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Dissertations

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Jaroslav Hlava: Anisochronic Internal Model Control of Time Delay Systems–
Potentials and Limits
Supervisor: Prof. Ing. Pavel Zítek, DrSc.
Faculty of Mechanical Engineering of the Czech Technical University, 1998

Summary. The thesis addresses the problem of robust control of time delay systems
that include not only delays in control but also internal state delays. Systems of this class
cannot be represented by a serial linkage of a pure transportation delay and delay free
systems and for this reason they cannot be controlled using standard control schemes such
as Smith predictor. Special control methods for this class of systems exist, however, they
are mostly of purely theoretical interest because of considerable complexity of control law
and sensitivity to modelling errors. Motivated by these drawbacks of previously described
approaches, this thesis proposes and elaborates a robust and easy to implement methods
that can be used for general time delay systems with delays in state and in control. This
method is based on an extension of internal model control strategy. The approach followed
is consistently anisochronic, i.e. no rational approximations of time delays are used and
controller employs both delayors and integrators as its basic structural components. A par-
ticular emphasis is put on the question of robustness and the design for robust performance
is described in detail. A separate section is also devoted to the use of control structure
with additional degrees of freedom for both good setpoint tracking and disturbance rejec-
tion in the presence of infinite dimensional disturbance dynamics. A possible extension to
anisochronic controller design for MIMO time delay systems is outlined. Relative simplicity
of application and good robustness properties of the proposed approach were demonstrated
in a detailed application example where anisochronic IMC controller was used to control a
small scale thermal system with two heat exchangers and with considerable internal delays
and nonlinearities in both steady-state and dynamic behaviour.

This thesis was awarded the First Prize of Zvoníček Foundation.

Michal Jankovský: **Design of Some Real-Time Program Systems of Semantics**
Supervisor: Doc. Ing. Miroslav Švéda, CSc.
Faculty of Electrical Engineering and Computer Science of the Technical University in
Brno, September 1999

Summary. The original contribution of the work is represented by the method that
utilizes formal specifications in design of RT programs systems for environment defined by
normatives POSIX 1003.4 and POSIX 12003.4a. The theoretical contribution consists of
extension of the formal apparatus for RT program system specification. Practical contribu-
tion involves the method for real-time program systems implementation, including analysis
of the method and practical examples implemented on LynxOS operating systems.
Creating the method for the real-time program system design was focused on (i) utilizing
the formal specification method in phase of system design and verification, (ii) straightfor-
ward implementation, (iii) testability, (iv) easy maintainability and (v) a correct system
behaviour after its setting. The formal specification tool is based on Temporal Logic of
Actions, which was extended by time-bounded temporal operators. The expressing power
of TLA remains unchanged, because the definition of time-bounded operators is formulated
on the level of syntactic construction.
The author decided to (i) identify suitable tools for the implementation, (ii) define the
conception of real-time system design in the environment of suitable operating systems
and (iii) demonstrate the efficiency of this method on practical examples. The methods is
based on the concept of *executive engine* that provides services for the effective and correct
execution of actions according to their specification. Features of the executive engine

enables the on-line solving of certain kind deadlocks. It is evident from the capacity tests that the execution engine is suitable for soft real-time system domain because its services are effective and ensure a good response to internal and external events. The execution engine can be used also on field of hard real-time systems, mainly as powerful tool during the phases of design and prototyping.

Mikuláš Gangur: **The System of the Objects Fuzzy Classification for Job Hunting**
Supervisor: Doc. Ing. Rudolf Novanský, CSc.
Faculty of Applied Sciences, Department of Computer Science and Engineering of the University of West Bohemia in Pilsen, November 1999

Summary. The thesis presents a proposal for the system of fuzzy classification in the area of job hunting. The system will search the set of the most suitable professions with the help of its knowledge base of described professions, and determine the level of suitability for every selected profession on the base of the user answers. The work proposes a method of data collection and saving. The special method is constructed for input collection of data obtained from the system users for classification purposes. The structure of input and output data is represented by fuzzy sets and saves the data in the form of membership function values of these sets. The fuzzy approach is especially important for the output data during the process of classification of described objects to professions (classes). The next part of the work proposes several ways of construction of learning the classification algorithms. Some of the proposed methods are intuitive (perceptron, Kohonen map, FLVQ), other come from the use of the basic operators with fuzzy sets and their membership function values from fuzzy theory, and finding the map function as the transformation fuzzy matrix. For tests of classification effectivity the classification effectivity coefficients are proposed and constructed. The proposed methods are compared by these coefficients between each other. Then the effectivity of classificators is tested on experimental data. The robustness and sensibility against mistakes, which are made artificially in learning data, are also tested. Finally the system outcomes are presented on the several examples of input objects.

