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Computer Science/Computer Engineering in Central Europe
A Report on Czechoslovakia, Hungary, and Poland

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COMPUTER SCIENCE/COMPUTER ENGINEERING IN CENTRAL EUROPE
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A Report on Czechoslovakia, Hungary, and Poland

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Science and Computer Engineering in the Office of Naval
Research European Office. He is on leave from the
University of Texas at Austin, where he holds the Bettie
Margaret Smith Professorship in Engineering in the
Department of Electrical and Computer Engineering.

INTRODUCTION

This report describes my impressions and provides a preliminary
assessment of the status of computer science/computer engineering
research and education in Central Europe (Czechoslovakia,
Hungary, and Poland). It is based on visits I paid to each
capital city. Ideas for promoting American-Central European
cooperation are outlined, including a plan for organizing a
series of three workshops that would advance the state-of-the-art
in high-performance computing.

OVERVIEW AND BACKGROUND

During my short visit to Czechoslovakia, Hungary, and Poland in
April 1992 I had candid conversations with top computer
scientists in all three countries. Their views on the status of
science and research there range from catastrophic to cautiously
optimistic. I report here on what I learned from them and the
impressions that I formed. (Appendixes A,B, and C provide more
in-depth information about scientist and research project in
these countries; they are given in the format supplied.)

The Labor Pool

The main concern of technical people seems to be that head
hunters from European Community (EC) countries (mainly Germany,
France, and the United Kingdom) are luring away the best minds
among students and faculty. It requires stamina, eternal
optimism, and a total commitment to research to decline offers
that exceed current professional salaries by a factor of 2 to 30,
since current academic salaries are about $200 per month! In
some cases, especially in Poland, students who work for software
houses earn from two to five times more than their professors.
In this situation it is very difficult to attract any new
researcher to academia and, if this trend continues, universities
will be depleted of quality instructors and researchers. The
ones who stay there are usually either the established, senior
academics or the younger optimistic ones hoping that the
situation will improve. (To them at least now there is room for
hope.) Many of them are involved in some sort of business on the

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side—some related to computers such as software development and computer services, others in unrelated fields such as import/export or the general service industry.

Cooperation with the U.S. and Europe
All of the scientists in all three countries are excited and hopeful about cooperation with U.S. researchers. They are very much in favor of technical interactions, especially joint research and/or exchange programs for students and faculty. They are quite realistic in recognizing that any special programs would be only short term fixes, so they are very much interested in long-term solutions such as linking themselves to the world science community. They have also expressed strong interest in joint National Science Foundation (NSF) (or any other U.S. agency) programs that stimulate research cooperation. Even modest, low-cost programs would be of interest to them. Their realism extends to expecting neither strong nor fast responses from the U.S. A relevant support program in the form of grants would indeed be welcome. It was evident that modest programs of this kind would have a stabilizing effect during these turbulent times and would prevent mass exodus from academia until the situation becomes normal. (These countries believe that they have been assured of becoming full members of the EC by the year 2,000. Neither their computer science research nor their political stability may last without earlier outside attention.)

The Central European researchers would also appreciate having access to U.S. databases and current information on grants, scholarships, fellowships, and other programs. Usually, research initiatives announcements for which they are eligible are not distributed to them or are so delayed that application deadlines

are often missed. They are also hampered by inappropriate administrative and support structures in all three countries.

It is important that U.S. research and development (R&D) agencies explicitly describe to the foreign technical communities they visit

o   what characterizes their agencies and activities in the U.S.,
o   how they fit into the U.S. national R&D scene, and
o   what their outputs are.

This is especially true for military R&D organizations (even U.S. ones) because of the residual stigma attached to the military from the past. It is also important that organizations such as the Office of Naval Research (ONR) clearly define to themselves and to the Central European research communities their goals,

their role in Central Europe, and the types of programs they can or cannot consider implementing with computer science researchers in Czechoslovakia, Hungary, and Poland.

Links already exist with the EC via two programs, TEMPUS and ESPRIT. TEMPUS focuses on education and student/faculty exchange; ESPRIT promotes joint research grants (for example, Polish scientists will participate in 13 ESPRIT programs).

Grants are usually about 20,000 ECU ($26K), and the upper limit is 100,000 ECU ($130K). Also, a few scientists from all these countries have direct links, mainly with American, French, and German researchers, and some of them have already spent some time in the United States, usually teaching courses or doing research at U.S. universities.

Academic Programs

The level of academic programs in all three countries is good. Many state-of-the-art courses are available including software engineering, robotics, neural networks, parallel algorithms, and computer architecture (including multicomputing). The students' laboratories mainly have IBM clones, but several laboratories are already equipped with SUN workstations (including Sparcs). IBM RISC/6000s, VAXes, IBM mainframes, and even Evans and Sutherland graphics stations as well as parallel systems based on transputers (Supernodes) and Convex are also available. The U.S. embargo was recently lifted, and it seems that especially workstations will begin to flow in. SUN and others are offering university discounts (at least at present in Poland, where there are three SUN dealers).

Research Perspectives

The level of research varies. In some areas it matches the highest standards; in other areas it seems to be lagging immensely. Some specifics follow.

CZECHOSLOVAKIA

Twenty-five top Czech and Slovak computer scientists attended the meeting from 10 institutions of note. The meeting was held in Prague at the Czech Technical University (CTU), whose Faculty of Electrical Engineering has about 4,000 students and about 900 faculty and staff. Dean Jan Hlavicka was the host and organizer of the meeting. (Appendix A provides more specific information aboutr scientist and research projects in Czechoslovakia)

The main technical concern of Czech and Slovak scientists is their quickly dying, local computer industry, which is no longer able to compete. Traditionally, that industry was supplying

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local and Eastern Bloc markets, but this customer base has turned to western products.

The Computer Science laboratory at the CTU is equipped with SUNs (including Sparc Stations) and three VAXes. The scientists would love to have more equipment, but it is not their major concern. The main concern is what to do about graduates who, out of necessity, may soon be looking for work abroad if the trend toward shutting down the computer industry in-country continues. However, there is hope that some companies will invest in Czechoslovakia. Given the status of the world's computer industry, chances seem rather small to me. Nevertheless, scientists are hopeful, optimistic, and eager to work. They agree that personal contacts with American scientists would help them build strong educational and research programs. In their opinion, the key item needed to improve the situation is to have good and timely information about projects and grant announcements. Many of the scientists are widely travelled and speak good English. They would definitely be interested in exchange of students and faculty. Some of them have already spent one or two years in the United States. They would like, if possible, to have electronic access to selected research databases. This should be considered for implementation.

The Czech Technical University of Prague is opening an English track of education that will have visiting scientists from all over the world as lecturers. The first visitors will be mainly scientists on sabbatical, and others will be sponsored by foreign companies and institutions (e.g., a scientist of Czech descent from IBM).

Czechoslovakia is participating in seven EC-sponsored TEMPUS projects. The Czechoslovak scientists would like to extend their cooperation with agencies like NSF, even if the agreement would offer support for American participants only! It is contacts and interaction that are most desired now.

I spoke with Dr. Michael Chytil, the Secretary of the Council for Informatization. He told me that if he gets a positive signal from NSF he would try to arrange some special funds for this program to support Czech and Slovak scientists in cooperative efforts with the U.S. The grant program is in place, and they would like to enter joint proposals with NSF or other U.S. agencies and institutions. Since the number of computer scientists here is small, it is very difficult to get an unbiased evaluation of proposals; they would welcome an outside, objective judgment to improve the quality of their review process.

The major research areas in Czechoslovakia include fault-tolerant computing, testing, application-specific simulation, software verification, optimization, neural networks, distributed systems, stochastic informatics, formal methods, decision support systems,

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and concurrency. It seems to me that several areas, especially fault-tolerant computing and simulation, have some state-of-the-art projects.

Key institutions for computer research (based on one-day impressions) are:

o   Institute of Information Theory and Automation and Institute of Computer and Information Science at Czecho-Slovak Academy of Sciences, Prague
o   Czech Technical University, Prague
o   Charles University, Prague
o   Slovak Technical University, Bratislava
o   University of West Bohemia, Pilsen.

Czecho-Slovak scientists have written numerous books and have extensively published in local and foreign journals. They have close contacts with a number of West European and some American institutions (including the University of Texas at Arlington, the University of Hawaii at Manoa, and the University of Denver) but are very much interested in developing cooperation with other American universities, industry, and government institutions.

HUNGARY

Twenty-five tcp Hungarian computer scientists attended the meeting at the Technical University of Budapest. The Department of Measurement and Instrumentation Engineering of that university is the only electrical engineering department in Hungary; another one in Szeged will soon be in operation. The department in Budapest will probably change its name to reflect its research in computer engineering; with its world-class expertise in some

electrical properties measurements, the name should also reflect its instrumentation section. Appendix B provides more specific information about scientists and research projects in Hungrary)

Similarly, as in Czechoslovakia, the concern is the extinction of the hardware industry. But, on an optimistic note, the software industry is growing; there is a feeling that software research has a tremendous future in this country. The problem is that faculty background is mainly in hardware. It would be a loss, and probably an impossibility, to quickly shift the educational programs to software. The range of courses offered in computer engineering is quite impressive and ranges from foundations for computer science to software engineering, computer-aided design, machine intelligence, robotics, and computer systems. Content descriptions meet American standards. The glossy prospectus of the Technical University of Budapest could compete with the best from the United States in its form and content. It is an informative publication.

