2011 Optimization Workshop

Department of Mathematics
National Taiwan Normal University

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Jein-Shan Chen

Schedule of Programs
Place : M210, Mathematics Building

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10:50 11:30	Jyh-Horng Jeng	Evolutionary Computing for Fractal Image Coding
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14:00 14:40	Yuh-Jye Lee	Passive and Aggressive Algorithm with Class Means Information for Large Scale Classification Problems
14:40 15:20	Yih-Lon Lin	PSO-based Path Following for Mobile Robot
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16:20 17:00	Chun-Hsu Ko	Passive Control and Path Planning for Walk-Assist Robot

Genetic-based Cognition Exploration for Content Assessment

Shu-Ling Cheng
Department of Management Information System
Far East University
Tainan 74448, Taiwan
E-mail: emily@cc.feu.edu.tw

Abstract. With the advance of computational techniques, computerized assessment becomes increasingly popular due to the advantages of consistency, efficiency, and labor-saving. In computerized assessment, it evaluates the subject's performance based on the expert assessment criteria and also criteria preferences, thus indicating an effort to implement expert assessment policy. The key element of developing the computerized assessment system is to measure the complexity of an expert's cognitive structures containing assessment criteria and criteria preferences. To achieve this goal, I present an intelligent cognition-based systems approach which includes three integrated parts to build the computerized assessment model. It first utilizes text mining techniques to automatically elicit expert cognitive structures and grouped around important meaning themes that frame as assessment criteria. Human experts' criteria preferences are then derived from the pre-assessed essays by applying a multiple-criteria decision analysis. Meanwhile, the optimal parameter set for the assessment system is determined using the genetic algorithm. To demonstrate its effectiveness, the essays of university students majoring in information management are empirically evaluated by the proposed method. The results show that the proposed method can not only effectively model expert cognitive structures but also report high classification accuracy under different assessment settings.

Passive and Aggressive Algorithm with Class Means Information for Large Scale Classification Problems

Yuh-Jye Lee
Department of Computer Science and Information Engineering
National Taiwan University of Science and Technology
Taipei 106, Taiwan
E-mail: yuh-jye@mail.ntust.edu.tw

Abstract. Due to the nature of the online learning setting, the online learning algorithms have been successfully applied to large scale classification tasks. This type of algorithms can be interpreted as a stochastic gradient descent method that try to find the solution of the underlying minimization problem with the objective function consisting the sum of training loss and regularization term. How to decide the learning rate becomes an important issue in this type learning algorithms. The passive and aggressive algorithm proposed an updating scheme to determine the new updated classifier. It suggests that the new classifier should not only classify the new arriving data correctly but also as close to the current classifier as possible. A closed form of updating rule was derived that makes PA algorithm training extremely fast. However, a lack of memory for previous instances might hurt the learning efficiency. We propose a new updating rule that takes the accumulated class means information into account. The positive class mean and negative class mean of accumulated training data until now keep a memory of previous instances. Besides, the difference between them provides a good proximal classification model especially when the data set is almost linearly separable. We augment these information into PA algorithm updating rule in a closed form. Thus, our proposed method has the same computational advantage with PA algorithm. The preliminary numerical results show that our proposed method is less sensitive to the input order of training data than PA algorithm. It will return a near optimal classifier in a single pass. Two consecutive classifiers generated by two training epochs are very close. These evidences show that our method is suitable for the learning task with extremely large data set.

Optimization methods for large-scale L1-regularized linear classification

Chih-Jen Lin
Department of Computer Science
National Taiwan University
Taipei 10617, Taiwan
E-mail: cjlin@csie.ntu.edu.tw

Abstract. Large-scale linear classification is widely used in many areas. The L1-regularized form can be applied for feature selection, but its non-differentiability causes more difficulties in training. Various optimization methods have been proposed in recent years, but no serious comparison among them has been made. In this talk, we discuss several state of the art methods and propose two new implementations. We then conduct a comprehensive comparison. Results show that decomposition methods, in particular coordinate descent methods, are very suitable for training large-scale L1-regularized classifiers.

