctive iris features (folds, freckles etc.), which - in turn presupposes that iris segmentation has been accurately performed. In contrast to the inner (iris/pupil) iris boundary, which owing to the high contrast between the adjacent areas - is relatively easy to localize, detection of the outer (iris/sclera) iris boundary is more challenging since the low contrast between the separated areas often results in fragmented, ambiguous and spurious edges. A novel approach to iris boundary detection is presented here, featuring a genetic algorithm (GA) for outer iris boundary detection.

18. Neural Network Based Recognition by Using Genetic Algorithm for Feature Selection of Enhanced Fingerprints *Adem Alpaslan Altun, Novruz Allahverdi* LNCS 4432 p.467

    In order to ensure that the performance of a fingerprint recognition system will be powerful with respect to the quality of input fingerprint images, the enhancement of fingerprints is essential. In this study wavelet transform and contourlet transform which is a new extension of the wavelet transform in two dimensions are applied for fingerprint enhancement. In addition, feature selection is a process that chooses a subset of features from the original fingerprint features so that the feature space is optimally reduced according to a certain criterion. In

this study, a Genetic Algorithms (GAs) approach to fingerprint feature selection is proposed and selected features are input to Artificial Neural Networks (ANNs) for fingerprint recognition. The performance has been tested on fingerprint recognition.

19. Detail-Preserving Regularization Based Removal of Impulse Noise from Highly Corrupted Images *Bogdan Kwolek* LNCS 4432 p.599

    This paper proposes a new filtering scheme for eliminating random-valued impulse noise from gray images. In the first phase a noise detector is utilized to extract the noise candidates. Next, the algorithm applies a connected component analysis in order to gather the neighboring noisy pixels into separate sets of connected noise candidates. The corrupted pixels are restored using a detail preserving regularization method. The main idea of the proposed approach is to gather the noisy candidate pixels into separate sets of connected pixels and solve the minimization functional over these pixels. Experimental results illustrate the efficiency and effectiveness of the algorithm.

20. Fast Algorithm for Order Independent Binary Homotopic Thinning *Marcin Iwanowski, Pierre Soille* LNCS 4432 p.606

    In this paper an efficient queue-based algorithm for order independent homotopic thinning is proposed. This generic algorithm can be applied to various thinning versions: homotopic marking, anchored skeletonisation, and the computation of the skeleton of influence zones based on local pixel characterisations. An example application of the proposed method to detect the medial axis of wide river networks from satellite imagery is also presented.

21. A Perturbation Suppressing Segmentation Technique Based on Adaptive Diffusion *Wolfgang Middelmann, Alfons Ebert, Tobias Deissler, Ulrich Thoennessen* LNCS 4432 p.616

    Segmentation is a fundamental task in pattern recognition and basis for high level applications like scene reconstruction, change detection, or object classification. The performance of these tasks suffers from a distorted segmentation. In this contribution an adaptive diffusion-based segmentation method is proposed suppressing perturbations in the segmentation with focusing on small regions with high contrast to their surrounding. The algorithm determines in each step the diffusion tensor. It is re-weighted with respect to an assessment stage. A comparative study uses high-resolution remote sensing data.

22. Weighted Order Statistic Filters for Pattern Detection *Slawomir Skoneczny, Dominik Cieslik* LNCS 4432 p.624

    In this paper we propose a method of using Weighted Order Statistic (WOS) filters for the task of pattern detection. Usually WOS filters are applied to noise removal. An efficient algorithm for pattern detection is described in details with emphasis put on the problem of a proper choice of filter windows. Also practical results of different pattern detection cases are presented.

23. Real-Time Image Segmentation for Visual Servoing *Witold Czajewski, Maciej Staniak* LNCS 4432 p.633
    Precise and real-time segmentation of color images is a crucial aspect of many applications, where high accuracy and quick response of a system is required. There is a number of algorithms available, but they are either fast or accurate, but not both. This paper describes a modification to one of the fastest color segmentation methods based on constant thresholds. Our idea is to use variable thresholds and merge the results achieving higher precision of color segmentation, comparable with adaptive methods. Using variable thresholds requires multiple passes of the algorithm which is time consuming, but thanks to our modification the processing time can be reduced by up to 50%. The original algorithm as well as the proposed modification are described. The performance of the modified method is tested in a real-time visual servoing application.

24. Detection of Various Defects in TFT-LCD Polarizing Film *Sang-Wook Sohn, Dae-Young Lee, Hun Choi, Jae-Won Suh, Hyeon-Deok Bae* LNCS 4432 p.534
    The increasing use of TFT-LCDs has generated a great deal of interest in manufacturing defects on TFT-LCD polarizing film because the poor quality of TFT-LCD polarizing film result in undesirable effects on the TFT-LCD display devices. In this paper, we propose a new inspection method that reliably detects various defects of TFT-LCD polarizing films. First, we apply a least mean squares adaptive filtering technique to remove background noise. Next, we use statistical characteristics to detect possible defects. Finally, we make a binary image to identify weather the TFT-LCD polarizing film has defects or not based on an adaptive threshold value. The performance of the proposed method has been evaluated on real TFT-LCD polarizing film samples.

25. Kernels for Chemical Compounds in Biological Screening *Karol Kozak, Marta Kozak, Katarzyna Stapor* LNCS 4432 p.327
    Kernel methods are a class of algorithms for pattern analysis with a number of convenient features. This paper proposes extension of the kernel method for biological screening data including chemical compounds. Our investigation of extending kernel aims to combine properties of graphical structure and molecule descriptors. The use of such kernels allows comparison of compounds, not only on graphs but also on important molecular descriptors. Our experimental evaluation of eight different classification problems shows that a proposed special kernel, which takes into account chemical molecule structure and molecule descriptors, statistically improves significantly the classification performance.

26. Analysis of Microscopic Mast Cell Images Based on Network of Synchronised Oscillators *Michal Strzelecki, Hyongsuk Kim, Pawel Liberski, Anna Zalewska* LNCS 4432 p.346
    This paper describes automatic analysis of microscopic mast cell images using network of synchronized oscillators. This network allows for detection of image

objects and their boundaries along with evaluation of some geometrical object parameters, like their area and perimeter. Estimation of such mast cells' parameters is very important in description of both physiological and pathological processes in the human organism. It was also demonstrated, that oscillator networks is able to perform basic morphological operations along with binary image segmentation. Analysis of sample mast cell image was presented and discussed.

27. Detection of Gene Expressions in Microarrays by Applying Iteratively Elastic Neural Net *Max Chacon, Marcos Levano, Hector Allende, Hans Nowak* LNCS 4432 p.355

DNA analysis by microarrays is a powerful tool that allows replication of the RNA of hundreds of thousands of genes at the same time, generating a large amount of data in multidimensional space that must be analyzed using informatics tools. Various clustering techniques have been applied to analyze the microarrays, but they do not offer a systematic form of analysis. This paper proposes the use of Gorban's Elastic Neural Net in an iterative way to find patterns of expressed genes. The new method proposed (Iterative Elastic Neural Net, IENN) has been evaluated with up-regulated genes of the Escherichia Coli bacterium and is compared with the SelfOrganizing Maps (SOM) technique frequently used in this kind of analysis. The results show that the proposed method finds 86.7% of the up-regulated genes, compared to 65.2% of genes found by the SOM. A comparative analysis of Receiver Operating Characteristic (ROC) with SOM shows that the proposed method is 11.5% more effective.

28. A New Feature Selection Method for Improving the Precision of Diagnosing Abnormal Protein Sequences by Support Vector Machine and Vectorization Method *Eun-Mi Kim, Jong-Cheol Jeong, Ho-Young Pae, Bae-Ho Lee* LNCS 4432 p.364

Pattern recognition and classification problems are most popular issue in machine learning, and it seem that they meet their second golden age with bioinformatics. However, the dataset of bioinformatics has several distinctive characteristics compared to the data set in classical pattern recognition and classification research area. One of the most difficulties using this theory in bioinformatics is that raw data of DNA or protein sequences cannot be directly used as input data for machine learning because every sequence has different length of its own code sequences. Therefore, this paper introduces one of the methods to overcome this difficulty, and also argues that the capability of generalization in this method is very poor as showing simple experiments. Finally, this paper suggests different approach to select the fixed number of effective features by using Support Vector Machine, and noise whitening method. This paper also defines the criteria of this suggested method and shows that this method improves the precision of diagnosing abnormal protein sequences with experiment of classifying ovarian cancer data set.

29. Epileptic Seizure Prediction Using Lyapunov Exponents and Support Vector Machine *Bartosz Swiderski, Stanislaw Osowski, Andrzej Cichocki, Andrzej Rysz* LNCS 4432 p.373
The paper presents the method of predicting the epileptic seizure on the basis of EEG waveform analysis. The Support Vector Machine and the largest Lyapunov exponent characterization of EEG segments are employed to predict the incoming seizure. The results of numerical experiments will be presented and discussed.

30. Classification of Pathological and Normal Voice Based on Linear Discriminant Analysis *Ji-Yeoun Lee, SangBae Jeong, Minsoo Hahn* LNCS 4432 p.382
This paper suggests a new method to improve the performance of the pathological/normal voice classification. The effectiveness of the mel frequency-based filter bank energies using the fisher discriminant ratio (FDR) is analyzed. Also, mel frequency cepstrum coefficients (MFCCs) and the feature vectors through the linear discriminant analysis (LDA) transformation of the filter bank energies (FBE) are implemented. In addition, we emphasize the relation between the pathological voice detection and the feature vectors through the FBE-LDA transformation. This paper shows that the FBE LDA-based GMM is a sufficiently distinct method for the pathological/normal voice classification. The proposed method shows better performance than the MFCC-based GMM with noticeable improvement.

31. Efficient 1D and 2D Daubechies Wavelet Transforms with Application to Signal Processing *Piotr Lipinski, Mykhaylo Yatsymirskyy* LNCS 4432 p.391
In this paper we have introduced new, efficient algorithms for computing one- and two-dimensional Daubechies wavelet transforms of any order, with application to signal processing. These algorithms has been constructed by transforming Daubechies wavelet filters into weighted sum of trivial filters. The theoretical computational complexity of the algorithms has been evaluated and compared to pyramidal and ladder ones. In order to prove the correctness of the theoretical estimation of computational complexity of the algorithms, sample implementations has been supplied. We have proved that the algorithms introduced here are the most robust of all class of Daubechies transforms in terms of computational complexity, especially in two dimensional case.

32. A Branch and Bound Algorithm for Matching Protein Structures *Janez Konc, Dusanka Janezic* LNCS 4432 p.399
An efficient branch and bound algorithm for matching protein structures has been developed. The compared protein structures are represented as graphs and a product graph of these graphs is calculated. The resulting product graph is then the input to our algorithm. A maximum clique in the product graph corresponds to the maximum common substructure in the original graphs. Our algorithm, which gives an approximate solution to the maximum clique problem,

is compared with exact algorithms commonly used in bioinformatics for protein structural comparisons. The computational results indicate that the new algorithm permits an efficient protein similarity calculation used for protein structure analysis and protein classification.

33. A Method to Classify Collaboration in CSCL Systems *Rafael Duque, Crescencio Bravo* LNCS 4431 p.649

One of the most important challenges of collaborative learning systems is to offer mechanisms to facilitate the study of the relationships between the collaboration process and the characteristics of the solution (product) built by the learners in this work process. In this article, a machine learning algorithm that generates a set of rules to classify the different forms of collaboration within a group of learners with respect to the quality of the solution built is presented. The algorithm, based on a fuzzy model, is put into practice using data registered in a collaborative learning environment.