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Research depth is mainly in dependable systems (diagnosis, high reliability with small redundancy), instrumentation (intelligent measurement systems, measurement and processing of visual information), computer-aided logic synthesis, intelligent robotic systems, computer graphics, computer engineering in control systems, formal methods, software engineering, complexity, databases, parallel processing software, and simulation.

Scientists have links mainly with Western Europe, although there are also some contacts with the U.S., Czechoslovakia, and Estonia. Some researchers have spent a year or two in the United States.

Key institutions in computer research include: Technical University of Budapest; Institute of Informatics, Budapest; Research Institute for Measurement and Computing Techniques, Budapest; Hungarian Academy of Sciences, Budapest.

In addition, a special program called the Information Infrastructure Program (IIF) for Research, Development, and Higher Education (1991-1994) is supported by the National Committee for Technological Development, the Hungarian Academy of Sciences, and the Hungarian National Science Foundation to develop a national computer network.

Hungarian researchers are well organized; already more than 90% of their projects are externally funded. As mentioned earlier, they have quite a lot of cooperation in effect with Western Europe, but links with the U.S., especially in the area of joint workshops, are missing. Problems with faculty leaving academia are not as severe here as in Poland. Hungarian strengths, especially in instrumentation, should be of interest and value to U.S. research programs, and the existing cooperation should be expanded.

POLAND

The seminar in Poland was attended by about 25 scientists. (Appendix B provides more in-depth information about scientists and research projects in Poland) The meeting attracted the creme de la creme of Polish computer academics from all the major research institutions in Warsaw, Gdansk, Cracow, and Wroclaw. The only group missing was from Poznan: Prof. Cellary and his colleagues who were busy setting up the Ecole Franco-Polonaise de Poznan (French-Polish University for Computer/Communication Technologies), which will open in the fall 1992. It will be the first French "Grande Ecole" in Poland (!), and its supporters are the cities of Poznan and Rennes, Polish Ministry of Education, France-Poland Foundation, governments of Brittany and Ille-et-Vilaine, and major French high-tech companies such as France Telecom, Bull SA, and Alcatel.

The main problem at Polish universities is the loss of the existing faculty and the inability to recruit new faculty because of highly competitive offers from local industry and abroad. Not surprisingly, the discussion concentrated on how to preserve the existing human resources and to reverse this situation.

The benefits of actions such as those described above may be enormous. Proper direction and focus can unleash the intellectual powers of many researchers who can make lasting contributions to computer science. This process may in effect strengthen the U.S. positions in striking cooperative program deals despite German and French activities to date, and may also strengthen political stability in those countries. It may also contribute to amplification of program effectiveness in the U.S. and abroad.

Most of the professors are well traveled and have rather close ties with American and West European scientists. The relatively large Polish-American community in the United States, coupled with significant research contributions, especially in mathematics, provide a number of opportunities to establish close contacts with American science. Poland has many traditional ties with the U.S. Also, Warsaw is one place where East meets West with ease.

Unfortunately, the $10M Marie Curie-Sklodowska Fund, recently established and managed by the American Embassy in Warsaw, is dominated by physicists; thus, Polish computer scientists have practically no access to it. I talked with an official at the embassy and was told that in the second round of grant distribution they were planning to add electronics but not computer science!

The accomplishments of Polish computer scientists are well known, especially in areas of concurrency, algorithm theory, parallel algorithms, computer graphics, languages, software semantics, numerical analysis, algebraic theory, specification language, rough sets theory, parallel processing, distributed systems, complexity, operating systems, graph theory, formal methods, system reliability, safety, and security. Some of the academics are at Berkeley, Carnegie-Mellon, and Columbia as visitors. They still seem to shuttle between Poland and the U.S., but the question is for how long. One of the arguments brought up by Prof. Turski of the University of Warsaw was in answer to my question on why America should try to save Polish science. He responded that over the last 50 years Poland has provided America with many brilliant scientists. If nothing is done, this pipeline of intellectual energy will be broken, so it is in the interest of America to keep it open. This seems to be true from all aspects, but I wish that a rationale more positive for Poland would have been presented as well. I also strongly believe that opening an American University in Warsaw would give a different

dimension to Polish-American relations, not to mention its stabilizing effect on science, ultimately saving it from destruction.

Another short-term solution voiced by the Poles would be a special grants program. Polish scientists would like to have a mechanism with direct impact on research support. It would boost research activity and allow them to persevere in this difficult time until the situation becomes stable. Their basic income is of fundamental concern to them.

Poles will participate in 13 ESPRIT projects (totaling about 100K ECU ($130K) funding) and will also participate in EC's TEMPUS program. They have some direct ties with NSF programs, but these are small and mainly focus on travel and short visit support—not on research grants.

The newly established Polish Society for Information Technology edits a monthly bulletin in which it outlines the strategy for revitalizing computer science in Poland by close ties with the computer industry, especially in the area of software services. The lengthy document describes in detail the proposals for development of information technology in Poland. Timeliness does not allow me to further elaborate on the issue. There is definitely an interest on the part of this society in incorporating Poland into the EC and U.S. research communities, so joint grants with NSF and others are of interest. Exchange of faculty is a form already practiced. Exchange of students and faculty frequently ends up to be "a brain drain;" many of them simply do not return. Until the situation in Poland changes for the better, this process will continue.

Laboratories here are generally equipped with IBM clones, SUN workstations, and some parallel computers, IBM mainframes, and VAXes. Among several interesting projects, I was most surprised to see a Pascal translator developed for the Array String Processor. This project from Brunel University (London) is supported by the U.S. Navy and the U.S. Air Force Rome Laboratory, and is, I believe, already installed in some systems. Dr. Chrzastowski of the University of Warsaw told me that there would be no problem in extending the translator to support Ada and Fortran. This translator converts the high-level language program in the ASP language, which, in turn, is compiled to produce machine-executable code.

WORKSHOPS

There is great interest on the part of computer science leaders in organizing top-quality workshops in all three of their countries. I was quite pleasantly surprised when Polish scientists suggested the organization of a workshop on Models for High Performance Computing, with special emphasis on concurrency.

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This topic coincided with my presentation in Washington D.C. during the ONR Computer Science Program review on January 30, 1992, in which I noted that models seem to be a major bottleneck in development of high-performance computer systems! (Such systems are the core of the recent Presidential Initiative on High Performance Computing and Communications.) The gain to U.S. computer science would be large if such a workshop were to be implemented. The workshop will be organized by Prof. A. Mazurkiewicz and myself with possible participation of Professors Chandy (Cal Tech), Valient (Harvard University), Snyder (University of Washington), Hoare (Oxford University) and others. Many of them are ONR contractors. Tentatively we discussed that the workshop could be held in the third week of November (Nov. 16-18, 1992) in Warsaw. This might be coupled with other related events.

Another workshop, suggested by Hungarian colleagues, also fell into computer design methodology and would form an excellent sequel to the one in Poland. It would be on Algorithms and Architectures for High Performance Computing. The date should be coordinated with related events that will take place in Europe. The timing for this workshop should be Spring or Fall 1993, and the site would be Budapest.

I also think that it would be worthwhile to organize a workshop on Instrumentation for computer systems as this topic is also quite advanced in Hungary; U.S. and Hungarian scientists could benefit from the exchange.

To complete the series, I suggested Applications Semantics for High Performance Computing as a topic for the third workshop. This topic is futuristic and at the moment has very few experts. I think it could be a booster for people who are interested in pursuing this area in Czechoslovakia. It is a crucial area that we also have to stimulate in the U.S. to succeed in supercomputing. This workshop would take place in Prague in the fall of either 1993 or 1994. It could be a strong positive influence on U.S. thought on this topic.

There was also a big interest in organizing a Fourth International Workshop on Responsive Computer Systems, to take place in October 1994. There is a high level of expertise in fault-tolerant computing in Czechoslovakia, a topic inherent to responsive systems and to ONR/US programs.

In summary, an outline of plans for potential workshops is as follows:

Title	Location	Date
Models for High-Performance Computing (HPC)	Warsaw	Fall 1992 or Spring 1993

Algorithms and Architectures for High-Performance Computing	Budapest	Spring cr Fall 1993
Applications Semantics for High-Performance Computing	Prague	Fall 1993 or 1994

Additional Workshops:

Instrumentation for Computer Systems	Budapest	1993/4

   (could also be called Instrumentation for High-Performance
   Computer Systems)

Responsive Computer Systems	Prague	October 1994

The cost of each workshop would be about $5-15K.

Dr. J. Gorski from the Technical University of Gdansk in Poland also requested additional support for SAFECOMP '93, an international conference on computer safety, reliability, and security, which is scheduled take place in Gdansk, Poland on October 27-29, 1993.

I am convinced that the suggested workshops would not only accelerate research and development of high-performance computing but would also have an impact on the ONR presence in Europe and on the development of new, exciting relations between U.S. and Central European computer scientists.

I recommend that the subjects and dates of the potential workshops be seriously considerd and planned for.

