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AUTOMATIC CONTROL and COMPUTER SCIENCE Section

CONTENTS

ON COUPLED OSCILLATORS WITH TIME DELAY

by
Vladimir Răsvan, Dan Popescu and Daniela Danciu

The paper starts from some synchronization models to focus then on a ring network with several identical oscillators with tunnel diode and local transmission line. Stability of equilibria as well as existence and exponential stability of forced oscillations for local oscillators are analysed. Both Popov frequency domain inequality and quadratic Liapunov functional are considered. This last approach appears more suitable for the stability analysis of the interconnected structure.

Keywords: Stability, Oscillators, Synchronization.

REAL-TIME SLIDING-MODE ADAPTIVE CONTROL OF PIONEER 3-DX WHEELED MOBILE ROBOT

by
A. Filipescu, A. Stancu and S. Filipescu

Parameter identification scheme and discrete-time adaptive sliding-mode controller applied to Pioneer 3-DX wheeled mobile robot (WMR) are presented in this paper. The dynamical model for mobile robot with one pair of active wheels, time-varying mass and moment of inertia have been used in slidingmode control. Two closed-loop, on-line parameter estimators have been used in order to achieve robustness against parameter uncertainties (robot mass and moment of inertia). Two slidingmode adaptive controllers corresponding to angular and position motion have been designed. Closed-loop circular trajectory tracking Pioneer 3-DX real-time control is presented.

DESIGN OF FERROFLUID ACTUATORS USING EVOLUTIONARY STRATEGIES AND FINITE ELEMENT METHOD

by
Lavinia Ferariu, Camelia Petrescu and Radu Olaru

The paper addresses the optimization of a DC ferrofiuid actuator, used for small pressures transmission. The approach considers a methodology based on evolutionary strategies, able to determine appropriate values of several mechanical parameters and of the magnetic permeability of the device components. The problem is formulated in the sense of equivalent force maximization. The magnetic field inside the actuator is evaluated using the finite element method and the force acting on the flexible parts is calculated by means of Maxwell's magnetic tensor. The evolutionary optimization procedure can consider Gaussian mutations with and without rotations and permits the adaptation of standard deviations and rotation angles.

Keywords: Nonlinear optimization, Evolutionary strategies, Magnetic permeability.

MACHINE LEARNING ALGORITHMS FOR CARPETS CLASSIFICATION

by
Rareş Damian, Robin De Keyser, Luc Boullart, Willem Waegeman, Lieva Van Langenhove and Corneliu Lazăr

For every carpet produced nowadays, the industry requires a label to attest the quality of product. This label is determined through visual assessment by human experts, but this method has a number of problems generated by the subjectivity of people. The idea of using computers for automatic labelling is not new but until now all the results were are satisfactory and the human experts are still the best choice. This paper presents an approach to this problem using 3D lasers for scanning the carpets. It is used a four dimensional virtual image of the carpet that is later analysed by computer software. Due to the specific characteristic of three-dimensional images new algorithms are developed to extract and process information from the digital copy of the carpet. In the end, a new quality scale is proposed to classify the carpets.

Keywords: Learning Algorithm, Classification, Four Dimensional Point Cloud, Linear Labelling.

A RULE BASED IMPLEMENTATION OF A MULTIAGENT SYSTEM FOR MANUFACTURING

by
Marius Şutu and Doru Pănescu

This paper presents a method regarding the implementation of a multi-agent system dedicated to computer integrated manufacturing. The main objective is to ensure the required autonomy for the designed agents, as well as a coordination mechanism to allow each of them being a whole in itself, but also a cooperative part of the manufacturing system. Some formal issues on agent design are presented, together with a rule-based implementation solution, a non-linear planning scheme and a coordination protocol based on message exchange.

Keywords: Multiagent system, Rule based programming, Computer Integrated Manufacturing, Planning, Agent communication.

A BIOLOGICALLY INSPIRED RULE FOR ELECTRONIC SYNAPSES PLASTICITY

by
Mircea Hulea

In this paper it is presented a new plasticity rule for artificial neural networks training. This rule is implemented on two types of electronic neurons based on integrate-and-fire model which way of operation mimics the natural neurons physiology. Being able to activate their synapses as a consequence of physical medium properties change and to strengthen recently activated synapses during postsynaptic neuron firing, this new feature of the electronic synapse brings a great contribution to associative learning. Moreover, after network training, a user could remove the synapses which were not activated during learning to reduce the number of computation neurons.

Keywords: Artificial Networks, Analog Model, Associative Learning, Synaptic Plasticity, Electronic Synapse.

SOFT COMPUTING METHOD FOR PRODUCTION ESTIMATION IN CENTRALIZED DISTRICT HEATING SYSTEMS

by
Dorin Ivana, Lucian Mastacan and Iosif Olah

Centralized district heating systems work with small efficiency because of their extent and improper control. The concept of a durable development in the field of thermal energy supply of the localities implies the use of efficient technical solutions that are capable to ensure the fulfilment of their social needs in conditions of economic and energetic efficiency. Having as research base the centralized district heating system of the Iasi city the research team proposes to improve the performance of its district heating substations using soft computing methods. The paper presents as method to improve the total activity of the centralized district heating system, the estimation of the heating agent parameters produced in the thermo-power stations starting from the consumers' necessities and imposing these estimated values as set points for the parameters control systems of the centralized district heating system. The estimating block based on soft computing techniques can be implemented as part of an expert system.

Keywords: Expert System, Fuzzy Logic, District Heating, Intelligent Model, Parameter Estimation.