Sessions on 13th April

Classification and Clustering I, Room 237 - Audience Hall

1. **10:40** Hierarchical Rules for a Hierarchical Classifier *Igor T. Podolak* LNCS 4431 p.749

   A system of rule extraction out of a complex hierarchical classifier is proposed in this paper. There are several methods for rule extraction out of trained artificial neural networks (ANN's), but these methods do not scale well, i.e. results are satisfactory for small problems. For complicated problems hundreds of rules are produced, which are hard to govern. In this paper a hierarchical classifier with a tree-like structure and simple ANN's at nodes, is presented, which splits the original problem into several sub-problems that overlap. Node classifiers are all weak (i.e. with accuracy only better than random), and errors are corrected at lower levels. Single sub-problems constitute of examples that were hard to separate. Such architecture is able to classify better than single network models. At the same time ifthen rules are extracted, which only answer which sub-problem a given example belongs to. Such rules, by introducing hierarchy, are simpler and easier to modify by hand, giving also a better insight into the original classifier behaviour.

2. **11:00** Social Organization of Evolving Multiple Classifier System Functioning in Changing Environments *Sarunas Raudys* LNCS 4431 p.711

   We model populations of classifiers which are aimed to function in permanently varying environments, adapt to unexpected changes, to comply fitness function and survive. A failure to fulfill survivability condition is resulting in unsuccessful agents being removed from the agent society and be replaced by newborns which inherit some upbringing learning information from parent agents. We split the agent population into groups and suggest storing agent's gains accumulated during most recent periods, distort randomly training signals and a level of survival threshold. A presence of optimal number of groups and a necessity of small groups with mutually collaborating agents is demonstrated.

3. **11:20** Softening Splits in Decision Trees Using Simulated Annealing *Jakub Dvorak, Petr Savicky* LNCS 4431 p.721

   Predictions computed by a classification tree are usually constant on axis-parallel hyperrectangles corresponding to the leaves and have strict jumps on their boundaries. Frequently a better approximation may be expected, if the prediction function of the original tree is replaced by a continuous approximation. The approximation is constructed using the same training data on which the

original tree was grown and the structure of the tree is preserved. The current paper uses the model of trees with soft splits suggested by Quinlan and implemented in C4.5, however, the training algorithm is substantially different. The method uses simulated annealing, so it is quite computationally expensive. However, numerical test with data derived from an experiment in particle physics shows that besides the expected better approximation of the training data, also smaller generalization error is achieved.

4. **11:40** Mutual Information Estimation in Higher Dimensions: A Speed-Up of a k-Nearest Neighbor Based Estimator *Martin Vejmelka, Katerina Hlavackova-Schindler* LNCS 4431 p.790
   We focus on the recently introduced nearest neighbor based entropy estimator from Kraskov, Stogbauer and Grassberger (KSG), the nearest neighbor search of which is performed by the so called box assisted algorithm. We compare the performance of KSG with respect to three spatial indexing methods: box-assisted, k-D trie and projection method, on a problem of mutual information estimation of a variety of pdfs and dimensionalities. We conclude that the k-D trie method is significantly faster then box-assisted search in fixed-mass and fixed-radius neighborhood searches in higher dimensions. The projection method is much slower than both alternatives and not recommended for practical use.
5. **12:00** Clustering of Leaf-Labelled Trees *Jakub Koperwas, Krzysztof Walczak* LNCS 4431 p.702
   This paper introduces novel methodology for the clustering of data represented as leaf-labelled trees on the same leaf-set. We define an abstract term - the representative tree, which can be represented with a variety of trees, depending on applications. The quality of treeclustering is based on Information Gain, which measures the increase of information contained by representative trees of the resulting clusters compared to a single representative tree of the whole dataset. Finally, we propose the k-best algorithm the objective function of which is to maximize the information gain. We show how it can be constructed for two different representative trees, well- known in phylogenetic analysis. Developed algorithms yield very promissing results.
6. **12:20** Locally Scaled Density Based Clustering *Ergun Bicici, Deniz Yuret* LNCS 4431 p.739
   Density based clustering methods allow the identification of arbitrary, not necessarily convex regions of data points that are densely populated. The number of clusters does not need to be specified beforehand; a cluster is defined to be a connected region that exceeds a given density threshold. This paper introduces the notion of local scaling in density based clustering, which determines the density threshold based on the local statistics of the data. The local maxima of density are discovered using a k-nearest-neighbor density estimation and used as centers of potential clusters. Each cluster is grown until the density falls below a pre-specified ratio of the center point's density. The resulting clustering technique is able to identify clusters of arbitrary shape on noisy backgrounds

that contain significant density gradients. The focus of this paper is to automate the process of clustering by making use of the local density information for arbitrarily sized, shaped, located, and numbered clusters. The performance of the new algorithm is promising as it is demonstrated on a number of synthetic datasets and images for a wide range of its parameters.

Genetic Algorithms I, Room 134

1. **10:40** Clonal Selection Approach with Mutations Based on Symmetric α-Stable Distributions for Non-stationary Optimization Tasks *Krzysztof Trojanowski* LNCS 4431 p.184
   Efficiency of two mutation operators applied in a clonal selection based optimization algorithm AIIA for non-stationary tasks is investigated. In both operators traditional Gaussian random number generator was exchanged by -stable random number generator and thus became one of the parameters of the algorithm. Obtained results showed that appropriate tuning of the parameter allows to outperform the results of algorithms with the traditional operators.
2. **11:00** Genetic-Greedy Hybrid Approach for Topological Active Nets Optimization *Jose Santos, Oscar Ibanez, Noelia Barreira, Manuel G. Penedo* LNCS 4431 p.202
   In this paper we propose a genetic and greedy algorithm combination for the optimization of the Topological Active Nets (TAN) model. This is a deformable model used for image segmentation that integrates features of region-based and edge-based segmentation techniques, being able to fit the edges of the objects and model their inner topology. The hybrid approach we propose can optimize the active nets through the minimization of the model energy functions and, moreover, it can provide some segmentation results unreachable by the GA method alone such as changes in the net topology.
3. **11:20** A New Mutation Operator for the Elitism-Based Compact Genetic Algorithm *Rafael R. Silva, Heitor S. Lopes, Carlos R. Erig Lima* LNCS 4431 p.159
   A Compact Genetic Algorithm (CGA) is a genetic algorithm specially devised to meet the tight restrictions of hardware-based implementations. We propose a new mutation operator for an elitism-based CGA. The performance of this algorithm, named emCGA, was tested using a set of algebraic functions for optimization. The optimal mutation rate found for high-dimensionality functions is around 0.5%, and the low the dimension of the problem, the less sensitive is emCGA to the mutation rate. The emCGA was compared with other two similar algorithms and demonstrated better tradeoff between quality of solutions and convergence speed. It also achieved such results with smaller population sizes than the other algorithms.

4. **11:40** Genetic Programming for Proactive Aggregation Protocols *Thomas Weise, Kurt Geihs, Philipp A. Baer* LNCS 4431 p.167

   We present an approach for automated generation of proactive aggregation protocols using Genetic Programming. First a short introduction into aggregation and proactive protocols is given. We then show how proactive aggregation protocols can be specified abstractly. To be able to use Genetic Programming to derive such protocol specifications, we describe a simulation based fitness assignment method. We have applied our approach successfully to the derivation of aggregation protocols. Experimental results are presented that were obtained using our own Distributed Genetic Programming Framework. The results are very encouraging and demonstrate clearly the utility of our approach.

5. **12:00** Minimizing Cycle Time of the Flow Line - Genetic Approach with Gene Expression *Pawel Dabrowski, Jaroslaw Pempera, Czeslaw Smutnicki* LNCS 4431 p.194

   This paper deals with the flow shop scheduling problem with no store policy and minimal cycle time criterion. The model and some properties of the problem have been presented. To solve the problem, we propose new genetic algorithm equipped with auxiliary gene expression mechanism, which creates offspring using genetic information from both parents as well as asleep information from ancestors (grand father, grand grandfather). The presented computational tests proved superiority of the proposed approach over traditional, basic GA scheme.

6. **12:20** Liquid State Genetic Programming *Mihai Oltean* LNCS 4431 p.220

   A new Genetic Programming variant called Liquid State Genetic Programming (LSGP) is proposed in this paper. LSGP is a hybrid method combining a dynamic memory for storing the inputs (the liquid) and a Genetic Programming technique used for the problem solving part. Several numerical experiments with LSGP are performed by using several benchmarking problems. Numerical experiments show that LSGP performs similarly and sometimes even better than standard Genetic Programming for the considered test problems.

Biomedical Signal and Image Processing, Room 123

1. **10:40** Novel Multi-layer Non-negative Tensor Factorization with Sparsity Constraints *Andrzej Cichocki, Rafal Zdunek, Seungjin Choi, Robert Plemmons, Shun-ichi Amari* LNCS 4432 p.271

   In this paper we present a new method of 3D non-negative tensor factorization (NTF) that is robust in the presence of noise and has many potential applications, including multi-way blind source separation (BSS), multi-sensory or multi-

dimensional data analysis, and sparse image coding. We consider alpha- and beta-divergences as error (cost) functions and derive three different algorithms: (1) multiplicative updating; (2) fixed point alternating least squares (FPALS); (3) alternating interior-point gradient (AIPG) algorithm. We also incorporate these algorithms into multilayer networks. Experimental results confirm the very useful behavior of our multilayer 3D NTF algorithms with multi-start initializations.

2. **11:00** A Real-Time Adaptive Wavelet Transform-Based QRS Complex Detector *Marek Rudnicki, Pawel Strumillo* LNCS 4432 p.281

   In this paper, the design and test results of a QRS complex detector are presented. The detection algorithm is based on the Discrete Wavelet Transform and implements an adaptive weighting scheme of the selected transform coefficients in the time domain. It was tested against a standard MIT BIH Arrhythmia Database of ECG signals for which sensitivity (Se) of 99.54% and positive predictivity (+P) of 99.52% was achieved. The designed QRS complex detector is implemented on TI TMS320C6713 DSP for real time processing of ECGs.

3. **11:20** Nucleus Classification and Recognition of Uterine Cervical Pap-Smears Using FCM Clustering Algorithm *Kwang-Baek Kim, Sungshin Kim, Gwang-Ha Kim* LNCS 4432 p.290

   Segmentation for the region of nucleus in the image of uterine cervical cytodiagnosis is known as the most difficult and important part in the automatic cervical cancer recognition system. In this paper, the nucleus region is extracted from an image of uterine cervical cytodiagnosis using the HSI model. The characteristics of the nucleus are extracted from the analysis of morphemetric features, densitometric features, colormetric features, and textural features based on the detected region of nucleus area. The classification criterion of a nucleus is defined according to the standard categories of the Bethesda system. The fuzzy c-means clustering algorithm is employed to the extracted nucleus and the results show that the proposed method is efficient in nucleus recognition and uterine cervical Pap-Smears extraction.

4. **11:40** Rib Suppression for Enhancing Frontal Chest Radiographs Using Independent Component Analysis *Bilal Ahmed, Tahir Rasheed, Mohammed A.U. Khan, Seong Jin Cho, Sungyoung Lee, Tae-Seong Kim* LNCS 4432 p.300

   Chest radiographs play an important role in the diagnosis of lung cancer. Detection of pulmonary nodules in chest radiographs forms the basis of early detection. Due to its sparse bone structure and overlapping of the nodule with ribs and clavicles the nodule is hard to detect in conventional chest radiographs. We present a technique based on Independent Component Analysis (ICA) for the suppression of posterior ribs and clavicles which will enhance the visibility of the nodule and aid the radiologist in the diagnosis process.