CONCLUSIONS

The situation in Central Europe, viz., Czechoslovakia, Hungary, and Poland, ranges from catastrophic to mildly optimistic. There is no doubt that years of effort and accomplishments must be preserved and reinforced. There is also no doubt that scientists in Czechoslovakia, Hungary, and Poland, with proper focus, stimulation, and funding, will significantly contribute to the world's computer science.

World-class research is already underway in the region in areas of formal methods, algorithms, software semantics, concurrency, reliability, fault-tolerant computing, simulation and instrumentation. Needs are mainly related to the interchange of ideas and closer ties with international science. They would be welcome. The computer industry is in trouble; perhaps a gradual switch to software research will alleviate the effects of this collapse. Each country has some specific ideas on how to proceed. One common theme is obvious: cooperation and encouragement from the U.S. would be of great help and welcomed,

even without any substantial financial assistance.

I personally believe that starting some cooperative and/or interactive research programs would not only help researchers to persevere during there turbulent times of political and economic change, but they would also would be of significant benefit to the U.S. and to computer science.

Let me describe one such idea. Based on the French involvement in Poznan and the outlook for human resources (both referred to above), I discussed possibilities with Polish colleagues of opening an "American University in Warsaw" that would serve all of Central Europe, the Former Soviet Union, and would probably attract a number of American and West European students because the education at such a university would be in English. This type of university would allow faculty to have competitive salaries, attract the best talent, and prevent the destruction of the existing structure. This idea will take strong efforts, coordination, and perhaps fervor. Of course, this is a large and special sort of effort, perhaps best considered at the highest levels of U.S. R&D planners.

Various alternatives are available that I think could have a tremendous impact on the American presence in this part of the world. There is a fundamental difference now in these countries. In the past there was not even hope; now with the new freedom comes hope (of becoming an EC member, of better times for personal growth, and of better times for science). This hope should be nourished and supported in small ways by promoting the exchange of faculty and students and by sponsoring workshops and small grants. It can also be done in bigger ways such as research initiatives and perhaps even by more ambitious efforts.

The potential is there. I propose that individual investigators, professional societies, government agencies, and planners rise to the challenge of the times by considering these suggestions.

Appendix A

Computer Science/Computer Engineering:

CZECHOSLOVAKIA

List of Projects

Prof. Ing. Jan Hlavicka, DrSc.:   Design of BISTE for ASIC's

Doc. Ing. Michal Servit, CSc.:   Formal Specification and
                                   Verification of ASIC's

Doc. Ing. Frantisek Plasil, CSc.:   Concurrency - Languages and
                                     Architectures
Prof. Ing. Jan Hlavicka, DrSc.:   Functional Verification of
                                   Fault-Tolerant Systems software
                                   through Simulation

Doc. Ing. Frantisek Vejrazka, CSc.:   Development of CNS Systems

Doc. Ing. Borivoj Melichar, CSc.:   Attribute Grammars (brief
                                     information)

Ing. Vladimir Kucera, DrSc.:   Data and Information Processing for
                                Decision Support in Planning and
                                Control of Continent-Wide Pipeline
                                Networks for Gas Transport and
                                Distribution

Ing. Pavel Kovanic, CSc.:   Gnostical Software for Robust Analysis
                             of Uncertain Data, Robust Filtering,
                             Robust Estimation and Identification

Ing. Igor Vajda, DrSc.:   Statistical Inference and Information in
                           Large Stochastic Systems

Ing. Jaroslav Dolezal, CSc.:   Computer-Aided Analysis and
                                Optimization of Nonlinear Dynamical
                                Systems

PROJECTS

Design of BISTE for ASIC's

Head: Jan Hlavicka

The project aims at investigation of efficient algorithms of
pseudo-exhaustive test pattern generation which can be easily
implemented within the ASIC VLSI designed at Dept. of Computers

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within the CAD Project. The problem of TPG complexity area as

compared with the test set coverage is to be solved on the basis of permutation matrices attached to LSFR's. The controller design will be considered as well.

Research team: Jan Hlavicka (head), Petr Slaba, Petr Brnak

Prof. Ing. Jan Hlavicka, DrSc.

Research Interests: Fault-tolerant computing, diagnostics of digital circuits and systems, design for testability, BISTE, parallel system architectures, parallel algorithms, computer performance evaluation.

Professional activities: Corresponding member of IFIP Working Group 10.4 on Dependable computing and fault tolerance. Chairman of IMEKO Czechoslovak National Committee. Czechoslovak delegate to IMEKO General Council, member of IMEKO Technical Committee TC-10 on Technical diagnostics. Co-founder of international conference Fault-Tolerant Systems and Diagnostics (FTSD), conference chairman in years 1979, 1981, 1983, 1986 and 1989. Chairman of professional group "Diagnostics in electronics" of Czechoslovak Scientific and Technical Society.

Main publications:

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Formal Specification and Verification of ASIC's

Head: Michal Servit

The project aims at investigation of efficient VLSI circuit

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specification based on deep knowledge and knowledge engeneering
methods. The use of deep knowledge (i.e. a small set of abstract
terms that lay behind the term used in IC engineering) can
provide a firm basis for integating various knowledge sources
(e.g. behaviour, timing, structure, schemata etc), for comparison
and verification and – in future – for automated synthesis. The
conceptual structures of Sowa are planned for knowledge
representation. As these structures have a close relationship to
logic, the methods of verification based on formal logic concepts
will be considered as well. The existing hardware description
tools will serve as source of conceptual analysis together with
contributions from linguistics (R. Jackendoff).

Research team: Michal Servit (head), Jan Hlavicka, Jan Schmidt,
Jan Zamazal, Karel Richta, Petr Zemanek

Doc. Ing. and Michal Servit, CSc.

Research Interests: CAD in electronics, VLSI design, graph
theory, automata theory, heuristic algorithms, combinatorial
optimization, formal specification and verification.

Professional activities: Member of the Scientific Council,
Faculty of Electrical Engineering. Correspondent of EUROMICRO
Board. Member if IFIP National Comitee. Member of IFIP TC-10
Comitee. Member of the Council of the Czechoslovak Scientific and
Technical Society, Faculty of Electrical Engineering.
Member of IEEE.

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Servit, M., Schmidt, J.: Strategy of One-And-Half Layer Routing. Microprocessing and Microprogramming, Vol.32, No.1, 1991, pp.417-424.

Servit, M., Zamazal, J.: Binate Covering Problem. Research Report DC-91-05, Dept. of Computers, CTU, 1991, 46pp.

Richta, K., Nesvera, S.: The Abstract Rewriting Machine. Research Report DC-91-04, Dept. of Computers, CTU, 1991.

Danecek, J., Nesvera, S., Richta, K.: Parallel Rewriting. Proc. SOFSEM'91, Jasna pod Chopkom, Masaryk University of Brno, 1991.

Schmidt, J., Kocura, P.: Open Systems Toward Synergy in Conceptual Graph Processor Construction. Proc. of 6th Annual Workshop on Conceptual Graphs, Binghampton, USA, 1991, pp.305-315.

Servit, M., Zamazal, J.: Heuristic Approach to Binate Covering

Problem. Proc. EDAC'92 Conference, Brussels, 1992, pp.123-131.

Address: Michal Servit, Czech Technical University, Dept.of
Computers, Karlovo namesti 13, CS - 12135 Praha, Czechoslovakia
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****

Research area: Concurrency - Languages and Architectures

Head: Frantisek Plasil

Research fields:

    - Object-oriented paradigm in programming and specification
    languages with concu operating systems; design and
    implementation of integrated programming environme
    developing parallel algorithms (embedding proposed topology
    into given multiproc
    distributed debugging tools, etc);
    - Paradigms of operating systems for multiprocessor
    architectures (hypercubes, m Kautz digraphs, etc.)
    - Design and implementation of parallel programming
    languages based on nonimpera (data-flow, logical inference,
    object-object-based semantics);
    - Algebraic models of concurrency, extensions to known
    approaches, extension to based specification languages
    allowing for truly indirect addressing;
    - Design and analysis of parallel algorithms for distributed
    memory on multiproc and Kautz networks

Head of the research team:

Plasil Frantisek, Dr., Associate Professor

Research interests:

Current: Object-oriented paradigm in languages with concurrency
and in operating

Recent: Operating Systems, languages with concurrency. Taking
part in several co including an Ada compiler.

Professional Activities:

Member of the Advisory Board to the ACM Committee for Central and
Eastern Europe

Member of the Programm Committee of the SOFSEM conference,
Member of the Programm Committee of the Modern Programming

Conference

In the period 1989 - 1991 visiting associate professor at the
University of Denv Comp. Sci., USA

Members of the research team:

Korbar Frantisek, Dr. Assistant Professor
Research interests:
Models of concurrency CCS, CSP, author of the Structural theory
of Concurrency.

Tvrdik Pavel, Dr., Assistant Professor
Research interests: Application of graph theory in multiprocessor
architectures

Professional Activities:

In the period 1988-1989 research stay at the Shinshu University,
Japan

Zemanek Petr, Dr., Assistant Professor

Research interests: Probabilistic models of concurrency,

Programming transputer

Professional Activities:

In the period Aug.1991 - Jan.1992 Research Stay in the Institute
National des Te Evry, France
Bartos Radim, PhD Student
Currently continuing his Phd study in the U.S.A.