MARCH TEST FOR A REDUCED MODEL OF ALL RAM STATIC 3 - CELL COUPLING FAULTS

by
Petru Caşcaval and Doina Caşcaval

A fault, primitive based analysis of all static simple (*i.e.* not linked) 3-cell coupling faults in *n x 1* random-access memories (RAMs) is discussed. All realistic 3-cell coupling faults that, have been shown to exist, in real designs are considered: state coupling faults, transition coupling faults, write disturb coupling faults, read destructive coupling faults, deceptive read destructive coupling faults, and incorrect read coupling faults. A new march test with 66 n operations, able to detect all primitive 3-cell coupling faults, is proposed. To reduce the length of the test, only the coupling faults between physically adjacent memory cells have been considered. The test assumes that the storage cells are arranged in a rectangular grid and that, the mapping from logical addresses to physical cell locations is known completely. To compare this test with other industrial march tests, simulation results are also presented in this paper.

Keywords: Memory Testing, Static Fault Models, 3-Cell Coupling Faults, Fault Primitive, March Tests.

UNDERSTANDING AND PREDICTING UNBIASED BRANCHES IN GENERAL-PURPOSE APPLICATIONS

by
Adrian Florea, Ciprian Radu, Horia Calborean, Adrian Crapciu, Arpad Gellert and Lucian Vinţan

In this paper we continue our work concerning the detecting and predicting unbiased branches, extending the qualitative and quantitative analysis from C procedural benchmarks to Java benchmarks, which are entirely object-oriented programs. We focused on two directions: firstly, based on a simple example from *Perm* - Stanford benchmark, we show that extending context information some of branches in certain contexts became fully biased, thus diminishing the frequency of unbiased branches at benchmark level. Secondly, we use some state-of-the art branch predictors to predict the unbiased branches. Following our aims we developed the ABPS tool (Advanced Branch Prediction Simulator), an original useful simulator written in Java that performs trace-driven simulation on 33 benchmarks from Stanford, SPEC2000 and SPECJVM98 suites.

Keywords: Unbiased Branches, Neural Predictors, Trace-Driven Simulation, Benchmarking, Object-Oriented Programs.

IMAGERY BASED PROCESSING OVER GRID

by
Dorian Gorgan, Cornelia Melenti, Victor Bâcu and Ovidiu Mureşan

The paper describes the MedioGrid infrastructure and the software supporting the development of the satellite images based processing applications. The satellite data processing is able to reveal important geographical and environmental information. The Greenland, Waterland and Minerals applications exemplify the performance of processing the satellite imagery over MedioGrid.

Keywords: Grid Computing, Satellite Image Processing; Diagrammatic Process Description; Grid Applications.

OPTIMIZING ASSOCIATION RULE MINING ALGORITHMS USING C++ STANDARD TEMPLATE LIBRARY

by
Alexandru Archip, Cristian Mihai Amarandei, Simona Aruştei and Mitică Craus

The results of a study concerning time response optimizations for association rule mining algorithms (ARM algorithms) using C++ STL are presented. A new method for encoding transactions and items is presented: this method assumes that each item is represented as a single boolean value; and each transaction is a set of such values. For the purpose of this study, Apriori (as being the base sequential ARM algorithm) and HPA (Hash Partitioned Apriori - an intelligent parallelization of Apriori) are also implemented. Time results for both candidate generation and candidate pruning are presented. As conclusions, a method of exposing a Data Mining grid service based on the current HPA implementation was also suggested.

Keywords: Data Mining, Apriori Algorithm, C++ STL, Parallel/Distributed Computing; Grid Services.

TEST VECTORS STATIC COMPACTION FOR COMBINATIONAL CIRCUITS

by
Cătălin Teodoru and Radu Silion

This paper presents several methods for static compaction of test vector sets for combinational circuits. The goal of static compaction is to obtain, from a given set of test vectors, the smallest possible set of test vectors that detects the same faults as the initial set of vectors. A case study was made on a set of ten combinational circuits and the best results were given by the linear programming methods.

Keywords: Combinational Circuit, Test Vector, Static Compaction, Linear Programming.

PARALLEL RANSAC FOR PLANE DETECTION IN POINT CLOUDS

by
Simona Aruştei, Alexandru Archip and Cristian Mihai Amarandei

A parallel algorithm for detecting planar structures in point clouds acquired by range scanners is proposed. These devices have become common instruments for visual data acquisition and they are able to produce immense data sets that need to be visualized at interactive frame rates. Such visualizations are possible using a representation of the point cloud consisting of textured planar structures. When the size of the data set is very large and high quality images are required, the processing of the point cloud becomes computationally demanding. To overcome this problem a parallel approach to the well known RANSAC (RANdom SAmple Consensus) algorithm is introduced which proved to give good output when trying to detect multiple planar structures in point clouds. The proposed algorithm partitions the data so that at each step of the RANSAC algorithm the support for a plane candidate is computed in parallel by all processing nodes. The results of executing our algorithm over different sized point clouds show that it scales well with the processor count and that it handles large data sets efficiently.

Keywords: Parallel RANSAC, Point Cloud, Plane Detection, Parallel Processing.

PROCESSOR ARRAY STRUCTURE DESIGNED ON NUMA ARCHITECTURE CONCEPT

by
Călin Mircea Monor and Florin Hoza

When computing systems with array of processors are designed, the use of a common memory may lead to a bottleneck, slowing down not only the communication between processors, but also their independent execution. The NUMA (Non-Uniform Memory Access) concept is seen as a solution to that problem. In order to implement a NUMA architecture, it is necessary to create a protocol and an arbiter for an easy access to the global memory. The paper presents such a protocol and the automaton that implements the arbiter for a global memory and a protocol for passing messages among the cells. The system consists of an array of *n* cells - a cell consisting in a processor and its local memory - and the global memory, easily accessed by all cells for communication purposes. The cells are interfaced for message communication.

Keywords: NUMA, Array of Processors, Common Memory Arbiter, Message Passing Bus.