5. **12:00** White Blood Cell Automatic Counting System Based on Support Vector Machine *Tomasz Markiewicz, Stanislaw Osowski, Bozena Marianska* LNCS 4432 p.318

   The paper presents the automatic system for white blood cell recognition on the basis of the image of bone marrow smear. The paper proposes the complete system solving all problems, beginning from cell extraction using watershed algorithm, generation of different features based on texture, geometry and the statistical description of image intensity, feature selection using Linear Support Vector Machine and final classification by applying Gaussian kernel Support Vector Machine. The results of numerical experiments of recognition of 10 classes of blood cells of patients suffering from leukaemia have shown that the proposed system is sufficiently accurate so as to find practical application in the hospital practice.

6. **12:20** A Novel Hand-based Personal Identification Approach *Miao Qi, Yinghua Lu, Hongzhi Li, Rujuan Wang, Jun Kong* LNCS 4432 p.309

   Hand-based personal identification is a stable and reliable biometrically technique in the field of personal identity recognition. In this paper, both hand shape and palmprint texture features are extracted to facilitate a coarse-tofine dynamic identification task. The wavelet zero-crossing method is first used to extract hand shape features to guide the fast selection of a small set of similar candidates from the database. Then, a circular Gabor filter, which is robust against brightness, and modified Zernike moments methods are used to extract the features of palmprint. And one-class-one-network (Back-Propagation Neural Network (BPNN) classification structure is employed for final classification. The experimental results show the effectiveness and accuracy of the proposed approach.

Classification and Clustering II, Room 237 - Audience Hall

1. **15:10** Boosting RVM Classifiers for Large Data Sets *Catarina Silva, Bernardete Ribeiro, Andrew H. Sung* LNCS 4432 p.228

   Relevance Vector Machines (RVM) extend Support Vector Machines (SVM) to have probabilistic interpretations, to build sparse training models with fewer basis functions (i.e., relevance vectors or prototypes), and to realize Bayesian learning by placing priors over parameters (i.e., introducing hyperparameters). However, RVM algorithms do not scale up to large data sets. To overcome this problem, in this paper we propose a RVM boosting algorithm and demonstrate its potential with a text mining application. The idea is to build weaker classifiers, and then improve overall accuracy by using a boosting technique for

document classification. The algorithm proposed is able to incorporate all the training data available; when combined with sampling techniques for choosing the working set, the boosted learning machine is able to attain high accuracy. Experiments on REUTERS benchmark show that the results achieve competitive accuracy against state-of-the-art SVM; meanwhile, the sparser solution found allows real-time implementations.

2. **15:30** A Demonstration of Clustering in Protein Contact Maps for alpha Helix Pairs *Robert Fraser, Janice Glasgow* LNCS 4431 p.758

   The purpose of this work is to demonstrate that it is possible to cluster contact maps for pairs of alpha helices such that each of the clusters corresponds to a group of pairs of alpha helices with similar properties. The property of the configuration of helix pairs that was chosen for study is the packing attribute. The contact maps are compared to one another using a novel contact map comparison scheme based upon the locations of contacts in the contact maps. A k-nearest neighbours technique is used to perform the clustering, and the cosine between vectors corresponding to contact map regions was the distance metric. The clustering of contact maps to determine whether maps corresponding to similar packing values are placed into the same clusters yielded promising results.

3. **15:50** Dynamic Data Probes *David W. Pearson* LNCS 4431 p.767

   In this paper we look at a dynamic method for analysing data, called a data probe. The probe flies through the data space and is affected by the proximity and number of data points. The trajectory followed by the probe provides information about how the data are organised geometrically. We apply a state feedback method to the probe equations to make the probe search out certain data values.

4. **16:10** Support Vector Machine Detection of Peer-to-Peer Traffic in High-Performance Routers with Packet Sampling *Francisco J. Gonzalez-Castano, Pedro S. Rodriguez-Hernandez, Rafael P. Martinez-Alvarez, Andres Gomez-Tato* LNCS 4432 p.208

   In this paper, we explore the possibilities of support vector machines to identify peer-to-peer (p2p) traffic in high-performance routers with packet sampling. Commercial networks limit user access bandwidth -either physically or logically-. However, in research networks there are no individual bandwidth restrictions, since this would interfere with research tasks. User behavior in research networks has changed radically with the advent of p2p multimedia file transfers: many users take advantage of the huge bandwidth (e.g. compared to domestic DSL access) to exchange movies and the like. This behavior may have a deep impact on research network utilization. Consequently, in the framework of the MOLDEIP project, we have proposed to apply support vector machine detection

to identify those activities in high-performance research network routers. Due to their high port rates, those routers cannot extract the headers of all the packets that traverse them, but only a sample. The results in this paper suggest that support vector machine detection of p2p traffic in high-performance routers with packet sampling is highly successful and outperforms recent approaches.

5. **16:30** Classifying Chemical Compounds Using Contrast and Common Patterns *Andrzej Dominik, Zbigniew Walczak, Jacek Wojciechowski* LNCS 4431 p.772

   The problem of classifying chemical compounds is studied in this paper. An approach based on minimal contrast and common topological patterns discovered from compounds dataset is presented. The algorithm is strongly associated with the classical emerging patterns techniques known from decision tables. We tested the proposed algorithm on real classification problems. Results show that it provides better classification accuracy than other existing algorithms. Another advantage of the introduced classifier is that it has a simple, understandable structure and can be easily extended by the expert knowledge.

6. **16:50** A Hybrid Automated Detection System Based on Least Square Support Vector Machine Classifier and k-NN Based Weighted Pre-processing for Diagnosing of Macular Disease *Kemal Polat, Sadik Kara, Aysegul Guven, Salih Gunes* LNCS 4432 p.338

   In this paper, we proposed a hybrid automated detection system based least square support vector machine (LSSVM) and k-NN based weighted pre-processing for diagnosing of macular disease from the pattern electroretinography (PERG) signals. k-NN based weighted pre-processing is preprocessing method, which is firstly proposed by us. The proposed system consists of two parts: k-NN based weighted pre-processing used to weight the PERG signals and LSSVM classifier used to distinguish between healthy eye and diseased eye (macula diseases). The performance and efficiency of proposed system was conducted using classification accuracy and 10-fold cross validation. The results confirmed that a hybrid automated detection system based on the LSSVM and k-NN based weighted pre-processing has potential in detecting macular disease. The stated results show that proposed method could point out the ability of design of a new intelligent assistance diagnosis system.

Genetic Algorithms II, Room 134

1. **15:10** Multi-objective Feature Selection with NSGA II *Tarek M. Hamdani, Jin-Myung Won, Adel M. Alimi, Fakhri Karray* LNCS 4431 p.240

   This paper deals with the multi-objective definition of the feature selection problem for different pattern recognition domains. We use NSGA II the latest multi-objective algorithm developed for resolving problems of multiobjective aspects with more accuracy and a high convergence speed. We define the feature selection as a problem including two competing objectives and we try to find a set of optimal solutions so called Pareto-optimal solutions instead of a single optimal solution. The two competing objectives are the minimization of both the number of used features and the classification error using 1-NN classifier. We apply our method to five databases selected from the UCI repository and we report the results on these databases. We present the convergence of the NSGA II on different problems and discuss the behavior of NSGA II on these different contexts.

2. **15:30** On Sum Coloring of Graphs with Parallel Genetic Algorithms *Zbigniew Kokosinski, Krzysztof Kwarciany* LNCS 4431 p.211

   Chromatic number, chromatic sum and chromatic sum num ber are important graph coloring characteristics. The paper proves that a parallel metaheuristic like the parallel genetic algorithm (PGA) can be efficiently used for computing approximate sum colorings and finding upper bounds for chromatic sums and chromatic sum numbers for hard tocolor graphs. Suboptimal sum coloring with PGA gives usually much closer upper bounds then theoretical formulas known from the literature.

3. **15:50** Design of 2-D IIR Filters Using Two Error Criteria with Genetic Algorithm *Felicja Wysocka-Schillak* LNCS 4431 p.248

   The paper presents a method for designing 2-D IIR filters with a quadrantally symmetric magnitude response. The method is based on two error criteria, i.e., equiripple error criterion in the passband and least-squared error criterion in the stopband. Two objective functions are introduced and the filter design problem is transformed into an equivalent bicriterion optimization problem. The stability of the filter is ensured by explicitly including stability constraints in the considered optimization problem. A two-step solution procedure of the considered problem is proposed. In the first step, a genetic algorithm is applied. The final point from the genetic algorithm is used as the starting point for a local optimization method. A design example is given to illustrate the proposed technique. A comparison with a 2-D IIR filter designed using LS approach is also presented.

4. **16:10** Genetic Based Distribution Service Restoration with Minimum Average Energy Not Supplied *Thitipong Charuwat, Thanatchai Kulworawanichpong* LNCS 4431 p.230
   This paper presents optimal planning of tie-switch operation in an electric power distribution system under an emergency feed condition, i.e. operation during a post-fault condition. A heuristic fault isolation algorithm and a genetic-based service restoration algorithm are proposed and compared. With the proposed restoration algorithm, high reliable service of electric distribution systems is expected. To ensure a small number of customer interruption, average energy not supplied (AENS) is used as the objective function to be minimized. 25-node and 118-node distribution test feeders were employed for test. Satisfactory results show that the genetic approach is appropriate to a kind of tie-switch operation planning in order to minimize effects of a permanent fault on customer service interruption.
5. **16:30** Improving SVM Performance Using a Linear Combination of Kernels *Laura Diosan, Mihai Oltean, Alexandrina Rogozan, Jean-Pierre Pecuchet* LNCS 4432 p.218
   Standard kernel-based classifiers use only a single kernel, but the real-world applications and the recent developments of various kernel methods have emphasized the need to consider a combination of multiple kernels. We propose an evolutionary approach for finding the optimal weights of a combined kernel used by the Support Vector Machines (SVM) algorithm for solving some particular problems. We use a genetic algorithm (GA) for evolving these weights. The numerical experiments show that the evolved combined kernels (ECKs) perform better than the convex combined kernels (CCKs) for several classification problems.
6. **16:50** Automatic Synthesis for Quantum Circuits Using Genetic Algorithms *Cristian Ruican, Mihai Udrescu, Lucian Prodan, Mircea Vladutiu* LNCS 4431 p.174
   This paper proposes an automated quantum circuit synthesis approach, using a genetic algorithm. We consider the circuit as a successive rippling of the so-called gate sections; also, the usage of a database is proposed in order to specify the gates that will be used in the synthesis process. Details are presented for an appropriate comparison with previous approaches, along with experimental results that prove the convergence and the effectiveness of the algorithm.

Biometrics, Room 123

1. **15:10** Multimodal Hand-Palm Biometrics *Ryszard S. Choras, Michal Choras* LNCS 4432 p.407

   Hand geometry based biometric verification has proven to be the most suitable and acceptable biometrics trait for medium and low security applications. Hereby a new approach for the personal identification using hand images is presented. Two kinds of biometric indicators are extracted from the low-resolution hand images; (i) palmprint features, which are composed of principal lines, wrinkles, minutiae, delta points, etc., and (ii) hand geometry features which include area/size of palm, length and width of fingers. In the article we focus on feature extraction methods applied to one-sensor multimodal hand-palm biometrics system.