Research Interest: Specification Languages for Concurrency with
special respect language.

Current Research of the team:

Study of the Object-Oriented paradigm in parallel programming and
specification 9X, Beta, Lotos, extended Z-Schemes), Algebraic
models of concurrency, process a problems of embedding different
architectures into hypercubes. Study of networks

Research results:

The research results have been published in the following

publications:

Muller, K., Plasil, F., Vladik, J.: Programming Language Ada, SNTL Prague, in print

Plasil, F.,Staudek, J.: Operating Systems, SNTL Prague, in print, (in Czech)

Plasil, F., Korbar, F., Vlachovsky, V.: Peripheral Drivers' Concepts, in: SOFSEM'89, (in Czech)

Plasil, F.: Object Oriented Programming, in SOFSEM'91

Plasil, F.: Taxonomy of Peripheral Drivers, CS Seminar, Dept. of Math & Comp. Sci. University of Denver, 1990

Korbar, F.: Structural Theory of Concurrency, PhD Thesis, CTU Prague, 1989

Korbar, F.: A Parallel Composition of Regular Processes in CCS. Presented at the Models of Concurrent Computations. Telavi, Georgia, USSR, 1989.

Korbar, F.: A Structural Theory of Concurrency. A short contribution at the Inter School "Logic and Algebra of Specification". Marktoberdorf, Germany, 19

Tvrdik, P.: Embedding some Trees into Hypercubes. In: proceeding of the 11th sym applied Func. Analysis, Science Univ. of Tokyo, Noda City, Chiba, Japan

Tvrdik, P.: On Hamiltonian Circuits, Paths and Spanning Trees of Hypercubes. In: Parallel computing 89, North-Holland, Amsterdam, 1990

Tvrdik, P., Nakamura, Y.: Embedding Paths and Circuits into the Hypercubes. Journal of Engineering, Shinshu Univ., Vol.65, No1

Tvrdik, P.: Spanning Subgraphs of Hypercubes. PhD Thesis, TU Prague 1991

Zemanek P.: Probability Model of Concurrency, PhD Thesis, TU Prague 1990

Zemanek, P., Korbar, F.: Models of parallel processes In: Proceedings of the Summer School "Parallel Algorithms and Architect Academy of Science 1989 Bratislava, UTK 1988.(in Czech)

Zemanek, P.: Parallel Processes with Random Behaviour Acta Polytechnica, 1990, III, 2, pp.33-50.

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Zemanek, P.:   Standards of Protocols in LAN PC. Ceskoslovenska
standardizace, 1990, 15, 4, pp. 127-131.

Zemanek, P.:   Probabilistic Concurrent Processes and their
Application in reliability In: Reliability 1990 (Conference
proceedings)

Bartos, R.:   Specification Languages LOTOS and LINDA, their
strengths and limits of Math and Comp. Sci, University of Denver.

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Themes of Research:

FUNCTIONAL VERIFICATION OF FAULT-TOLERANT SYSTEMS SOFTWARE THROUGH SIMULATION

The Head of the Research Team:

JAN HLAVICKA
Czech Technical University, Department of Computer Science

1) Introduction

Verification of dependability is one of the most important
steps in the design of a fault-tolerant system. This includes
verification of software, especially the system's reaction to the
faults and real-time inputs from its environment. Finding an
appropriate verification method may save a considerable amount of
time, expenses and manpower, therefore it is paid an ever-growing
attention.

A broad spectrum of methods have been suggested so far. On
one side of the spectrum there are exact mathematical methods
using the specification of the system under design to perform the
formal proof of its correct function. The opposite extreme with
in the choice of verification methods is the purely experimental
approach which is based on a statistical or deterministic testing
of the software products on existing hardware of the system.

2) Suggested methods

The suggested method is based on the discrete simulation and
assumes a partial verification of correct function of a
fault-tolerant system software before the system under design is
physically implemented. The considered method of simulation
should facilitate to join models of computational processes with
the model of environment and a process of fault injection. There
is also a possibility of validation (e.g. the timing) of
different algorithms chosen for specific system functions like
programmed voting, synchronization, reconfiguration, etc. We

shall consider above all the application of the fault-tolerant systems to the control and monitoring of real objects and processes. Their typical structure is mostly N-modular redundant, composed of loosely synchronised microcomputer modules with software checking of correct function. However, the method considered to examine is general enough and its application is by no means limited only to the mentioned class of fault-tolerant systems.

The main problem is to minimize the difference between the tested and really utilized version of the system software. It will require an investigation as for the methodology of modeling and the construction of suitable software tools. The software tools for simulation-based verification should be created in the same language as the tested software.

3) Successive goals and stages of the research

a) The implementation of C (and C++) based simulation tool (first version of such a tool has been already created and can be utilized in order to gain a preliminary experience)

b) The investigation of the modeling methodology. It includes for example the following partial problems:
- the necessary degree of similarity between a tested and final form of cooperating computational processes
- the taxonomy of faults whose influence can be tested
- deterministic testing of the reaction to malicious faults
- deterministic testing of the reaction to a sequence of near-coincident faults
- statistical evaluation of the system behavior under a stochastic stream of non-malicious faults

c) The analysis of properties of convenient simulation tools for the ADA-based FT software, an optional design of such a tool (it can run in parallel with the b) stage).

d) The simulation-based verification of the control software of a chosen fault-tolerant system(s), presentation of results.

Members of the research team:

JAN HLAVICKA

Professor at Czech Technical University in Prague, Dean of the Faculty of Electrical Engineering, member of the Department of Computer Science. His research interest includes architecture of computer systems, methods of diagnosis digital-based electronic equipment, architecture and design of fault-tolerant systems.

STANISLAV RACEK

Associated professor at the University of West Bohemia in
Pilsen, member of the Department of Computer Science. His
research interest and experience is in the area of performance
and reliability modeling of computer systems, digital simulation
methods and real-time programming.

PAVEL SMRHA

Research worker in the Laboratory of Computer Systems at the
University of West Bohemia in Pilsen. His research interest
includes distributed computing, computer networks and
communication software, algorithms to achieve an agreement in
distributed environment in the presence of faults.

PAVEL HEROUT

Assistant lecturer at the University of West Bohemia in
Pilsen, member of the Department of Computer Science. He is
teaching Programming Languages and Software engineering.

The team can be extended with members from both universities in
Prague and in Pilsen and with doctorate students as well.

Racek S.: Design of the Kernel of symmetric multiprocessor
system, PhD. thesis, Institute of Technology in Pilsen, 1979

Racek S., et. al.: RTI80 - Real-time operating system for I8080
based microcomputers. 1983-1984, internal research reports of
SKODA Plzen Company

Racek S., Herout P.: RTI86 - Real-time operating system for
I8086 based microcomputers. 1984-1985, internal research
reports of SKODA Plzen Company

Racek S., Herout P., Vais V.: Software tools for BITBUS-based
local area networks, 1986-1988, research reports of SKODA Plzen
Company and Institute of Technology in Pilsen

Racek S.: Reliability models of FT computers systems. Research
report ofInstitute of Technology in Pilsen no. 209-26-85, Nov
1985

Jezek K., Racek S., Rychlik J.: Simulation of distributed
control systems. Research report of Institute of Technology in

Pilsen no. 209-07-85, Jun. 1985

Kocur P., Novacek J., Racek S.: A survey of architectures of distributed control systems. Proceedings of conf. Mikrosystem, Tabor, Oct. 1985, pp. 194-203

Racek S., Kocur P.: Sensitivity analysis of reliability parameters. Proceedings of conf. FTSD, Brno, Jun. 1986, pp. 97-101

Smrha P., Kocur P., Racek S.: A reliability model of LAN with doubled serial bus. Automatizace, Vol. 30, 1986, no. 6, pp. 159-162

Racek S., Smrha P.: Markov Reliability Model Generation Based on Components Behavior Description. Proceedings of conf. FTSD, Praha, 1989, pp. 122-125

Hlavicka J, Racek S.: Reliability model of an airborne computer. Seminar on reliability and Diagnosis, Zvikov, Apr. 1990

Racek S., Herout P.: C-Sim, C-based simulation tool. research report of University of West Bohemia, Dept. of Computer Science, Jun. 1991

Hlavicka J, Racek S., Golan P., Blazek T.: FT computer systems, Czech Technical Univ. publ. comp., prepared for year 1992

Racek S., Herout P.: RTI86 - Real-time operating system for I8086 based microcomputers. 1984-1985, internal research reports of SKODA Plzen Company

Racek S., Herout P., Vais V.: Software tools for BITBUS-based local area networks, 1986-1988, research reports of SKODA Flzen Company and Institute of Technology in Pilsen

Racek S., Herout P.: C-Sim, C-based simulation tool. research report of University of West Bohemia, Dept. of Computer Science, Jun. 1991

Herout P.: MS-DOS for practical utilization ver. 3.30, KOPP publ. comp., 1991

Cerny V., Herout P.: MS-DOS for practical utilization ver. 5.0, KOPP publ. comp., 1992

Herout P, Rudolf V., Smrha P.: ABC of Programmer in the C Language (ANSI C, Borland C and C++), KOPP publ. comp., 1992

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Development of CNS systems

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Mr. F. Vejrazka is the head of the Group for Radio Signals and Systems at The Department of Radio Engineering of The Czech Technical University of Prague. He lectures on communication and navigation, and his group has developed the GPS receiver in the last few years. Results of their R&D are used by Czechoslovak industry. Mr. Vejrazka and his team published about 100 works (articles, research reports); some of the most recent are in English. Two members of the team and Mr. Vejrazka stayed in London with Inmarsat and solved such problems as performance of the Inmarsat-M offset QPSKmodem, global differential GPS corrections and performance of GPS supported by Inmarsat satellites.