Pavel Nový: **The Design of Audiometric Perception Threshold Test**
Supervisor: Doc. Ing. Jiří Melichar, CSc.
Faculty of Applied Sciences, Department of Computer Science and Engineering of the University of West Bohemia in Pilsen, August 1999

Summary. Air or bone conduction threshold audiometry is a method of ear threshold perception value determination. The perception threshold is ear's objective property, which is independent on stimulus intensity and masking and is impossible to measure directly. The threshold value is therefore estimated from a sequence of elementary experiments. We present an approach to mathematical modeling of the perception threshold, describe choice of the optimal number of elementary experiments and discuss its application.

Jiří Štika: **A Simulation Method for Verification of RT Programs**
Supervisor: Doc. Ing. Stanislav Racek, CSc.
Faculty of Applied Sciences, Department of Computer Science and Engineering of the University of West Bohemia in Pilsen, February 2000

Summary. The work presents a method of functional validation of an embedded real-time program which is working in a well defined environment. The validation of the

program function is based on the process-oriented discrete simulation. It is possible to model independent activity of separate program's tasks in simulation time. The method assumes an utilization of a simple C-based process-oriented simulation tool which allows to utilize slightly modified C-written program code as a part of the simulation model.

Vladimír Toncar: **Datalog Extensions and the Use of Datalog for Large Data Analysis**
Supervisor: Doc. Ing. Karel Ježek, CSc.
Faculty of Applied Sciences, Department of Computer Science and Engineering of the University of West Bohemia in Pilsen, February 2000

Summary. The thesis is centered around the logic language Datalog and the Datalog-based Experimental Deductive Database (EDD), a deductive system that is being developed at the Department of Computer Science and Engineering. The aim of the thesis is to propose useful extensions of Datalog that would allow its use for the analysis of large data. The two most important extensions we study in the work are imperative programming and aggregates. We study the influence of imperative instruction (e.g. assignment) on logic rules, classify the rules according to the influence, and propose a translation algorithm for each class of rules. As to aggregates, we propose a translation algorithm and semantics that allow the use of aggregates even in recursive predicates. We also study the possibilities of using Datalog in OLAP and Data Mining. Additional information about the EDD project is available at http://www-kiv.zcu-cz/groups/db/.

Václav Vais: **Modeling of a Distributed Authentication System**
Supervisor: Doc. Ing. Stanislav Racek, CSc.
Faculty of Applied Sciences, Department of Computer Science and Engineering of the University of West Bohemia in Pilsen, February 2000

Summary. This thesis is devoted to the construction and analysis of models, which can be used to evaluate the performance and reliability of a distributed authentication system. Within this system, some providers are offering their services to a group of registered users whose identity and access rights has to be verified.

Three-layer hierarchical architecture of the distributed authentication system is introduced including a specification of a client-server protocol. Data replication is supposed to provide fault tolerance and to improve the performance of a system.

Various replication techniques are modeled and studied. The general object of the modeling is to inspect the influence of queries rates, services rates and breakdowns and repairs rates on read and are write response time and the mean time of data inconsistency. Four models based on Markov approach are presented: strong consistency protocol, two-level consistency protocol, primary copy protocol and fragmented primary copy protocol.

The last part of theses studies the problem of reliability and dependability of an authentication process implemented in a WAN environment. The authentication system is active over a set of metropolitan centers (autonomous areas). These autonomous areas are interconnected via wide area network (WAN). Modified combinatorial model with simplified representation of WAN is presented using factorization of Markov process.

A case study of a distributed system covering a large territory is presented and used as an example of model application. Some conclusions regarding the preferred system architecture, use of redundancy, maintenance organization, etc., are made.