2. **15:30** A Study on Iris Feature Watermarking on Face Data *Kang Ryoung Park, Dae Sik Jeong, Byung Jun Kang, Eui Chul Lee* LNCS 4432 p.415

   In this paper, we propose a new iris feature watermarking method on face data. This research has following three objectives. First, by using watermarked iris features in addition to face data, the multimodal biometric authentication can be possible, which can increase the authentication accuracy. Second, in case that the saved face data is illegally let out and privacy infringement happens, by checking the inserted iris feature watermark, we can solve the legal responsibility problem about the outflow of face data. In detail, if the iris feature watermark cannot be extracted from the outflow face data, we can insist that the face data is let out from other organization instead of ours. Third, in case that the iris features need to be transmitted via non-secure and noisy communication channel, it can be invisibly hidden on face data by our method. For the first objective, the face recognition accuracy with iris feature watermark should not be degraded. For the second and third objectives, the inserted iris watermark should be "strong" enough to be extracted irrespective of various kinds of attacks (such as blurring, cropping and rotation attacks) and noise insertion on face data. This research has three advantages compared to previous works. First, to overcome the vulnerability of blurring attack to previous biometric watermarking based on spatial domain, we use the watermarking method in frequency domain. Second, to reduce the degradation of face recognition accuracy due to iris watermarking, we insert the watermark into mid and high frequency bands. Third, through using individual unique iris features for biometric watermarking information and secondary authentication, the security level is much enhanced and we can solve legal responsibility problem about the outflow of face data. Experimental results showed that our algorithm could be used to accomplish above objectives.

3. **15:50** Keystroke Dynamics for Biometrics Identification *Michal Choras, Piotr Mroczkowski* LNCS 4432 p.424
   Personal identification has lately become a very important issue in the still evolving network society. Biometrics identification methods proved to be very efficient, more natural and easy for users than traditional methods of human identification. Hereby we discuss the idea of human identification based on keystroke dynamics. In the article we focus on our methods of feature extraction from the typing patterns. Moreover, we present satisfactory experimental results and possible applications of keystroke biometrics.
4. **16:10** Protecting Secret Keys with Fuzzy Fingerprint Vault Based on a 3D Geometric Hash Table *Sungju Lee, Daesung Moon, Seunghwan Jung, Yongwha Chung* LNCS 4432 p.432
   Biometrics-based user authentication has several advantages over traditional password-based systems for standalone authentication applications such as home networks. This is also true for new authentication architectures known as crypto-biometric systems, where cryptography and biometrics are merged to achieve high security and user convenience at the same time. Recently, a cryptographic construct, called fuzzy vault, has been proposed for crypto-biometric systems. In this paper, we propose an approach to provide both the automatic alignment of fingerprint data and higher security by using a 3D geometric hash table. Based on the experimental results, we confirm that the proposed approach of using the 3D geometric hash table with the idea of the fuzzy vault can perform the fingerprint verification securely even with one thousand chaff data included.
5. **16:30** Face Recognition Based on Near-Infrared Light Using Mobile Phone *Song-yi Han, Hyun-Ae Park, Dal-ho Cho, Kang Ryoung Park, Sangyoun Lee* LNCS 4432 p.440
   Recently, many companies have attempted to adopt biometric technology in their mobile phones. In this paper, we propose a new NIR (NearInfra-Red) lighting face recognition method for mobile phones by using megapixel camera image. This paper presents four advantages and contributions over previous research. First, we propose a new eye detection method for face localization for mobile phones based on corneal specular reflections. To detect these SRs (Specular Reflections) (even for users with glasses), we propose successive On/Off activation of the dual NIR illuminators of mobile phone. Second, because the face image is captured by the NIR illuminator, the nose area can be highly saturated, which can degrade face recognition accuracy. To overcome this problem, we use a simple logarithmic image enhancement method, which is suitable for mobile phones with low processing power. Third, considering the low processing speed of mobile phones, we adopt integer-based PCA (Principal Component Analysis) method for face recognition excluding floating-point operation. Fouth, by comparing the recognition performance using the integer-based PCA to those using LDA (Linear Discriminant Analysis) and ICA (Independent Component Analysis) methods, we could know that the integer-based PCA showed better

performance apt for mobile phone with NIR image.

6. **16:50** NEU-FACES: A Neural Network-Based Face Image Analysis System *Ioanna-Ourania Stathopoulou, George A. Tsihrintzis* LNCS 4432 p.449

   Towards building more efficient human control interactive systems, we developed a neural network-based image processing system (called NEUFACES), which first determines automatically whether or not there are any faces in given images and, if so, returns the location and extent of each face. Next, NEU-FACES uses neural network-based classifiers, which allow the classification of several facial expressions from features that we develop and describe. NEU-FACES is fully implemented and evaluated to assess its performance.

Poster Session II, Poster Area

1. Quantum-Behaved Particle Swarm Optimization with Binary Encoding *Jun Sun, Wenbo Xu, Wei Fang, Zhilei Chai* LNCS 4431 p.376

   The purpose of this paper is to generalize Quantum-behaved Particle Swarm Optimization (QPSO) Algorithm to discrete binary search space. To design Binary QPSO (BQPSO), we redefine the position vector and the distance between two positions, and adjust the iterative equations of QPSO to binary search space. The operations designed for BQPSO are far different from those in BPSO, but somewhat like those in Genetic Algorithms (GAs). Therefore, BQPSO integrates strongpoint of GA with the features of PSO, which make it able to find out the global optimum of the problem more efficiently than BPSO, as shown by the experiment results of BQPSO and BPSO on De Jong's five test functions.

2. Artificial Environment for Simulation of Emergent Behaviour *Rafal Sienkiewicz, Wojciech Jedruch* LNCS 4431 p.386

   The paper presents an artificial world model in which various self-organization and self-modification processes could be simulated. The model is a two dimensional space in which there are stacks of hexagonal tiles which are moving, colliding, and making bonds between them. On the higher level of organization a structure of tiles specifies some function whose execution affects other tiles in its neighborhood. The functions encoded in the structures of tiles are expressed in the simple Prolog like language. Few examples illustrate the behavior of the system.

3. A Novel and More Efficient Search Strategy of Quantum-Behaved Particle Swarm Optimization *Jun Sun, Choi-Hong Lai, Wenbo Xu, Zhilei Chai* LNCS 4431 p.394

   Based on the previous proposed Quantum-behaved Particle Swarm Optimization (QPSO), in this paper, a novel and more efficient search strategy with a

selection operation is introduced into QPSO to improve the search ability of QPSO. While the center of position distribution of each particle in QPSO is determined by global best position and personal best position, in the Modified QPSO (MQPSO), the global best position is substituted by a personal best position of a randomly selected particle. The MQPSO also maintains the mean best position of the swarm as in the previous QPSO to make the swarm more efficient in global search. The experiment results on benchmark functions show that MQPSO has stronger global search ability than QPSO and PSO.

4. Handling Linguistic Values in Knowledge Acquisition *Dae-Young Choi* LNCS 4431 p.517

   An algorithmic approach for handling linguistic values defined in the same linguistic variable is proposed. It can explicitly capture the differences of individuals' subjectivity regarding linguistic values. The proposed approach can be employed as a useful tool for discovering hidden relationship among linguistic values. Thus, it provides a basis for improving the precision of knowledge acquisition in handling linguistic values. We apply the proposed approach to a collective linguistic assessment among multiple experts.

5. An IA Based Approach for the Optimal Design of Traffic-Monitor Systems *Yi-Chih Hsieh, Yung-Cheng Lee, Ta-Cheng Chen* LNCS 4431 p.526

   To improve the safety of drivers and walkers in a city, several traffic monitors are usually set on lanes. These traffic monitors can also improve the security of communities. In this paper, we integrate the socalled linear/circular consecutive-k-out-of-n:F systems into our proposed traffic-monitor system. The objective is to find the optimal design of monitors under limited budget for the system. The main purposes of this paper are : (1) to propose a new traffic-monitor system, (2) to present an immune algorithm (IA) for the optimal design of traffic monitors, and (3) to report numerical results of various parameters by the proposed algorithm. It is shown that the proposed immune algorithm performs well for all test problems.

6. Finding the Optimal Path in 3D Spaces Using EDAs - The Wireless Sensor Networks Scenario *Bo Yuan, Maria Orlowska, Shazia Sadiq* LNCS 4431 p.536

   In wireless sensor networks where sensors are geographically deployed in 3D spaces, a mobile robot is required to travel to each sensor in order to download the data. The effective communication ranges of sensors are represented by spheres with varying diameters. The task of finding the shortest travelling path in this scenario can be regarded as an instance of a class of problems called Travelling Salesman Problem with Neighbourhoods (TSPN), which is known to be NP-hard. In this paper, we propose a novel approach to this problem using Estimation of Distribution Algorithms (EDAs), which can produce significantly improved results compared to an approximation algorithm.

7. Evidential Reasoning Based on Multisensor Data Fusion for Target Identification *Xin Wang, Yunxiao Wang, Xiao Yu, Zhengxuan Wang, Yunjie Pang* LNCS 4431 p.546

   Air target identification is an important issue in threat warning, airline security and surveillance. To obtain accuracy and reliability, the multisensor is used to give multiple sources information. Thus, an algorithm to fuse the information from the multisensor is needed. The (Dempster-Shafer) evidence theory is a generalization of Bayesian statistics. Evidential reasoning is suited to a range of decision-making activities. But it is invalid when dealing with conflicting probabilities. In this paper, a new weighted D-S combination rule is proposed to solve the conflicting management in the air target identification system. In the weighted method presented here, it is to modify evidences rather than to modify the combination rule. The rationality and effectiveness of the weighted method are evaluated by the target identification system.

8. A Simple and Compact Algorithm for the RMQ and its Application to the Longest Common Repeat Problem *Inbok Lee, Ha Yoon Song* LNCS 4431 p.554

   The Range Minimum Query (RMQ) problem is to find the smallest element in an array for given range (a,b). We propose a simple and compact algorithm for this problem when the queries are sorted in ascending order. Then we show how to use this algorithm for the generalised longest common repeat problem. Our algorithm is easy to understand and implement and requires much smaller memory.

9. Improved Bacterial Foraging Algorithms and Their Applications to Job Shop Scheduling Problems *Chunguo Wu, Na Zhang, Jingqing Jiang, Jinhui Yang, Yanchun Liang* LNCS 4431 p.562

   Bacterial foraging algorithm is a novel evolutionary computation algorithm proposed four years ago, which is based on the foraging behavior of E.coli bacteria living in human intestine. In this paper an improved operation, individual-based search, is presented with regard to the important component (Chemotaxi) of bacterial foraging algorithm. The improved algorithm is applied to job shop scheduling benchmark problems. Numerical experiments show the effectiveness of the improved algorithm.

10. Optimization of Fuzzy Model Driven to IG and HFC-based GAs *Jeoung-Nae Choi, Sung-Kwun Oh, Hyung-Soo Hwang* LNCS 4431 p.622

    The paper concerns the hybrid optimization of fuzzy inference systems that is based on Hierarchical Fair Competition-based Genetic Algorithms (HFCGA) and information data granulation. HFCGA is a kind of multi-populations of Parallel Genetic Algorithms (PGA), and it is used for structure optimization and parameter identification of fuzzy model. The granulation is realized with the aid of the Hard C-means clustering (HCM). The concept of information

granulation was applied to the fuzzy model in order to enhance the abilities of structural optimization. By doing that, we divide the input space to form the premise part of the fuzzy rules and the consequence part of each fuzzy rule is newly organized based on center points of data group extracted by the HCM clustering. It concerns the fuzzy model-related parameters such as the number of input variables, a collection of specific subset of input variables, the number of membership functions, and the polynomial type of the consequence part of fuzzy rules. In the hybrid optimization process, two general optimization mechanisms are explored. The structural optimization is realized via HFCGA and HCM method whereas in case of the parametric optimization we proceed with a standard least square method as well as HFCGA method as well. A comparative analysis demonstrates that the proposed algorithm is superior to the conventional methods.