Currently they are engaged in activities connected with differential GPS and especially with global corrections, indevelopment of the GLONASS receiver and in issues with integrity of satellite navigation. List of selected papers and research reports:

[1] Vejrazka,F.; Hrdina,Z.; Nagle,J.: Performance of GPS supported by Inmarsat satellites. In: NAV91, Satellite Navigation. The Royal Institute of Navigation, London, 1991.

[2] Sykora,J.: Bit error rate performance of F-O-QPSK modem with convolutional coding in AWGN and Ricean fading channel. [Inmarsat technical report, rev.1.1.] London, Inmarsat 1991.

[3] Sykora,J.: Performance analysis of decision directed carrier tracking loop for offset QPSK modulation. [Inmarsat preliminary technical report, rev.1.0.] London, Inmarsat 1991.

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[4] Vejrazka,F.: Provisional Report on GPS Signal Coverage supported by Inmarsat-3 overlay. [Prepared for LM&SS Division, Inmarsat, London.] London, Inmarsat 1991.

[5] Vejrazka,F.: Method for optimization of processing of radar signals. (In Czech). Slaboproudy obzor,34, 1973, No.8, pp. 354-359.

[6] Hrdina,Z.; Vejrazka,F.: Phase corrections in Omega Navigation System. (In Czech) Slaboproudy obzor,48, 1987, No.11, pp.502-510.

[7] Hrdina,Z.; Vejrazka,F.: Linear filtration. (In Czech) Slaboproudy obzor, 51, 1990, No.1,pp.12-19.

[8] Vejrazka,F.: Satellite navigation. (In Czech) Letecky obzor, 33, 1990, No.1, pp.18-21.

[9] Vejrazka,F.: Satellite navigation systems. (In Czech) Letecky obzor, 33, 1990, No.2, pp.45-48.

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Research topics

Head: Borivoj Melichar

The history of our Research Group started in 1965. Compilers of ALGOL 60 and FORTRAN IV were implemented that time. They were used in many spots in Czechoslovakia and former East Germany. Compilers of Pascal for various architectures of computers (incl.8-bits) followed. Recently a compiler of CHILL (programming language for telecommunication) has been implemented.

It was soon realised, that compilers are very complex systems and that systematic research in that field should be done. This research started in the early 70's and led to a series of original results which are apparent from the list of publications of the current members of the Group below.

One of the interesting results of the research was the fact, that the methods of translation used in compiler writing could be used in many other branches involving trasformation of structured data. Data compression could serve as a typical example of such area.

Our Research Group has some contacts with abroad universities. As a result of these contacts, summer school called "Attribute Grammars, Applications and Systems" took place in Prague, Czechoslovakia in June 1991.

The topics studied by the Research Group include:
1) Attribute evaluation during LR analysis. Two approaches are studied, that are applicable for a large scale of L-attributed grammars.
2) Conditional attributed grammars. Conditional attributed grammars form the basis for an experimental compiler constructor called "ATRAG".
3) Concurrent methods of data transformation. Methods of concurrent translation, attribute evaluation and term rewriting are studied.
4) Methods of data transformation in data compression. This areahas been studied recently and promises to bring some new results.

List of current members of the Group:
Melichar Borivoj, Dr., Associate Professor

Professional activities:
    Head of the Department of Computers.
    Member of program committee of seminar Modern Programming.
    Member of Czechoslovak Society for Computer Science.
    Member of Czechoslovak Scientific and Technical Society.

Research interests:
    Programming languages, formal languages, grammars and
    automata, compiler construction.

Main publications:
Melichar, B.:   Evalution of attributes during LR syntax analysis.
          In: Vortrage des Problem seminars Attributierte
                Gramatiken und ihre Anwendungen, Pruchten. WPU
                Rostock (1984), pp.
Melichar, B.:   Attributed translation directed by LR parser and
                its implementation. In: Compiler-compilers and
                their use. Akademie der Wissenschaften, Bautzen,
                NDR (1986), pp.
Melichar, B.:   Strong LR grammars. In: Compiler-compilers and
                high speed compilation. Akademie der
                Wissenschaften, Berlin (1988).
Molnar,   L.:   Ceska, M.- Melichar, B.: Grammars and languages.
                ALFA, Bratislava (1987), (in Slovak).
Melichar, B.:   Structural translations. Publishing House of
                Czech Technical University, Prague 1989, (in
                Czech).
Melichar, B.:   Syntax sensitive editor. Research report, Prague
                1989, (in Czech).
Melichar, B.:   Sommer, T.: Implementation of regular expressions
                language. In: Modern programming MOP'89, Vinn26
                1989, (in Czech).
Melichar, B.:   Introduction to compilers, Publishing House of
                Czech Technical University, Prague 1889, (in
                Czech).

Melichar, B.:   Structural and logic programming. In: Modern
                programming MOP'90, Valkov 1930, (in Czech).
Melichar, B.:   Incremental LL parsing. In: Compilers'90.
                Czechoslovak Scientific and Technical Society,
                Faculty of Electrical Engineering, Czech
                Technical University, Prague 1990.
Melichar, B. op den Akker, R. Tarhio, J.: The hierarchy of LR
                attributed grammars. In: Proceedings of the
                Workshop on attribute grammars and their
                applications, Paris 1990.
Melichar, B. op den Akker, R. Tarhio, J.: Attribute
                evaluation and parsing. SAGA, Praha, June 1991.
Alblas, H., Melichar, B.: Attribute Grammars, Applications and
                Systems. International Summer School SAGA,
                Prague, June 1991, Springer-Verlag 1991.
Melichar, B.:   Formal Translation Directed by LR Parsing. In:
                Kybernetika, vol. 28, no. 1, pp. 50-61, 1992.

MULLER Karel, Dr., Associate Professor

Professional activities:
    Member of the Commitee of Czechosloval. Society for Computer
    Science.
    Member of Czechoslovak Scientific and Technical Society.

Research interests:
    Programming languages, grammars and automata, compiler
construction.

Main publications:
Jinoch, J., Muller, K., Vogel, J.: Programming in Pascal.
                Prague, SNTL 1984, 1986, 1989, (in Czech).
Muller, K., Richta, K.: Modular and Object Oriented Programming.
                MAA 1989, (in Czech).
Muller, K., Danecek, J.: System FEL-CHILL. In: Compilers'90.
                Czechoslovak Scientific and Technical Society,
                Faculty of Electrical Engineering, Czech
                Technical University Prague 1990, (in Czech).
Danecek, J., Muller, K., Santus, A.: Introduction to
                FEL-CHILL, Language Description. Faculty of
                Electrical Engineering, Czech Technical
                University Prague 1990.
Muller, K.: Programming and Compilers I. Publishing House of the
                Czech Technical University Prague 1990, (in
                Czech).

RICHTA Karel, Dr., Associate Professor

Professional activities:
    Member of Czechoslovak Society for Computer Science
    Member of Czechoslovak Scientific and Technical Society.
Research interests:

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Algebraic specifications, term rewriting systems, software technology and prototyping, CASE.

Main publications:

Richta, K.: The Abstract Data Types and Their Implementation, PhD. thesis, Czech Technical University, Faculty of Electrical Engineering 1980, (in Czech).

Richta, K., Sima, S.: Algebraic Specifications. Proc. SOFSEM'83, VVS+UJEP 1983, (in Czech).

Richta, K.: Mathematical Theory of Computing. Publishing House of Czech Technical university, Prague 1987 (in Czech).

Richta, K., Slavik, P., Polak, J.: Computer and Programming II. Publishing House of Czech Technical University, Prague 1988, (in Czech).

Muller, K., Polak, J., Richta, K.: Comparison of Modular and Object Oriented Programming. Proc. SOFSEM'88 VUSEI-AR+UJEP Malenovice 1988, (in Czech).

Muller, K., Richta, K.: Modular and Object Oriented Programming. MAA 1989, (in Czech).

Richta, K.: Data Structures. Publishing House of Czech Technical University, Prague 1989, (in Czech).

Richta, K., Bruha, I.: From An Algebraic Specification to An Executable Program. McMaster Technical Report 90-09, Hamilton, Canada 1990.

Richta, K., Nesvera, S.: The Efficient Implementation of Term Rewriting. In: SOFSEM'90, Janske Lazne 1990, (in Czech).

NESVERA Simon, Assistant Professor

Research interests:
Term rewriting systems, algebra, prototyping, semantics, programming languages.

Main Publications:

Nesvera, S., Richta, K.: Program Development from Algebraic Specification, Poland-Germany-Czech Seminarium on Computer Science, Temesvar 1987

Nesvera, S.: AC Unification. In: SOFSEM'88, Beskydy 1988, (in Czech).