A Novel Multiple Objective Generic Algorithm Based on Strengthen Dominant Species

Ping-Chen Lin
Institute of Finance and Information
National Kaohsiung University of Applied Sciences
Kaohsiung 807, Taiwan
E-mail: letylin@gmail.com

Abstract. Multi-objective optimization is to simultaneously optimize two or more conflicting objectives subject to certain constraints. The conventional popular quadratic programming and goal programming techniques are applied to find an efficient frontier. These algorithms lead to non-convex, discontinuous and time-consuming optimizations across the search space. The multi-objective genetic algorithm (MOGA) is a state-of-the-art nonlinear optimization methodology that applies Pareto-based ranking schemes. These well-known MOGA methods, such as Non-dominated Sorting Genetic Algorithm-II (NSGA-II) and Strength Pareto Evolutionary Approach 2 (SPEA-2), maintains diversity solution set in the optimization process. However, the sexual selection theory proposed by Charles Darwin states that certain evolutionary effects can be explained as the struggle between the individuals of one sex. In this paper, an improved MOGA methodology is introduced, which incorporates the fine-grained fitness assignment strategy, the crowding estimation technique and an enhanced selection mechanism to extract more dominated species. It uses the distance metrics and crowding density to guide the search of Pareto front.

PSO-based Path Following for Mobile Robot

Yih-Lon Lin
Department of Information Engineering
I-Shou University
Kaohsiung 84001, Taiwan
E-mail: yllin@isu.edu.tw

Abstract. This topic presents the swarm intelligence based approach to path tracking problem for SRV mobile robot in which the path consists of straight lines and arcs. In the robot, particle swarm optimization (PSO) is implemented to obtain the optimal velocity and direction control according to the captured images. Experimental results show that PSO can efficiently control the mobile robot in the path tracking problem.

Keywords: SRV Robot; Particle Swarm Optimization; Path Following

Brief Introduction to Robust Neural Networks

Jer-Guang Hsieh
Department of Electrical Engineering
I-Shou University
Kaohsiung 84001, Taiwan
E-mail: jghsieh@isu.edu.tw

Abstract. In many practical applications, data collected inevitably contain one or more anomalous observations called outliers; that is, observations that are well separated from the majority of the data, or in some way deviate from the general pattern of the data. As is well known in linear regression theory, classical least squares fit of a regression model can be very adversely influenced by outliers, even by a single one, and often fails to provide a good fit to the bulk of the data. Robust regression that is resistant to the adverse effects of outlying response values has been the subject of an enormous amount of literature over the past decades. In robust regression, rather than omitting outliers, it dampens their influence on the fitted regression curve by down-weighting them. In this speech, I will give a brief introduction to some recently developed robust neural networks, including Wilcoxon neural networks (W-NNs), M-neural networks (M-NNs), and least trimmed squares neural networks (LTS-NNs), which are generalizations of the robust methods frequently used in linear parametric regression problems.

Evolutionary Computing for Fractal Image Coding

Jyh-Horng Jeng
Department of Information Engineering
I-Shou University
Kaohsiung 84001, Taiwan
E-mail: jjeng@isu.edu.tw

Abstract. Fractal image compression is promising both theoretically and practically. The encoding speed of the traditional full search method is a key factor rendering the fractal image compression unsuitable for real-time applications. In this study, evolutionary computing algorithms such as genetic algorithm (GA), particle swarm optimization (PSO), and ant colony optimization (ACO) are adopted in order to speedup the encoder. Although only sub-optimal solutions are obtained, the image quality can be preserved since image characteristics such as spatial correlation and edge properties are considered in the optimization process.

Passive Control and Path Planning for Walk-Assist Robot

Chun-Hsu Ko
Department of Electrical Engineering
I-Shou University
Kaohsiung 84001, Taiwan
E-mail: chko@isu.edu.tw

Abstract. With the growth of elderly population in our society, technology will play an important role in providing functional mobility to humans. From the perspective of human safety, it is desirable that controllers for walk-assist robots be dissipative, i.e., the energy is supplied by the human to the walker, while the controller modulates this energy, also the motion of the walker, while dissipating this energy. The simplest form of a dissipating controller is a brake, where resistive torques are applied to the wheels proportional to their speeds. The fundamental question that we ask in this paper is how to modulate these proportionality gains over time for the two wheels so that the walker can perform point-to-point motions in the state space. The unique contribution of this paper is a novel way in which the theory of differential flatness is used to plan the trajectory of these braking gains. Since the user input force is not known prior, the theory of model predictive control is used to periodically compute the trajectory of these braking gains. The simulation results show that the walking assist robot, along with the structure of this proposed control scheme, can guide the user to a goal accurately.