11. Potential Assessment of an Ellipsoidal Neural Fuzzy Time Series Model for Freeway Traffic Prediction *Ping-Feng Pai, Kuo-Ping Lin, Ping-Teng Chang* LNCS 4431 p.631

    Forecasting of traffic flow is one of the most important approaches to control the capacity of highway network efficiently during peak flow periods. Therefore, many emerging methods have been designed to predict traffic flow of freeways. However, the ellipsoidal neural fuzzy model, originally developed for control and pattern recognition problems, was seldom used in forecasting traffic flow. The aim of this study is to investigate the potential of ellipsoidal neural fuzzy model in predicting highway traffic. Monthly traffic data at TaiShan tollgate of a freeway in Taiwan are collected to depict the performance of forecasting models. Three other neural network models, namely backpropagation neural networks (BPNN), and radial basis function neural networks (RBFNN) and general regression neural networks (GRNN) models are used to predict the same traffic data sets. Simulation results reveal that the ellipsoidal neural fuzzy time-series (ENFTS) model is superior to the other models. Therefore, the ENFTS is a feasible and promising approach in predicting freeway traffic.

12. Digital Model of Series Resonant Converter with Piezoelectric Ceramic Transducers and Fuzzy Logic Control *Pawel Fabijanski, Ryszard Lagoda* LNCS 4431 p.640

    Abstract Sandwich type piezoelectric ceramic transducers are the most frequently applied source of ultrasounds in technical cleaning system. They have the ability to radiate in an ultrasonic medium, e.g. water, with maximum acoustic power when the vibration is activated by a current whose frequency equals the mechanical resonance frequency of the transducer. In resonant inverters the transducer units are part of the oscillating circuit, for which equivalent electrical circuit consist of connection in parallel: Co end RLC. The resonant frequency of the real circuit varies during the operation in function of many parameters, among others, the most important are temperature, time, the column of cleaning factor, and the surface of the cleaned elements. In this situation, to obtain the

maximum value of the converter efficiency, its important role of control system to assure the optimal mechanical resonant frequencies of converter.

13. Electromagnetic Levitation System with Clustering Based Fuzzy Controller *Min-Soo Kim, Yeun-Sub Byun* LNCS 4431 p.657

    This paper describes the development of a clustering based fuzzy controller of an electromagnetic suspension vehicle using gain scheduling method and Kalman filter for a simplified single magnet system. Electromagnetic suspension vehicle systems are highly nonlinear and essentially unstable systems. For achieving the levitation control, we considered a fuzzy system modeling method based on clustering algorithm which a set of input/output data is collected from the well defined Linear Quadratic Gaussian (LQG) controller. Simulation results show that the proposed clustering based fuzzy controller robustly yields uniform performance over the mass variation range.

14. Fuzzy Relation-Based PNNs with the Aid of IG and Symbolic Gene Type-Based GAs *Sung-Kwun Oh, In-Tae Lee, Hyun-Ki Kim, Seong-Whan Jang* LNCS 4431 p.666

    In this paper, we propose a new design methodology of fuzzy-neural networks Fuzzy Relationbased Polynomial Neural Networks (FRPNN) with symbolic genetic algorithms and Information Granules (IG). We have developed a design methodology based on symbolic genetic algorithms to find the optimal structure for fuzzy-neural networks that expanded from Group Method of Data Handling (GMDH). Such parameters as the number of input variables, the order of the polynomial, the number of membership functions, and a collection of the specific subset of input variables are optimized for topology of FRPNN with the aid of symbolic genetic optimization that has search capability to find the optimal solution on the solution space. The augmented and genetically developed FRPNN (gFRPNN) results in a structurally optimized structure and comes with a higher level of flexibility in comparison to the one we encounter in the conventional FRPNNs. The GAbased design procedure being applied at each layer of FRPNN leads to the selection of the most suitable nodes (or FRPNs) available within the FRPNN. The performance of genetically optimized FRPNN (gFRPNN) is quantified through experimentation where we use a number of modeling benchmarks data which are already experimented with in fuzzy or neurofuzzy modeling.

15. Pricing the Foreign Currency Options with the Fuzzy Numbers Based on the Garman-Kohlhagen Model *Fan-Yong Liu* LNCS 4431 p.674

    This paper starts from the fuzzy environments of foreign currency options markets, introduces fuzzy sets theory, and gives a fuzzy version of Garman-Kohlhagen currency options pricing model. By taking exchange rate, domestic interest rate, foreign interest rate, and volatility as triangular fuzzy numbers, the currency option price will turn into a fuzzy number. This makes the financial investors who can pick any currency option price with an acceptable belief degree for the later

use. In order to obtain the belief degree, an optimization procedure has been applied. An empirical study is performed based on market data. The study result indicates the fuzzy currency options pricing method is a useful tool for modeling the imprecise problem in the real world.

16. Designing Rough Sets Attributes Reduction Based Video Deinterlacing System *Gwanggil Jeon, Marco Anisetti, Valerio Bellandi, Jechang Jeong* LNCS 4431 p.684

    The use of rough set's theoretic concepts has permitted in this work to make the mathematical model on mode decision in deinterlacing system. In this paper, a rough set approach based decision making problem is proposed. In the literature, some conventional deinterlacing methods provide high performance with higher computational burden. On the other hand, some other methods give low performance with lower computational burden. Those all methods have been reported that interpolate missing pixels indiscriminately in the same way. Our algorithm chooses the most suitable method adaptively based on rough set theory using four parameters. This deinterlacing approach employs a size reduction of the database system, keeping only the essential information for the process, especially in the representation of and reasoning with vague and/or imprecise knowledge. Decision making and interpolation results are presented. The results of computer simulations show that the proposed method outperforms a number of methods presented in the literature.

17. Optimization of Fuzzy Membership Function Using Clonal Selection *Ayse M. Sakiroglu, Ahmet Arslan* LNCS 4431 p.694

    A clonal selection algorithm (Clonalg) inspires from Clonal Selection Principle used to explain the basic features of an adaptive immune response to an antigenic stimulus. It takes place in various scientific applications and it can be also used to determine the membership functions in a fuzzy system. The aim of the study is to adjust the shape of membership functions and a novice aspect of the study is to determine the membership functions. Proposed method has been implemented using a developed Clonalg program for a single input and output fuzzy system. In the previous work, using genetic algorithm (GA) is proposed to it. In this study they are compared, too and it has been shown that using clonal selection algorithm is advantageous than using GA for finding optimum values of fuzzy membership functions.

18. Learning Bayesian Classifiers from Dependency Network Classifiers *Jose A. Gamez, Juan L. Mateo, Jose M. Puerta* LNCS 4431 p.806

    In this paper we propose a new method for learning Bayesian network classifiers in an indirect way instead of directly from data. This new model is a classifier based on dependency networks [1] that is a probabilistic graphical model similar to Bayesian networks but in which directed cycles are allowed. The benefits from doing things in this way are that learning process for dependency networks can be easier and simpler than learning Bayesian networks, with the direct con-

sequence that learning algorithms could have good propierties about scalability. We show that it is possible to take advantage of this facility to get Bayesian networks classifiers without losing quality in classification.

19. Determining the Dependency among Clauses Based on Machine Learning Techniques *Mi-Young Kim* LNCS 4431 p.814
The longer the input sentences, the worse the syntactic parsing results. Therefore, a long sentence is first divided into several clauses, and syntactic analysis for each clause is performed. Finally, all the analysis results are merged into one. In the merging process, it is difficult to determine the dependency among clauses. To handle such syntactic ambiguity among clauses, this paper proposes two-step clause-dependency determination method based on machine learning techniques. We extract various clause-specific features, and analyze the effect of each feature on the performance. For the Korean texts, we experiment using four kinds of machine-learning methods. Logitboosting method performed best and it also outperformed the previous rule-based methods.

20. Using Real-Valued Meta Classifiers to Integrate and Contextualize Binding Site Predictions *Mark Robinson, Offer Sharabi, Yi Sun, Rod Adams, Rene te Boekhorst, Alistair G. Rust, Neil Davey* LNCS 4431 p.822
Currently the best algorithms for transcription factor binding site predictions are severely limited in accuracy. However, a non-linear combination of these algorithms could improve the quality of predictions. A supportvector machine was applied to combine the predictions of 12 key real valued algorithms. The data was divided into a training set and a test set, of which two were constructed: filtered and unfiltered. In addition, a different "window" of consecutive results was used in the input vector in order to contextualize the neighbouring results. Finally, classification results were improved with the aid of under and over sampling techniques. Our major finding is that we can reduce the False-Positive rate significantly. We also found that the bigger the window, the higher the F-score, but the more likely it is to make a false positive prediction, with the best trade-off being a window size of about 7.

21. Effectiveness of Feature Space Selection on Credit Engineering on Multi-group Classification Cases *Junghee Park, Kidong Lee, Jinhwa Kim* LNCS 4431 p.830
This study tests the sensitivity of input feature space selection on credit rating using four classifiers as backpropagation (BP), Kohonen selforganizing feature map, discriminant analysis(DA), and logistic regression. The results of the study are that at individual methods applied, BP network outperforms two statistical counterparts while Kohonen network shows the least accuracy among the models. The results also show that the selection of the feature spaces to the accuracy outcome may not be very sensitive when we test the four methodologies altogether at aggregate level.

22. Constructing Stereotypes for an Adaptive e-Shop Using AIN-based Clustering *Maria Virvou, Anastasios Savvopoulos, George A. Tsihrintzis, Dionisos N. Sotiropoulos* LNCS 4431 p.837

    This paper describes an adaptive electronic video store application that monitors customers' actions and provides dynamic movie recommendation. The adaptive recommendation is formed based on double stereotypes that have been constructed for user modeling. The construction of stereotypes has been based on a novel approach that uses an Immune Network System (INS). In particular, the INS has been applied on data collected from 150 users of an earlier version of the e-commerce application. Specifically, the INS clustered users' interests as well as movies and represented each resulting cluster with corresponding antibodies. The double classification (users' interests movies) was performed in a hierarchical way that resulted in several levels of user stereotypes: These stereotypes are then used dynamically by the e-commerce application to infer users' interests in movies based on a small set of observed users' actions.

23. Predicting Mechanical Properties of Rubber Compounds with Neural Networks and Support Vector Machines *Mira Trebar, Uros Lotric* LNCS 4432 p.254

    The quality of rubber compounds is assessed by rheological and mechanical tests. Since mechanical tests are very time consuming, the main idea of this work is to quest for strong nonlinear relationships between rheological and mechanical tests in order to reduce the latter. The multilayered perceptron and support vector machine combined with data preprocessing were applied to model hardness and density of the vulcanizates from the rheological parameters of the raw compounds. The results outline the advantage of proper data preprocessing.

24. An Evolutionary Programming Based SVM Ensemble Model for Corporate Failure Prediction *Lean Yu, Kin Keung Lai, Shouyang Wang* LNCS 4432 p.262

    In this study, a multistage evolutionary programming (EP) based support vector machine (SVM) ensemble model is proposed for designing a corporate bankruptcy prediction system to discriminate healthful firms from bad ones. In the proposed model, a bagging sampling technique is first used to generate different training sets. Based on the different training sets, some different SVM models with different parameters are then trained to formulate different classifiers. Finally, these different SVM classifiers are aggregated into an ensemble output using an EP approach. For illustration, the proposed SVM ensemble model is applied to a real-world corporate failure prediction problem.