Richta, K., Nesvera, S.: Efficient Implementation of Term Rewriting Systems. In: SOFSEM'90, Janske Lazne 1990, (in Czech).

Muller, K., Nesvera, S.: Computers and Computing II. Publishing House of Czech Technical University, Prague 1990, (in Czech).

Nesvera, S., Richta, K.: The Abstract Rewriting Machine. In: LOP'91, Ruprechtov 1991.

Danecek, J., Nesvera, S. - Richta, K.: Parallel Term Rewriting. In: SOFSEM'91, Nizke Tatry 1991.

PAVLU Petr, Assistant Professor

Research interests:
     Languages, syntax, semantics, compilers, compiler writing systems, text processing.

Main publications:

Pavlu, P.: Error recovery in bottom-up parsing. Diploma Thesis, Czech Technical University, Prague, 1988, 88 pp. (in Czech).

Pavlu, P.: Incremental LR(k) parsing. In: Proceedings of "Compilers '90", Czechoslovak Scientific and Technical Society, Prague, 1990 (in Czech).

Pavlu, P.: Another way to evaluate attributes in parallel with LR parsing. Research Report DC-90-03, Department of Computers, Czech Technical University, Prague, 1990, 28 pp.

Pavlu, P.: An Efficient Attribute Evaluation Method for All L-Attributed LR Grammars. Memoranda Informatica 91-37, University of Twente, Enschede, the Netherlands, 1991, 37 pp.

Pavlu, P.: An Optimized Attribute Evaluation During LR Parsing. Preliminary thesis for Ph.D., Department of Computers, Czech Technical University, Prague, 1991, 19 pp.

Pavlu, P.: On efficient implementation of LR-attributed grammars. Information Processing Letters, Vol. 41, No. 2, 1992, pp. 57-75.

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DATA AND INFORMATION PROCESSING FOR DECISION SUPPORT IN PLANNING AND CONTROL OF CONTINENT-WIDE PIPELINE NETWORKS FOR GAS TRANSPORT AND DISTRIBUTION.

(EXTENDED VERSION)

****** **WHAT HAS BEEN DONE** *****

Two program packages have been finished: SIMONE-G/S for steady state modelling, and SIMONE for simulation of transients. They both allow modelling networks that consist of all possible technological equipment in any number and configuration. Besides its basic function -- the state reconstruction and the simulation of dynamic processes -- SIMONE features a set of simulation related functions, some of them being unique: Identification and correction of systematic errors of flow rate and pressure meters (self-calibration) making all the data-based subsequent operations (state reconstruction, simulation, quality tracking, leak detection) more precise, sensitive and reliable [3], [4].

Our concept of modelling the compressor stations is very
universal: any series-parallel combination of machines of any
types equipped by coolers, is allowed. Moreover, it is supported
by a system for checking the feasibility of the internal
configuration [11], [4]. The definition and control of
simulationruns is realized by a set of statements. Among these,
a specific meaning and position has the conditioned statement,
[4]. It allows defining a logical variable the value of which is
checked during the simulation run. According to the result some
other statement(s) come in force. This effective tool is briefly
described in [15].

There is a kind of tasks (planning, development, repairs, etc.)
for which the simulation runs are needed over long periods of
time. To this end, an experimental environment has been
developed which allows the user to make simulation runs even up
to one year.

Tools for tailor-made design of metering dislocation, optimum
from the leak detection viewpoint.

Leak detection system for on-line identification and monitoring
of leaks.

For systems supported by gases of different quality, the quality
trackingsystem has been developed [4] which allows to model the
penetration of gases over the network, their spontaneous mixing
and the quality of gas in all respective off takes.

SIMONE is currently running on-line in the routine daily gas
transport control at Transgas, Prague [1] and at RUHRGAS A.G.,
Essen [14].

The best available detailed and comprehensive information about
practical aspects of all SIMONE simulation functions, as well as
about all extended features, can be found in [4]. This book can
be ordered at LIWACOM GmbH, Huyssenallee 15, 4300 Essen1,
Germany. The theoretical background is described in [6], [7],
[8], [10].

***** WHAT WE ARE ACTUALLY WORKING ON *****

Our goal is to work out a control designer --- a set of method
and means for continuous generation of an ahead (optimum)
operating plan applicable for large-scale networks. Two main
conditions will be respected:

the operating plan must be generated under the condition of
incessantly transient state of the control system; the method
must be flexible in defining the performance index to be
applicable under different technical and economic conditions.

The control designer is planned to be used in an on-line

installation, no matter whether its results will be realized by an automatic control system or applied by the dispatcher.

The task outlined above leads to optimization of a large-scale dynamic system subject to control, state-space and mixed state-control constraints. The solution must be developed under the following conditions:

stiffness and sparsity of the dynamic system; large number of state variables (thousands); large number of control variables (hundreds); large number of constraints including nonlinearities as well as simple lower and upper bounds; consistency of the constraints is not guaranteed; the objective is a sum of a large number of nonlinear terms; the reliability of the resulting algorithm must be very high to allow the on-line application of the system.

The applicability of the results in practice requires a relatively short time of computation and an acceptable memory demands. Also the nonconsistent constraints have to be appropriately handled.

To satisfy these conditions, the specific structure of the problem will be taken into account providing us with various possibilities of primal and dual decompositions and augmentations of the constraints to the objective. We shall also take advantage of our methods and algorithms for mathematical and simulation modelling of large scale networks.

The method to be developed for optimal control will be based on the nonlinearprogramming and adapted to the above specified requirements.

***** FUTURE INTERESTS *****

The extent of continent-wide network will be the main problem in the implementation and use of algorithms for decision support. We think that the next several ways should be followed to overcome these complications:

Parallel processing or another novel computer architecture.

Development of a method based on the input/output data aggregation and processing, with the aim to get synoptical image for decision making.

The i/o sensitivities for ''large distances'' in a pipeline network are weak and negligible. To use this fact for effective simulation and control of large scale systems, we propose to adopt methods for decentralized robust control[2], [12], [13].

To reduce the extent of the network described, a study is planned

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to analyze the possibilities and effects of offtakes aggregation, elements aggregation, parallel lines substitution etc..

Model based procedure and testing of global profit distribution with respect to local (national) policies. (Conflicts of interests, stability, technical and economy growth, etc..)

****** TO BE DONE *****

A control designer for continuous generation of an ahead (optimum) operating plan applicable for large-scale pipeline networks. Two main conditions will be respected:

the operating plan must be generated under the condition of incessantly transient state of the control system; the method must be flexible in defining the performance index to be applicable under different technical and economic conditions.

The control designer is planned to be used in an on-line installation, no matter whether its results will be realized by an automatic control system or applied by the dispatcher.

***** MAIN STEPS OF SOLUTION *****

Parallel processing or another novel computer architecture. Development of a method based on the input/output data aggregation and processing, with the aim to get synoptical image for decision making.

The i/o sensitivities for ''large distances'' in a pipeline network are weak and negligible. To use this fact for effective simulation and control of large scale systems, we propose to adopt methods for decentralized robust control.

To reduce the extent of the network described, a study is planned to analyze the possibilities and effects of offtakes aggregation, elements aggregation, parallel lines substitution etc..

Model based procedure and testing of global profit distribution with respect to local (national) policies. (Conflicts of interests, stability, technical and economy growth, etc..)

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***** CURRICULA VITAE OF THE MAIN INVESTIGATORS *****

V. Kucera was born in Prague, Czechoslovakia in 1943. He studied
at the Czech Technical University, Prague, where he obtained the
Ing. degree(Electrical Engineering) with distinction in 1966.
Soon after, he joined the Czechoslovak Academy of Sciences, where
he received the CSc. and DrSc. degrees (Control Science) in 1970
and 1979, respectively.

Since 1967, Dr. Kucera has been with the Institute of Information
Theory and Automation, one of the research institutes of the
Czechoslovak Academy of Sciences in Prague. He held various
research positions and he is currently Director of the Institute.

Dr. Kucera held visiting positions at the National Research
Council, Ottawa, Canada in 1970/71; at the Center for
Mathematical System Theory, University of Florida, Gainesville,
USA in 1977; at the Laboratiore d'Automatiqu ENSM, Nantes, France
in 1981/82; at the Research School of Physical Sciences,
Australian National University, Canberra, Australia in 1984; at
Teknikum Uppsala University, Sweden in 1989; at the Centro de
Investigacion y de Estudios Avânzados del IPN, Mexico City in
1991 and a number of short visiting appointments.

The research interests of Dr. Kucera include linear system
theory, computer controlled systems, and process control. He
contributed to the theory of Riccati equation, to the design of
deadbeat controllers, and he pioneered the use of Diophantine
equations in the analysis and synthesis of control systems.

Dr. Kucera is the author of three books: Algebraic Theory of
Discrete Linear Control (in Czech) (Academia, Prague, 1978),
Discrete Linear Control: The Polynomial Equation Approach
(Wiley, Chichester, 1979) and Analysis and Design of Discrete
Linear Control Systems (Prentice-Hall, London, 1991). He
published about 160 articles, papers, lecture notes and research
reports and regularly presents results at scientific events. By
1991, Science Citation Index included 620 citations of his
publications.

