Capsule Reviews

FAIROUZ KAMAREDDINE

The Capsule Reviews are intended to provide a short succinct review of each paper in the issue in order to bring it to a wider readership. The Capsule Reviews were compiled by Fairouz Kamareddine. Professor Kamareddine is an Associate Editor of *The Computer Journal* and is based in the Department of Mathematical and Computer Sciences at Heriot-Watt University, Edinburgh, UK.

Plant Image Retrieval Using Color, Shape and Texture Features. HANIFE KEBAPCI, BERRIN YANIKOGLU AND GOZDE UNAL

This paper gives a plant retrieval system which takes an image of a house plant as input and returns the most similar images from a database, so that the Latin name of the plant, the care instructions and other information can be obtained. After an overview of work related to content-based image retrieval, the authors introduce the methodology used for their proposed system. First, the system, interactively with the user, segments the plant from the background (pot, table, etc.). Then, the segmented region is used for feature extraction of well-known colour, shape and texture. Then, the dissimilarity between the query image and a database image is assessed according to the extracted features using different metrics to match colour, shape and texture. The used database consists of 380 plant images from 78 different plant types, and the authors illustrate a rich variety of tests involving different methods for matching the three features and for also involving combinations of methods and features.

Test results outline the performance of the retrieval methods for each of these features and for their combinations. The results are followed by a discussion of the challenges involved.

Full Tomographic Reconstruction of 2D Vector Fields Using Discrete Integral Data. MARIA PETROU AND ARCHONTIS GIANNAKIDIS

The paper starts by the observation that unlike a scalar function, a vector field requires two or three component functions to be determined. The purpose of the paper is to deal with the tomographic reconstruction of a 2D vector field using integral data. The paper moves from the earlier approaches which used conventional scalar tomography theory and adopts a new approach by solving a system of linear equations. After discussing the problem and presenting the proposed methodology for achieving full vector field reconstruction based on linear algebra, the authors observe the duality between the so-called Radon transform scheme and the matrix formalism in their proposed methodology. This is exploited to uniformly sample the parametric space which is a necessary requirement for producing accurate constructions. The authors manage to find the necessary coordinates to achieve a uniform sampling of the parameter space. An electric field imaging example is discussed and this is followed by a discussion of the effect of noise on the reconstruction of the vector field, especially when some of the sensor measurements/positions have inaccuracies.

Natural Language Understanding, Where Are We Going? Where Could We Go? GERARD SABAH

This is a position paper which intends to stress that understanding the surface meaning of a natural language document is not enough and that instead, the intensions and goals of the participants of the dialogue must be understood. When human understanding is simulated, programs can claim cognitive validity. Although it is important to understand human understanding, the current position of natural language processing is rather statistic-based than formal-based. The author states that the development of real applications should not reduce the theoretical work leaving natural processing/understanding to the engineers. The author discusses the evolution of natural language processing stating that in the symbolic approach, numerous problems remain (e.g., the links between the syntax and semantics have to be understood from both theoretical and practical perspectives) and that while statistical methods are robust and effective, they can be unreliable. The author further states that both symbolic and statistical methods could be useful to language understanding and it is important that they collaborate. Furthermore, to simulate language understanding on computers, it is important to accommodate classification, categorization and learning. The author proposes an implementable model that takes these aspects into account.

Swarm Robots: From Self-assembly to Locomotion. HONGXING WEI, YOUDONG CHEN, MIAO LIU, YINGPENG CAI AND TIANMIAO WANG

Research into the self-assembly control of swarm robots is inspired by the swarm behaviour of social insects which

organize into collective patterns/structures without outside intervention. This paper starts from the observation that there are very few platforms for self-assembly and locomotion in swarm robotics, proposes distributed control algorithms of self-assembly and locomotion and designs the self-developed self-assembling modular swarm robot (sambot) which shares characteristics with both swarm robots and self-reconfigurable robots and which moves autonomously and connects well with others.

After a brief overview of related work, the authors present the sambot platform complete with the control system, the docking mechanism, the self-assembly controller and the locomotion controller. An autonomous docking experiment, a self-assembly experiment and a locomotion experiment are given and then followed by an experiment on how to combine self-assembly and locomotion.

Asset-Task Assignment Algorithms in the Presence of Execution Uncertainty. STELIOS TIMOTHEOU

An assignment problem is a combinatorial optimization problem which assigns assets to tasks in order to minimize a cost function. However, in real applications, assigning a task does not necessarily imply successful execution. This paper studies a general assignment problem where the outcome of any assignment is uncertain. The aim is to minimize the overall expected costs. Uncertainty is modelled by assuming that assets have probabilities in executing tasks. First, the asset-task assignment problem is mathematically formulated stating the assumptions made by the author for this problem and giving a cost function based on the overall failure probability of a task and the probability that an asset will successfully execute a task. The paper assumes that one asset can be assigned to at most one task. After a discussion of related problems, the author discusses an earlier work of his: the random neural network (RNN)-based solution to the asset task assignment problem. The solution is used in the examination of the introduced network flow algorithms. The author states that network flow problems are an important class of linear programming problems that can be solved much faster than other linear programming problems and that there are bounds on their worst case performance.