25. Cone-Realizations of Discrete-Time Systems with Delays *Tadeusz Kaczorek* LNCS 4432 p.694

    A new notion of cone-realization for discrete-time linear systems with delays is proposed. Necessary and sufficient conditions for the existence of cone-realizations of discrete-time linear systems with delays are established. A proce-

dure is proposed for computation of a cone-realization for a given proper rational matrix T(z). It is shown that there exists a (P,Q,V)-cone realization of T(z) if and only if there exists a positive realization of T (z) = VT(z)Q-1 where V, Q and P are non-singular matrices generating the cones V, Q and P respectively.

26. Global Stability of Neural Networks with Time-Varying Delays *Yijing Wang, Zhiqiang Zuo* LNCS 4432 p.704
This paper deals with the problem of global stability for a class of neural networks with time-varying delays. A new sufficient condition for global stability is proposed by using some slack matrix variables to express the relationship between the system matrices. The restriction on the derivative of the delay function to be less than unit is removed. A numerical example shows that the result obtained in this paper improves the upper bound of the delay over some existing ones.

27. A Sensorless Initial Rotor Position Sensing Using Neural Network for Direct Torque Controlled Permanent Magnet Synchronous Motor Drive *Mehmet Zeki Bilgin* LNCS 4432 p.713
This paper presents a method to determine the initial rotor position for Direct Torque Controlled (DTC) Permanent Magnet Synchronous Motor (PMSM) using Artificial Neural Network (ANN).The inductance variation is a function of the rotor position and stator current for PMSM. A high frequency and low magnitude voltage is applied to the stator windings and examined the effects the stator currents by using ANN for initial rotor position detection.

28. Postural Control of Two-Stage Inverted Pendulum Using Reinforcement Learning and Self-organizing Map *Jae-kang Lee, Tae-seok Oh, Yun-su Shin, Tae-jun Yoon, Il-hwan Kim* LNCS 4432 p.722
This paper considers reinforcement learning control with the selforganizing map. Reinforcement learning uses the observable states of objective system and signals from interaction of the system and environment as input data. For fast learning in neural network training, it is necessary to reduce learning data. In this paper, we use the self-organizing map to partition the observable states. Partitioning states reduces the number of learning data which is used for training neural networks. And neural dynamic programming design method is used for the controller. For evaluating the designed reinforcement learning controller, a double linked inverted pendulum on the cart system is simulated. The designed controller is composed of serial connection of self-organizing map and two Multi-layer Feed-Forward Neural Networks.

29. Neural Network Mapping of Magnet Based Position Sensing System for Autonomous Robotic Vehicle *Dae-Yeong Im, Young-Jae Ryoo, Jang-Hyun Park, Hyong-Yeol Yang, Ju-Sang Lee* LNCS 4432 p.730
In this paper a neural network mapping of magnet based position sensing system for an autonomous robotic vehicle. The position sensing system using magnetic

markers embedded under the surface of roadway pavement. An important role of magnetic position sensing is identification of vehicle's location. The magnetic sensor measures lateral distance when the vehicle passes over the magnetic marker. California PATH has developed a table-look-up as an inverse map. But it's requires too many memories to store the vast magnetic field data. Thus we propose the magnetic guidance system with simple mapping using neural network.

30. Application of Fuzzy Integral Control for Output Regulation of Asymmetric Half-Bridge DC/DC Converter *Gyo-Bum Chung* LNCS 4432 p.738

    This paper considers the problem of regulating the output voltage of an asymmetric half-bridge (AHB) DC/DC converter via fuzzy integral control. First, we model the dynamic characteristics of the AHB DC/DC converter with the state-space averaging method, and after introducing an additional integral state of the output regulation error, we obtain the Takagi-Sugeno (TS) fuzzy model for the augmented system. Second, the concept of the parallel distributed compensation is applied to the design of the TS fuzzy integral controller, in which the state feedback gains are obtained by solving the linear matrix inequalities (LMIs). Finally, numerical simulations are performed for the considered application.

31. Obtaining an Optimum PID Controller via Adaptive Tabu Search *Deacha Puangdownreong, Sarawut Sujitjorn* LNCS 4432 p.747

    An application of the Adaptive Tabu Search (ATS), an intelligent search method in industrial control domain, is presented. The ATS is used to search for the optimum controller's parameters denoted as proportional, integral, and derivative gains. The obtained controllers are tested against some hard-to-be-controlled plants. The results obtained are very satisfactory.

Sessions on 14th April

Fuzzy and Rough Systems, Room 237 - Audience Hall

1. **10:40** An Evolutionary Approach for Approximating the Solutions of Systems of Linear Fuzzy Equations *Nguyen H. Viet, Michal Kleiber* LNCS 4431 p.570

   In this paper systems of linear equations Ax = b, where both A and b contain uncertain factors in terms of fuzziness are investigated. The classical solutions being vectors of fuzzy numbers are considered. The complex problem of finding the exact classical solutions is replaced by a corresponding optimization task with the cost function based on the Hausdorff metric. This cost function is next minimized with use of genetic algorithms. A number of numerical experiments are provided in order to verify the given approach. The results and some conclusions are also included.

2. **11:00** On Fuzzy Driven Support for SD-Efficient Portfolio Selection *Wlodzimierz Ogryczak, Andrzej Romaszkiewicz* LNCS 4431 p.578

   The stochastic dominance (SD) is based on an axiomatic model of risk-averse preferences and therefore, the SD-efficiency is an important property of selected portfolios. As defined with a continuum of criteria representing some measures of failure in achieving several targets, the SD does not provide us with a simple computational recipe. While limiting to a few selected target values one gets a typical multiple criteria optimization model approximating the corresponding SD approach. Although, it is rather difficult to justify a selection of a few target values, this difficulty can be overcome with the effective use of fuzzy target values. While focusing on the first degree SD and extending the target membership functions to some monotonic utility functions we get the multiple criteria model which preserves the consistency with both the first degree and the second degree SD. Further applying the reference point methodology to the multiple criteria model and taking advantages of fuzzy chance specifications we get the method that allows to model interactively the preferences by fuzzy specification of the desired distribution. The model itself guarantees that every generated solution is efficient according to the SD rules.

3. **11:20** Fuzzy Kernel Ridge Regression for Classification *YoungSik Choi , JiSung Noh* LNCS 4431 p.588

   We present a robust version of kernel ridge regression for classification, which can gracefully handle outliers. We first show that the ridge regression can be reduced to the proximal support vector machine (PSVM) which has been suc-

cessfully applied in classification problems. In order to incorporate robust-ness into kernel ridge regression, we reformulate and derive a fuzzy version of kernel ridge regression so that each sample can contribute to formation of a decision boundary according to its corresponding fuzzy class membership. We also present how to determine the fuzzy class membership values. Experiments over synthetic and real data sets demonstrate superiority of the proposed method, comparing with traditional methods such as support vector machines (SVMs).

4. **11:40** Assessment of the Accuracy of the Process of Ceramics Grinding with the Use of Fuzzy Interference *Dariusz Lipinski, Wojciech Kacalak* LNCS 4431 p.596
   Grinding of ceramic materials is an expensive process considering the cost of abrasive tools and a relatively small machining efficiency. This paper presents methods to increase the use of the technological potential of automatic machining of ceramic materials with a concurrent control of the machining accuracy. A method of an assessment of the influence of process variables monitored on the accuracy of the sizes and shape of ceramic elements machined was presented. An application of fuzzy interference methods facilitated a creation of a universal algorithm to assess the accuracy of machining independent of the accepted parameters and machining conditions.

5. **12:00** Improving Business Failure Predication Using Rough Sets with Non-financial Variables *Jao-Hong Cheng, Chung-Hsing Yeh, Yuh-Wen Chiu* LNCS 4431 p.614
   Rough set models with financial variables have proven to be effective in predicting business failure. To enhance the predictive performance of rough set models, this paper includes a non-financial variable, auditor switching, into the modeling process, in addition to 14 financial ratios commonly used in business failure research. An empirical study on 62 failed firms and 62 oneto-one matching non-failed firms in Taiwan between 1998 and 2005 is conducted, using available data for the three years before failure. Six rough set models are constructed individually with and without the auditor switching variable, using the three-year data respectively. The empirical study shows that the non-financial variable is the most significant attribute and plays an essential role in enhancing the performance of rough set models. These findings highlight the effectiveness of rough set models for business failure prediction and particularly the importance of incorporating non-financial variables in business failure research.

6. **12:20** A Dynamic Resource Broker and Fuzzy Logic Based Scheduling Algorithm in Grid Environment *Jiayi Zhou, Kun-Ming Yu, Chih-Hsun Chou, Li-An Yang, Zhi-Jie Luo* LNCS 4431 p.604
   Grid computing is a loosely couple distributed system, and it can solve complex problem with large-scale computing and storage resources. Middleware plays important role to integrate heterogeneous computing nodes. Globus Toolkit (GT) is a popular open source middleware to build grid environment. However,

a job submission has lots of complicate operations in GT especially in a large scale gird. Moreover, the information discovery component of Globus Toolkit can only provide the summarized information from Grid Head instead of each computing node. Furthermore, job scheduling is another important issue in the high performance Grid computing. An appropriate scheduling algorithm can efficiently reduce the response time, turnaround time and increase the throughput. In this paper, we develop a resource broker module for GT infrastructure, which can dynamically describe and discover the resource information of computing nodes. Moreover, we design an adaptive fuzzy logic scheduler, which utilizes the fuzzy logic control technology to select the most suitable computing node in the Grid environment. For verifying the performance of the proposed scheduling algorithm, we also implement a resource broker as well as fuzzy logic scheduler based on Globus Toolkit 4. The experimental results show our algorithm can reduce the turnaround time compared with round-robin and random dispatching methods. The experiments also show that our algorithm has better speed-up ratio than round-robin and random dispatching when number of computing nodes increasing.

7. **12:40** Applying Dynamic Fuzzy Model in Combination with Support Vector Machine to Explore Stock Market Dynamism
Deng-Yiv Chiu, Ping-Jie Chen LNCS 4432 p.246
In the study, a new dynamic fuzzy model is proposed in combination with support vector machine (SVM) to explore stock market dynamism. The fuzzy model integrates various factors with influential degree as the input variables, and the genetic algorithm (GA) adjusts the influential degree of each input variable dynamically. SVM then serves to predict stock market dynamism in the next phase. In the meanwhile, the multiperiod experiment method is designed to simulate the volatility of stock market. Then, we compare it with other methods. The model from the study does generate better results than others.

Learning and Optimisation, Room 134

1. **10:40** Reinforcement Learning in Fine Time Discretization
Pawel Wawrzynski LNCS 4431 p.470
Reinforcement Learning (RL) is analyzed here as a tool for control system optimization. State and action spaces are assumed to be continuous. Time is assumed to be discrete, yet the discretization may be arbitrarily fine. It is shown here that stationary policies, applied by most RL methods, are improper in control applications, since for fine time discretization they can not assure bounded variance of policy gradient estimators. As a remedy to that difficulty, we propose the use of piecewise non-Markov policies. Policies of this type can be optimized by means of most RL algorithms, namely those based on likelihood ratio.