Dr. Kucera is the Editor-in-Chief of Kybernetika, an Associate
Editor of Automatica and J. Math. Systems, Estimation and

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Control, and serves on the editorial boards of Int. J. Control,
Int. J. Robust and Nonlinear Control, Int.J. Systems Science, and
Systems & Control Letters. He is a Senior Member of theIEEE,
President of the Czechoslovak National Member Organization of
IFAC, a member of the IFAC Council, and Chairman of the IFAC
Awards Committee.

Dr. Kucera received the Prize of the Czechoslovak Academy of
Sciences in 1973, the National Prize of Czech Republic in 1989
and the Automatica Prize Paper Avard in 1990. In 1988 he was
elected a Member of the Czechoslovak Academy of Sciences.

Z. Vostry was born in Brno, Czechoslovakia, in 1946. He received
the M.S. degree in control engineering from the Prague Technical
University, in 1969, the CSc. (Ph.D.) degree in control
engineering from the Czechoslovak Academy of Sciences, Prague in
1973, and the DrSc. (Doctor of Sciences) degree in 1990.

Since 1970 he has been with the Institute of Information Theory
and Automation of the Czechoslovak Academy of Sciences, Prague,
as a researcher. His current research interests include
numerical methods for optimal control, polynomial theory,
simulation of large-scale dynamic systems, and control and
simulation of real systems like large pipeline gas networks and
systems of water channels with gates.

Dr. Vostry is the author and co-author of more than 50 scientific
publications. He is the co-author of two books: Kralik J.,
Stiegler P., Vostry Z., Zaworka J.: Dynamic Modeling of
Large-Scale Networks with Application to Gas Distribution
(Elsevier, Amsterdam, 1988) and

Jenicek T., Kralik J., Vostry Z., Sterba J., Zaworka J.:
Textbook on Dynamic Simulation of Gas Pipeline Networks SAEX,
Prague, 1991).

J. Zaworka was born in Prague, Czechoslovakia, in 1934. He
received the degree in chemical engineering from the Technical
University of Chemical Technology, Prague, Czechoslovakia in
1957. He received the CSc. (Ph.D.) degree in control engineering
from the Czechoslovak Academy of Sciences, Prague,
Czechoslovakia, in 1961, and the DrSc. (Doctor of Sciences)
degree in 1990.

Currently he is a researcher of the Institute of Information
Theory and Automation of the Czechoslovak Academy of Sciences.
His research interests include the dynamic identification of
control systems. His recent research projects have dealt with the
dynamic simulation of large-scale intricate systems.

He is the author and co-author of more than 50 scientific
publications and six books: Zaworka J.: Plate Column Dynamics

(Academia, Prague, 1963); Cermak J., Peterka V., Zaworka J.:
Control System Dynamics (Academia, Prague, 1968); Zaworka J.:
Rectification Column Dynamics (Academia, Prague, 1978); Kralik
J., Stiegler P., Vostry Z., Zaworka J.: Dynamic Modeling of
Large-Scale Networks with Application to Gas Distribution
(Elsevier, Amsterdam,1988); Jenicek T., Kralik J., Vostry Z.,
Sterba J., Zaworka J.: Textbook on Dynamic Simulation of Gas
Pipeline Networks SAEX, Prague, (1991).

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PROJECT DESCRIPTION:

Gnostical software for robust analysis of uncertain data,
robust filtering, robust estimation and identification.

Contact: Pavel Kovanic, UTIA, CSAV, P.O.Box 182 08, Prague,
Czechoslovakia
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SHORT DESCRIPTION

The gnostical theory of uncertain data (gnostics) is a
fundamentally new alternative of statistics developed inthis
Institute. The gnostical approach yields maximum information
even from small sets of strongly dispersed data,i.e. for cases
where statistics is not reasonably applicable.

The project could contribute to exploitation of the
potential of this theory by development of the gnostical
methodology and software tools. The possible fields of
application include analysis of one – and multidimensional data
samples and data series, forcasting and decision support,
identification of model parameters including reliability and
survival models, intelligent sensors, etc. Gnostical programs
exhibit extraordinary robustness in all these functions yielding
results insensitive to gross data errors and completely
insensitive to statistical assumptions (because they rely only on
data, they need no a priori statistical model of uncertainty).

BACKGROUNDS OF THE SOLUTION

There is experience available in the Institute based on the
long term development of gnostical software and on many
experimental applications which included both micro-and
macroeconomic studies, production quality control, reliability
problems of atomic power stations and of trucks, monitoring of
environment, dosimetric control, emergency systems, etc. These

applications demonstrated the robustness and other qualities of the gnostical methods outperforming currently used statistical methods. They have also opened attractive new theoretical problems to be solved during further development of the theory.

POINTS OF SPECIAL INTEREST

Gnostical methods have already been developed and tested deserving a special attention of military research:

- Robust identification of nonlinear multidimensional reliability models. This method has been successfully applied to evaluation of reliability tests of trucks produced by TATRA company. Although no a priori statistical assumptions are used, results obtained by the program involve probability distribution of life-tim (of vehicles or of their parts) in dependence on given factors. Similar problem is surviving of people and animals under different conditions.
- Both robust and efficient onlinear filters for treating noisy measurements. These filters generate excellent estimates not only of the signal level, but also ofits trend and aceleration. Such filters might be applied to automatic stabilization of vehicles (adaptive minimization of vibrations), guns, ships as well as to vibration diagnostics. They may also been used in the form of single-chip computers integrated with sensors in the form of intelligent sensor units. High robustness of these filters could be substantial for guidance of missils under heavy noise of unknown nature.
- Robust data analyzer enabling to evaluate the production quality in terms of probability distributions of different risks as well as the influence of given factors on the quality. Analogous application is the evaluation of shooting efficiency. These programs can also be used for objective (data based) establishing of norms of quality, productivity, costs, overhead, etc.

These non-exhaustive examples should only give rise to interest related to gnostical theory and application. A moredetailed information on gnostics can be found in Appendix.

PROJECT OUTPUT AND COSTS

- PROJECT OUTPUTS:
    Extended gnostical theory of uncertain data. (Commercial) software systems supporting interactive application of gnostical methods to real data oriented to military, research and industrial laboratories. These systems would also be useable to economic analyses, marketing activity, stock market analyses, forcasting and investment decision support, etc. Such

systems would be also helpful as tools for development
of special applications of gnostics, e.g. for
single-chip microprocessors and intelligent sensors.
They could also be built-in into different guidance
systems, quality control systems and used in
normalization, etc.

- PROJECT LENGTH AND PERSONNEL:
     To be agreed in dependence on the size and complexity
     of the tasks.

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Title of project:
Statistical Inference and Information in Large Stochastic Systems

Principal investigator:
Igor Vajda

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Investigators:
Martin Janzura, Jiri Michalek, Antonin Otahal

Project length: Starting date:
2 years   1--1--1993

PI Signature: Date: March 26, 1992

Statistical Inference and Information in Large Stochastic Systems

Project Summary

This cooperative research centers on the following three
problems:
1.   Evaluation of generalized entropy and divergence in large
stochastic systems.
2.   Application of asymptotic formulas for entropy and divergence
in testing statistical hypotheses about large stochastic systems.
3.   Statistical estimation of parameters of large stochastic
systems.

The first problem consists in evaluation of R38nyi distances and
related generalized entropies and their asymptotics for
continuous time Gaussian processes, general diffusion processes,
regression data fields and Markov processes with local
interactions.

In the second problem conditions for existence of adaptive tests will be derived together with adaptive tests for Gaussian processes, diffusion processes, regression data fields and for Markov processes with local interactions.

In the third problem stochastic annealing type estimators of parameters of these processes and fields will be obtained, as well as consistent M-estimators of parameters of regression field models.

The aim of the proposed research is given by necessity of investigating models for complex systems composed of a large number of mutually related parts, such as images, languages, sensor arrays, logistic and communication networks, etc. Extension of useful information-theoretic and statistical methods to relevant models seems to be a nowadays challenge for research in information sciences.

The proposed research will continue the long-term tradition of the Institute in application of information-theoretic methods in data processing, including especially the results obtained by the team of investigators in their previous papers.

About investigators:

Igor Vajda, principal investigator, Head of Department of Stochastic Informatics

Research area:
statistical distances and information measures, statistical decisions, asymptotic methods in estimation and testing, statistics of random processes

Selected recent publications:

F. Liese, I. Vajda (1987): Convex Statistical Distances. Teubner,Leipzig.
I. Vajda (1989): Theory of Statistical Inference and Information. Kluwer Academic, Dordrecht - Boston.
I. Vajda (1990): Distances and discrimination rates of stochastic processes. Stoch. Processes and their Applications 35,47-57.
I. Vajda (1990a): Generalization of discrimination-rate theorems of Chernoff and Stein. Kybernetika 26, 273-288.
M. Teboulle, I. Vajda (1991): Convergence of best phi-entropy estimates. Res. Rep. 91-22. Univ. of Maryland (submitted to Trans. IEEE of Inform. Th.).
H. Luschgy, A. Rukhin, I. Vajda (1992): Adaptive tests for stochastic processes in the ergodic case. Stoch. Proc. and their Applications (accepted).