The MCF network flow problem is formulated and the author uses the MCF approach to give a solution to the assignment problem he formulated earlier. This solution involves a solution of a sequence of MCF problems. A tight lower bounding scheme is then developed and used to assess the performance of the algorithms presented in the paper. Two generated data families have been used to test the effectiveness of the algorithms.

Mel- and Mellin-cepstral Feature Extraction Algorithms for face Recognition. S. CAKIR AND A. ENIS CETIN

This paper defines two-dimensional (2D) mel-cepstrum and 2D Mellin-cepstrum and shows that they are useful for image representation and lead to robustness against illumination variations. The authors propose 2D mel-cepstrum and mellin-cepstrum-based feature extraction methods which are applied to face recognition. First, the authors present the 2D Mel- and Mellin-cepstrum and the steps for 2D mel-cepstrum-based feature extraction and for 2D Mellin computation and explain the importance of the invariance of cepstrum to the pixel amplitude changes and the importance of the 2D cepstrum symmetry. Thereafter, the feature classification approaches used in the article are introduced. In particular, the common matrix approach and the multi-class supervised machine-learning SVM are introduced. Experimental results are carried out within a number of databases (AR Face Image Database, ORL Face Database, Yale Face Database and FRGC version 2 Database). Emphasis is placed on the robustness in recognition results and on lower computational complexity.

A Content-Boosted Collaborative Filtering Approach for Movie Recommendation Based on Local and Global Similarity and Missing Data Prediction. GÖZDE ÖZBAL, HİLAL KARAMAN AND FERDA N. ALPASLAN

Information overload has created interest in automated filtering, refinement and presentation of relevant information, and in ranking and sorting information based on user preferences. With this in mind, recommendation strategies and methods are used. Collaborative filtering (CF) is a recommendation method that automatically predicts the interest of an active user by collecting rating information from the similar users or items. This paper addresses the sparsity problem of CF by studying content-boosted CF in movie recommendation giving the movie recommendation system ReMovender. After an introduction to the background and related work, the content-boosted CF approach is presented. The system components consist of information extraction, user interface and recommender. Domain and distance measures as well as other features and dimensions are given and followed by the prediction and recommendation mechanism. Predictions are based on ratings of similar users and ratings of similar items. Item and user similarity calculations were carried out by the PCC method but augmented with content-boosted item similarity calculation in order to deal with sparse data. Local neighbour selection and local/global user similarity also take their place in the calculation and so does the effective missing data prediction algorithm. All this leads to the ReMovender, the content-boosted CF movie recommender which is then evaluated through a number of experiments.

Cascade Generalization with Reweighting Data for Handling Imbalanced Problems. S.B. KOTSIANTIS

The paper starts by listing the three ways used by the machine-learning community to address the issue of class imbalance and poses the open question of whether one can tailor learning algorithms so that the accuracy for the extreme class values can be improved. In order to handle such imbalance problem, the author proposes a cascade generalization ensemble that

is applied in reweighted data. After a short introduction to learning techniques and algorithms and the problems they face in imbalance data sets, a review of existing techniques for handling imbalanced data sets is given. This review illustrates that multi-expert systems are a suitable alternative to cope with imbalanced data sets. For this reason, the author proposes to achieve diversity in the errors of the learned models by using different learning algorithms. Hence, the idea is to use cascade generalization which can be regarded as a special case of stacking generalization due to the layered-learning structure. Experiments are carried out to demonstrate the effectiveness of the proposed approach. Eight imbalanced data sets are used in the evaluation.

An Adaptive GA-PSO Approach with Gene Clustering to Infer S-system Models of Gene Regulatory Networks. WEI-PO LEE AND YU-TING HSIAO

Constructing gene regulatory networks (GRNs) has benefited from automated tools which allow altering the gene network in some ways, observing the outcome and using computational methods to infer the underlying principles of the network. This paper aims to establish a practical methodology for such a procedure of network inference. Recently, a population-based optimization technique, the so-called particle swarm optimization (PSO), was proposed as an alternative to the more traditional evolutionary algorithms (EAs) computational method. The so-called genetic algorithms (GAs) are particular cases of EAs. Since performance comparisons carried out between EAs and PSO were inconclusive, hybrid techniques were proposed to effectively exploit the qualities and uniqueness of the two methods. This paper adopts the non-linear S-system model to represent GRNs and develop an adaptive GA-PSO hybrid method that exploits the advantages of both GA and PSO to infer networks from expression gene profiles. After a review of the background and related work, the network model and performance measurement are introduced and an adaptive GA-PSO hybrid approach is presented to infer GRNs. Three series of experiments for performance evaluation are presented to compare the performance of different inference methods, to examine whether the proposed method can be used to infer robust networks and to reconstruct complicated networks with more gene nodes.