2. **11:00** Agent-Based Approach to Solving the Resource Constrained Project Scheduling Problem *Piotr Jedrzejowicz, Ewa Ratajczak-Ropel* LNCS 4431 p.480
   JABAT is a middleware supporting the construction of the dedicated A-Team architecture that can be used for solving variety of computationally hard optimization problems. The paper includes a general overview of the JABAT followed by a description and evaluation of the architecture designed by the authors with a view to solving RCPSP and MRCPSP instances. To construct the proposed system a number of agents, each representing a different optimization algorithm including local search, tabu search, as well as several specialized heuristics have been used. The system has been evaluated experimentally through solving a set of benchmark instances of the RCPSP and MRCPSP.
3. **11:20** Support, Relevance and Spectral Learning for Time Series *Bernardete Ribeiro* LNCS 4432 p.199
   This paper proposes the Spectral Clustering Kernel Machine (SCKM) for times series prediction. Support Vector Machine (SVM), Relevance Vector Machine (RVM) and the Spectral Clustering Kernel Machine (SCKM) are compared in terms of performance accuracy for a simple time series approximation problem. The three outlined algorithms each of which with interesting features to perform automated learning are examined, analysed and empirically tested. In case of the SVM, our tests combine also a preprocessing stage including Kohonen Maps (SOM) as well as K-means clustering. In the case of RVM we also implemented a constructive approach based on the fast marginal likelihood maximization described in [14]. Prediction results in two benchmark time series have been addressed using various performance metrics. The results demonstrate that whereas RVM models achieve larger parsimony of the fitted model, both SVM and SCKM attain higher accuracy. The learning models are competitive for real world problems.
4. **11:40** A Model of Non-elemental Associative Learning in the Mushroom Body Neuropil of the Insect Brain *Jan Wessnitzer, Barbara Webb, Darren Smith* LNCS 4431 p.488
   We developed a computational model of the mushroom body (MB), a prominent region of multimodal integration in the insect brain, and tested the model's performance for non-elemental associative learning in visual pattern avoidance tasks. We employ a realistic spiking neuron model and spike time dependent plasticity, and learning performance is investigated in closed-loop conditions. We show that the distinctive neuroarchitecture (divergence onto MB neurons and convergence from MB neurons, with an otherwise non-specific connectivity) is sufficient for solving non-elemental learning tasks and thus modulating underlying reflexes in context-dependent, heterarchical manner.

5. **12:00** Improved Production of Competitive Learning Rules with an Additional Term for Vector Quantization *Enrique Merida-Casermeiro, Domingo Lopez-Rodriguez, Gloria Galan-Marin, Juan M. Ortiz-de-Lazcano-Lobato* LNCS 4431 p.461

   In this work, a general framework for developing learning rules with an added term (perturbation term) is presented. Many learning rules commonly cited in the specialized literature can be derived from this general framework. This framework allows us to introduce some knowledge about vector quantization (as an optimization problem) in the distortion function in order to derive a new learning rule that uses that information to avoid certain local minima of the distortion function, leading to better performance than classical models. Computational experiments in image compression show that our proposed rule, derived from this general framework, can achieve better results than simple competitive learning and other models, with codebooks of less distortion.

6. **12:20** A Hybrid Simulated-Annealing Algorithm for Two-dimensional Strip Packing Problem *Turkay Dereli, Gulesin Sena Das* LNCS 4431 p.508

   This paper presents a hybrid simulated-annealing (SA) algorithm for two--dimensional strip packing problem (2D SPP) where a set of small rectangular items has to be allocated on a larger stock rectangle in order to find a minimum height. A new recursive placement procedure is proposed and the procedure is combined with the SA algorithm. The hybrid-SA algorithm was tested on a set of benchmark problems taken from the literature. The computational results have validated the quality of the solutions and usefulness of the proposed hybrid-SA algorithm.

7. **12:40** Performance-Based Bayesian Learning for Resource Collaboration Optimization in Manufacturing Grid *Jian Zhou, Qing Li, Jim Browne, Qing Wang, Paul Folan, TianYuan Xiao* LNCS 4431 p.498

   Following the rapid development of Grid computing, Grid technology has been introduced into the manufacturing realm and is contemporarily being considered for the sharing of manufacturing resources. However current research in the subject-area is still immature and mainly focuses on conceptual framework development. Here a concrete performancebased Bayesian method for resource collaboration optimization in Extended Enterprise is proposed which improves and promotes research in applying Gridthinking in inter-organizational manufacturing value chains. Based on the research background, problem statement, and the consideration of Bayesian learning, the method for probability dependency relationship modeling between the performance values of different manufacturing resource nodes in the Extended Enterprise is analysed; and is subsequently complimented by the development of an extended method for more general use. Finally, a system dynamics simulation model for the proposed method is estab-

lished and the validity and effectivity of the suggested method is tested via a simple case study.

Neural Networks III, Room 123

1. **10:40** Mining Data from a Metallurgical Process by a Novel Neural Network Pruning Method *Henrik Saxen, Frank Pettersson, Matias Waller* LNCS 4432 p.115
   Many metallurgical processes are complex and due to hostile environment it is difficult to carry out reliable measurement of their internal state, but the demands on high productivity and consideration of environmental issues require that the processes still be strictly controlled. Due to the complexity and non-ideality of the processes, it is often not feasible to develop mechanistic models. An alternative is to use neural networks as black-box models, built on historical process data. The selection of relevant inputs and appropriate network structure are still problematic issues. The present work addresses these two problems in the modeling of the hot metal silicon content in the blast furnace. An algorithm is applied to find relevant inputs and their time lags, as well as a proper network size, by pruning a large network. The resulting models exhibit good prediction capabilities and the inputs and time lags detected are in good agreement with practical metallurgical knowledge.
2. **11:00** Automatic Diagnosis of the Footprint Pathologies Based on Neural Networks *Marco Mora, Mary C. Jarur, Daniel Sbarbaro* LNCS 4432 p.107
   Currently foot pathologies, like cave and flat foot, are detected by an human expert who interprets a footprint image. The lack of trained personal to carry out massive first screening detection campaigns precludes the routinary diagnostic of these pathologies. This work presents a novel automatic system, based on Neural Networks (NN), for foot pathologies detection. In order to improve the efficiency of the neural network training algorithm, we propose the use of principal components analysis to reduce the number of inputs to the NN. The results obtained with this system demonstrate the feasibility of building automatic diagnosis systems based on the foot image. These systems are very valuable in remote areas and can be also used for massive first screening health campaigns.
3. **11:20** Dynamic Ridge Polynomial Neural Networks in Exchange Rates Time Series Forecasting *Rozaida Ghazali, Abir J. Hussain, Dhiya Al-Jumeily, Madjid Merabti* LNCS 4432 p.123
   This paper proposed a novel dynamic system which utilizes Ridge Polynomial Neural Networks for the prediction of the exchange rate time series. We performed a set of simulations covering three uni-variate exchange rate signals

which are; the JP/EU, JP/UK, and JP/US time series. The forecasting performance of the novel Dynamic Ridge Polynomial Neural Network is compared with the performance of the Multilayer Perceptron and the feedforward Ridge Polynomial Neural Network. The simulation results indicated that the proposed network demonstrated advantages in capturing noisy movement in the exchange rate signals with a higher profit return.

4. **11:40** Neural Systems for Short-Term Forecasting of Electric Power Load *Michal Bak, Andrzej Bielecki* LNCS 4432 p.133
   In this paper a neural system for daily forecasting of electric power load in Poland is presented. Basing on the simplest neural architecture - a multi-layer perceptron - more and more complex system is built step by step. A committee rule-aided hierarchical system consisting of modular ANNs is obtained as a result. The forecasting mean absolute percentage error (MAPE) of the most effective system is about 1.1%.
5. **12:00** Jet Engine Turbine and Compressor Characteristics Approximation by Means of Artificial Neural Networks *Maciej Lawrynczuk* LNCS 4432 p.143
   This paper is concerned with the approximation problem of the SO-3 jet engine turbine and compressor characteristics. Topology selection of multilayer feedforward artificial neural networks is investigated. Neural models are compared with Takagi-Sugeno fuzzy models in terms of approximation accuracy and complexity.
6. **12:20** Speech Enhancement System Based on Auditory System and Time-Delay Neural Network *Jae-Seung Choi, Seung-Jin Park* LNCS 4432 p.153
   This paper proposes a speech enhancement system based on an auditory system for noise reduction in speech that is degraded by background noises. Accordingly, the proposed system adjusts frame by frame the coefficients for both lateral inhibition and amplitude component according to the detected sections for each input frame, then reduces the noise signal using a time-delay neural network. Based on measuring signal-to-noise ratios, experiments confirm that the proposed system is effective for speech that is degraded by various noises.
7. **12:40** Power Transients Characterization and Classification Using Higher-Order Cumulants and Competitive Layers *Juan-Jose Gonzalez-de-la-Rosa, Antonio Moreno Munoz, Isidro Lloret, Carlos G. Puntonet, Juan-Manuel Gorriz* LNCS 4431 p.782
   This paper deals with power-quality (PQ) event detection, classification and characterization using higher-order sliding cumulants to examine the signals. Their maxima and minima are the main features, and the classification strategy is based in competitive layers. Concretely, we concentrate on the task of differentiating two types of transients (short duration and long duration). By measuring the fourth-order central cumulants' maxima and minima, we build the two-dimensional feature measured vector. Cumulants are calculated over

high-pass digitally filtered signals, to avoid the low-frequency 50-Hz signal. We have observed that the minima and maxima measurements produce clusters in the feature space for 4 th-order cumulants; 3 rd-order cumulants are not capable of differentiate these two very similar PQ events. The experience aims to set the foundations of an automatic procedure for PQ event detection.

Particle Swarm Optimisation, Room 237 - Audience Hall

1. **14:15** Many-objective Particle Swarm Optimization by Gradual Leader Selection *Mario Koeppen, Kaori Yoshida* LNCS 4431 p.323

   Many-objective optimization refers to multi-objective optimization problems with a number of objectives considerably larger than two or three. This papers contributes to the use of Particle Swarm Optimization (PSO) for the handling of such many-objective optimization problems. Multi-objective PSO approaches typically rely on the employment of a so-called set of leaders that generalizes the global best particle used in the standard PSO algorithm. The exponentially decreasing probability of finding non-dominated points in search spaces with increasing number of objectives poses a problem for the selection from this set of leaders, and renders multi-objective PSOs easily unusable. Gradual Pareto dominance relation can be used to overcome this problem. The approach will be studied by means of the problem to minimize the Euclidian distances to a number of points, where each distance to the points is considered an independent objective. The Pareto set of this problem is the convex closure of the set of points. The conducted experiments demonstrate the usefulness of the proposed approach and also show the higher resemblance of the proposed PSO variation with the standard PSO.

2. **14:35** Mixed Ant Colony Optimization for the Unit Commitment Problem *Ana-Talida Serban, Guillaume Sandou* LNCS 4431 p.332

   In this paper, a mixed integer programming method based on ant colony optimization is presented, and applied to the classical Unit Commitment problem. The idea is to reformulate the problem into a graph exploration structure, and to use discrete ant colony optimization to explicitly take into account time down, time up and demand constraints in the optimization procedure. This method is coupled with a continuous ant colony algorithm to compute produced powers. Results, obtained on relatively small cases, show the viability of the proposed approach: a near optimal solution, with guarantees of feasibility, can be computed with low computation times.

3. **14:55** Wasp Swarm Algorithm for Dynamic MAX-SAT Problems *Pedro C. Pinto, Thomas A. Runkler, Joao M. C. Sousa* LNCS 4431 p.350

   This paper proposes a wasp swarm optimization algorithm, which is applied to the dynamic variant of the maximum satisfiability problem, or MAXSAT. Here, we describe the changes implemented to optimize the dynamic problem and analyze the parameters of the new algorithm. Wasp swarm optimization accomplishes very well the task of adapting to systematic changes of dynamic MAX-SAT instances derived from static problems, and significantly outperforms the local search algorithm used as benchmark.

4. **15:15** Particle Swarm Optimization for the Multidimensional Knapsack Problem *Fernanda Hembecker, Heitor S. Lopes, Walter Godoy Jr.* LNCS 4431 p.358

   The multidimensional 0/1 knapsack problem is a classical problem of discrete optimization. There are several approaches for solving the different variations of such problem, including mathematical programming and stochastic heuristic methods. This paper presents the application of Particle Swarm Optimization (PSO) for the problem, using selected instances of ORLib. For the instances tested, results were very close or equal to the optimal solution known, even considering that the parameters of PSO were not optimized. The analysis of the results suggests the potential of a simple PSO for this class of combinatorial problems.

5. **15:35** Particle Swarms for Multimodal Optimization *Ender Ozcan, Murat Yilmaz* LNCS 4431 p.366

   In this paper, five previous Particle Swarm Optimization (PSO) algorithms for multimodal function optimization are reviewed. A new and a successful PSO based algorithm, named as CPSO is proposed. CPSO enhances the exploration and exploitation capabilities of PSO by performing search using a random walk and a hill climbing components. Furthermore, one of the previous PSO approaches is improved incredibly by means of a minor adjustment. All algorithms are compared over a set of well-known benchmark functions.

6. **15:55** A Shuffled Complex Evolution of Particle Swarm Optimization Algorithm *Jiang Yan, Hu Tiesong, Huang Chongchao, Wu Xianing, Gui Faling* LNCS 4431 p.341

   A shuffled complex evolution of particle swarm optimization algorithm called SCE-PSO is introduced in this paper. In the SCE-PSO, a population of points is sampled randomly in the feasible space. Then the population is partitioned into several complexes, which is made to evolve based on PSO. At periodic stages in the evolution, the entire population is shuffled and points are reassigned to complexes to ensure information sharing. Both theoretical and numerical studies of the SCE-PCO are presented. Five optimization problems with commonly used functions are utilized for evaluating the performance of the proposed algorithm, and the performance of the proposed algorithm is compared to PSO to

demonstrate its efficiency.

7. **16:15** Multi-class Support Vector Machines Based on Arranged Decision Graphs and Particle Swarm Optimization for Model Selection *Javier Acevedo , Saturnino Maldonado , Philip Siegmann , Sergio Lafuente , Pedro Gil* LNCS 4432 p.238

   The use of support vector machines for multi-category problems is still an open field to research. Most of the published works use the one-against-rest strategy, but with a one-against-one approach results can be improved. To avoid testing with all the binary classifiers there are some methods like the Decision Directed Acyclic Graph based on a decision tree. In this work we propose an optimization method to improve the performance of the binary classifiers using Particle Swarm Optimization and an automatic method to build the graph that improves the average number of operations needed in the test phase. Results show a good behavior when both ideas are used.

Linguistics and Games, Room 134

1. **14:15** Extracting Grammars from RNA Sequences *Gabriela Andrejkova, Helena Lengenova, Michal Mati* LNCS 4431 p.404

   In the paper, we describe an application of stochastic contextfree grammars (SCFG) to modelling of the formal RNA string language. The simplification of the stochastic context-free grammar and it's conversion to Chomsky normal form was used. We present the modification of Cocke-Kasami-Younger algorithm that is used for probabilistic estimations of stochastic grammars for RNA sequences. Some better algorithms were constructed to decrease the computational complexity but still on the level of O(n3) where n is the length of the RNA strings. The results of using the algorithms to the training sample consisted of tRNA chains of Acinetobacter sp. bactery are described.

2. **14:35** Grammar-Based Classifier System for Recognition of Promoter Regions *Olgierd Unold* LNCS 4431 p.798

   Identifying bacterial promoters is an important step towards understanding gene regulation. In this paper, we address the problem of predicting the location of promoters in Escherichia coli. Language of bacterial sequence can be described using formal system such a context-free grammar, and problem of promoter region recognition replaced by grammar induction. The accepted method for this problem is to use grammar-based classifier system (GCS).

3. **14:55** Modeling Human Performance in Two Player Zero Sum Games Using Kelly Criterion *Rafal Lopatka, Andrzej Dzielinski* LNCS 4431 p.414

   The paper presents a new way of modeling the human performance in two player games using a rating system based on Kelly Criterion which is often utilized for gambling and financial engineering. The advantage of the proposed system is the ability to assess playing strength based on both the final outcome of the game and the style of play. The last aspect of the rating assessment system is novel compared to the rating systems developed so far (like ELO, Bradley-Terry, etc.). Another advantage of the proposed method is the tackling of the problem of drawn games. To the very best authors knowledge the approach presented below is a relatively new look at the problem of playing strength assessment based on probability theory. The paper presents and discusses few illustrative examples.

4. **15:15** Evolutionary Approach to the Game of Checkers *Magdalena Kusiak, Karol Waledzik, Jacek Mandziuk* LNCS 4431 p.432

   A new method of genetic evolution of linear and nonlinear evaluation functions in the game of checkers is presented. Several practical issues concerning application of genetic algorithms for this task are pointed out and discussed. Experimental results confirm that proposed approach leads to efficient evaluation functions comparable to the ones used in some of commercial applications.

5. **15:35** No-Regret Boosting *Anna Gambin, Ewa Szczurek* LNCS 4431 p.422

   In the paper we analyze boosting from a game-theoretic perspective. We define a wide class of boosting classification algorithms called H-boosting methods, which are based on Hannan-consistent game playing strategies. These strategies tend to minimize the regret of a player, i.e. are able to minimize the difference between its expected cumulative loss and the cumulative loss achievable using the single best strategy. The "weighted majority" boosting algorithm is proved to belong to the class of H-boosting procedures. A new boosting algorithm is proposed, as an another example of such a regret-minimizing method.

6. **15:55** Implementation of an Interactive NPC Based on Game Ontology and Game Community Q/A Bulletin Board *Dookyung Park, Tae-bok Yoon, Kyo-hyun Park, Jee-hyong Lee, Keon-myung Lee* LNCS 4431 p.441

   Recently, there are many researches about NPC (Non-player character) which are appeared in many games. There is a little study which has view of the speech of NPC, but most of them are focused on the movement of NPC. Most of NPC say the same line repeatedly, that make the game unrealistic. In the paper, we construct the quest ontology of game World of Warcraft and collect the articles of Q/A bulletin board which is from the web site, also called community, of the game. With the game ontology and the article from the bulletin, we construct a

corpus consisted of game keywords as NPC knowledge. In the runtime, when a player asks a question to NPC, it can find the answer by comparing the question and its own knowledge.

7. **16:15** Theory of Saplings Growing up Algorithm *Ali Karci* LNCS 4431 p.450

   The saplings sowing and growing up algorithm (SGA) was inspired by a natural events evolution of growing up of trees. This algorithm contains two phases: Sowing Phase and Growing up Phase. In this paper, the theoretical foundations of SGA were determined. SGA is defined as a computational model, and it was depicted that there are a collection of Turing Machines for simulating SGA.

Robotics, Room 123

1. **14:15** Progressive Optimisation of Organised Colonies of Ants for Robot Navigation: An Inspiration from Nature *Tatiana Tambouratzis* LNCS 4432 p.649

   This piece of research introduces POOCA (Progressive Optimisation of Organised Colonies of Ants) as an appealing variant of the established ACO (Ant Colony Optimisation) algorithm. The novelty of POOCA lies on the combination of the co-operation inherent in ACO with the spread of activation around the winner node during SOM (Self-Organising Map) training. The principles and operation of POOCA are demonstrated on examples from robot navigation in unknown environments cluttered with obstacles: efficient navigation and obstacle avoidance are demonstrated via the construction of short and at the same time - smooth paths (i.e. optimal, or near-optimal solutions); furthermore, path convergence is speedily accomplished with restricted numbers of ants in the colony. The aim of this presentation is to put forward the application of POOCA to combinatorial optimisation problems such as the traveling salesman, scheduling etc.

2. **14:35** An Algorithm for Selecting a Group Leader in Mobile Robots Realized by Mobile Ad Hoc Networks and Object Entropy *Sang-Chul Kim* LNCS 4432 p.659

   This paper1 proposes a novel algorithm for mobile robots to select a group leader and to be guided in order to perform a specific work. The concepts of mobile ad hoc network (MANET) and object entropy are adopted to design the selection of a group leader. A logical robot group is created based on the exchange of request and reply messages in a robot communication group whose organization depends on a transmission range. A group leader is selected based on the transmission of confirmation message from a robot who initiates to make a logical robot group. The proposed algorithm has been verified based on the computer-based simulation. The performance metric such as the number of

message in order to make a logical robot group and to select a group leader is defined and verified by using the computer-based simulation.

3. **14:55** A Neural Framework for Robot Motor Learning Based on Memory Consolidation *Heni Ben Amor, Shuhei Ikemoto, Takashi Minato, Bernhard Jung, Hisroshi Ishiguro* LNCS 4432 p.641

   Neural networks are a popular technique for learning the adaptive control of non-linear plants. When applied to the complex control of android robots, however, they suffer from serious limitations such as the moving target problem, i.e. the interference between old and newly learned knowledge. However, in order to achieve lifelong learning, it is important that robots are able to acquire new motor skills without forgetting previously learned ones. To overcome these problems, we propose a new framework for motor learning, which is based on consolidation. The framework contains a new rehearsal algorithm for retaining previously acquired knowledge and a growing neural network. In experiments, the framework was successfully applied to an artifical benchmark problem and a real-world android robot.

4. **15:15** Robot Path Planning in Kernel Space *Jose A. Moreno, Cristina Garcia* LNCS 4432 p.667

   We present a new approach to path planning based on the properties of the minimum enclosing ball (MEB) in a reproducing kernel space. The algorithm is designed to find paths in high-dimensional continuous spaces and can be applied to robots with many degrees of freedom in static as well as dynamic environments. In the proposed method a sample of points from free space is enclosed in a kernel space MEB. In this way the interior of the MEB becomes a representation of free space in kernel space. If both start and goal positions are interior points in the MEB a collision-free path is given by the line, contained in the MEB, connecting them. The points in work space that satisfy the implicit conditions for that line in kernel space define the desired path. The proposed algorithm was experimentally tested on a workspace cluttered with random and non random distributed obstacles. With very little computational effort, in all cases, a satisfactory free collision path could be calculated.

5. **15:35** A Path Finding via VRML and VISION Overlay for Autonomous Robot *Kil To Chong, Eun-Ho Son, Jong-Ho Park, Young-Chul Kim* LNCS 4432 p.676

   We describe a method for localizing a mobile robot in its working environment using a vision system and Virtual Reality Modeling Language (VRML). The robot identifies the landmarks located in the environment, using image processing and neural network pattern matching techniques, and then it performs self-positioning based on vision information and a well-known localization algorithm. The correction of position error is performed using the 2-D scene of the vision and the overlay with the VRML scene. Through an experiment, the self-positioning algorithm has been implemented to a prototype robot and also it performed

autonomous path tracking.

6. **15:55** Neural Network Control for Visual Guidance System of Mobile Robot *Young-Jae Ryoo* LNCS 4432 p.685
   This paper describes a neural network control for a visual guidance system of a mobile robot to follow a guideline. Without complicated geometric reasoning from the image of a guideline to the robot-centered representation of a bird's eye view in conventional studies, the proposed system transfers the input of image information into the output of a steering angle directly. The neural network controller replaces the nonlinear relation of image information to a steering angle of robot on the real ground. For image information, the feature points of guideline are extracted from a camera image. In a straight and curved guideline, the driving performances by the proposed technology are measured in simulation and experimental test.

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