Martin Janzura

Research area:
random processes and fields, limit theorems, information theory
aspects, statistical analysis of spatial data

Selected recent publications:

(1988a): Asymptotic theory of parameter estimation for
Gauss-Markov random fields. Kybernetika 24, 161-176.(1988b):
Divergence of Gauss-Markov random fields with application to
statistical inference. Kybernetika 24, 6,401-412.
(1991): An expert system based on the simulated annealing.
(co-author S. Preucil) Workshop on Uncertainty Processing in
Expert Systems, Inst. of Inform. Theory, Prague, 1991.

Jiri Michalek

Research area:
analytical methods in stochastics, random processes, statistical
inference in stochastic processes, signal theory and signal
processing

Selected recent publications:
(1989): Multidimensional random processes with normal
covariances. Kybernetika 25, 5, 348-365.
(1990): Asymptotic R40nyi's rate of Gaussian processes. Problems
of Control and Information Theory, 19 (3), 209-227.
(1991): I-divergence of some diffusion processes. Problems of
Control and Information Theory 20.

Antonin Otahal

Research area:
random fields, spectral theory and statistical analysis, image
processing

Selected recent publications:

(1988): Spectrum decomposition for stationary weakly isotropic
random fields in the plane. Trans. 10-th Prague Conf. on Inform.
Theory, Stat. Dec. Functions, Random Processes, Vol. B, Prague,
223-228.
(1990): Ergodic coefficient in non-homogeneous Markov chains.
Trans. 11-th Prague Conf. on Inform. Theory, Stat. Dec.Functions,
Random Processes (accepted).
(1991): Parameter estimation for nearest-neighbor Gaussian
random fields in the plane. Probl. of Contr. and Inform. Th. 20,
N.6.

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Project Title: Computer-Aided Analysis and Optimization of Nonlinear
        Dynamical Systems

Principal investigator: DOLEZAL Jaroslav, Ing. CSc.

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Research Group: Scientists 5
                 Graduates 2
                 Others   1

Summary

The aim of the project is to provide a complex treatment of
optimization problems for continuous and discrete nonlinear
dynamical systems based on current achievements of the computer
technology. Theoretical and numerical aspects of this topic are
to be investigated in general and uniform setting to facilitate
an implementation in appropriate user-friendly environment.
Recent methodological results in the field of software
engineering are to be exploited, i. e. the developed
computer-aided optimization system should be as much as possible
independent of the used operating system (DOS, UNIX) and
object-oriented programming language C++ should be widely
applied.

The prototype system of this kind will contribute to more
effective applications of theoretical results in the area of
nonlinear systems optimization and will include a number of
nonstandard cases, e. g. multicriterial problems. In addition,
the automatic differentiation will be implemented to increase the
power of underlying numerical algorithms. The system can be also
used as an efficient educational tool encompassing methodology
and experience from several fields and will stimulate further
development of more problem-oriented decision support systems for
various applied areas.

PROJECT DESCRIPTION

The proposed topic includes unified treatement of theoretical,
numerical and implementation aspects connected with optimization
of nonlinear dynamical systems. In this complex approach also
other related areas of computer science and informatics cannot be
avoided. This trend becomes nowadays more common and widely
accepted. It is dictated by the increasing demand for new

efficient and nonstandard applications of the existing
theoretical achievements and developed methodology. In this
respect the field of optimization can serve as a typical example
with numerous available theoretical results and methodological
treatments which are, however, not accompanied by an apropriate
number of efficient real-world applications. Observe that this
field covers wide range of decision-making problems ranging from
optimal parameter selection and data fitting to optimal control
of complex nonlinear systems.

Aims of the Project

The aim of the project is contribute to overcome the above
indicated gap. The suggested multidisciplinary approach will
combine and develop the existing results and methodological
achievements in each particular area to provide higher quality of
treatement of optimization issue for nonlinear dynamical systems.
Attention will be focused on an optimal control problem for
dynamical systems described by ordinary differential equations
with possible parameters

$$x = f(x,u,a,t), \quad x(0)=x0, \quad t \text{ n } [t0;tf],$$
(1)

where x(t) is the n-dimensional state and u(t) the m-dimensional
control variable at time t, respectively, and a is the
q-demensional vector of parameters. An optimal control problem
consists in finding a function u(t) minimizing the value of an
objective functional

$$J = h(x(tf),a) + \overset{tf}{\underset{t0}{\overset{t}{\underset{u}{3}}}} L(x,u,a,t)dt.$$
(2)

As a rule, various constraints on all var iables can exist and
more general setting can be considered [3, 4, 28]. The related
results dealing with necessary optimality conditions 2, 31, 34]
will be generalized for the following non-standard problems:
periodic, with intermediate constraints and multicriterial.

Special attention will be paid to the multicriterial case, where
functions in (2) are vector-valued (p-dimensional) as such
formulation is urgently implied by real-world requirements. In
this respect the connected analysis of scalarization schemes
(convex combination, max-type function [14]) will be investigated
to provide efficient means for Pareto set determination   Till
now only limited experience is available [25, 33] for dynamical
systems and it has to be exploited in a unified way for the
indicated cases of interest.

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Closely related are also the so-called differential games [8, 9],
where several decision-makers are involved. Also saddle-point or
more general Nash equilibrium solution can be investigated by
similar methodology. Analogical approach will be applied also
for discrete systems [7, 15].

The effective solution of the related two-point boundary-value
problems will be treated for all these problems by implementation
of all necessary software in a user-oriented system which will
support all solution phases including the problem setting and
presentation of results in an appropriate graphical form.

Selected efficient algorithms [10, 17, 24] will be revisited and
implemented using the automatic differentiation [21, 27] option.
This new approach will permit to remove this part of solution
input from the user and considerably improve the reliability of
calculations for routine solution of optimal control problems.

As both implementations in DOS and UNIX environment of the
optimalization system are to be performed the advantage of object
oriented programming language C++ will be fully appreciated.
Such approach corresponds to the requested transferability option
of such system on high performance personal computers and
workstations. The aim of the project is to develop and implement
a computer system for optimal control problems in the sense of
the preceding discussion. Currently only partial results are
available in this respect. The "integrated environment" will be
developed in C++ programming language to provide its portability
and transferability in the above sense.

Basic items of the project are summarized as follows:
    o   Selection, unification and development of fundamental
        numerical algorithms; design of overall structure of the
        system. Deadline: July 1993.

    o   Prototype implementation of the supporting module for
        automatic differentiation; analysis of alternatives for
        graphical module implementation (toolbox versus
        problem-oriented). Deadline: Dec. 1993.
    o   System implementation for multicriteral and some
        nonstandard (periodic, intermediate constraints.
        differential games) optimal control problems: issue of
        scalarization. Deadline: July 1994.
    o   Analysis and implementation of appropriate trade-offs
        schemes for multicriterial optimal control problems.
        i.e. decision support system prototype; feasibility
        analysis of dicrete time version of such software
        system. Deadline: Dec. 1994.

All solution steps of the project will be documented in research
reports and important theoretical and methodological results will
be prepared for the publication in international journals. After

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fulfillment of the above indicated steps the "prototype system" will represent a powerful tool for the solution of a wide range of optimal control problems. If reasonable such system can be developed further. The successful solution of the project will positively influence the following items:

o Availability of an "efficient tool" for development and comparative analysis of numerical algorithms for optimal control problems. For complex applications a suitable method can be thus chosen based on the solution of certain simplified problem, and then incorporated in the respective problem-oriented environment.
o Availability of a flexible and many-sided tool for "educational" purposes. Early and extensive acquitance with optimization techniques will contribute to their later frequent and diverse applications.
o Straightforward treatment of related applications, as the implemented environment can serve as a "prototype" for dealing with a library-type algorithm base for decision support systems.

State-of-the-Art Summary

New area of optimal control theory started with "maximum principle" discovery in the late fifties [39]. Although with more then three decades after one evaluates this breakthrough more calmly, it stimulated a real explosion of activities in nonlinear system analysis and optimization. All posible classes of systems (1)-(2) were taken into account and characterization of optimal solutions by appropriate necessary optimality conditions was widely investiged [2, 3, 4].

In the same time also attempts to unify and generalize the existing results can be observed, seemingly starting in [26] and further developed for example in [3, 31]. Later also the issue of differentiability was analysed in [5, 37] to allow also treatement of systems described by not necessarily differentiable functions in (1)-(2). Nevertheless, it is worth to note that predecessors of many of these results are of older origin and they are related to the calculus of variations [28], from which functional optimization techniques without no doubts originated. More up-to-date treatement of this topic can be found in [34]. However, the mentioned optimization boom was not accompanied by desirable an adequate exploitation of available results in various applied areas, primarily in technology and engineering. Some authors may exaggerate by saying that "there are more alternative proofs of the maximum principle then its non-academic applications", but the available implementations of optimal control methodology have not evidently satisfied the original expectations.

The reasons for such phenomenon are mainly twofold. First, it

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has to be realized that any application of the developed
optimization methodology requires not only considerable amount of
the user's knowledge in optimal control theory, but also in
closely related areas of numerical methods and computer
implementations. Such interdisciplinary character of the problem
treatement may often discourage potencial users not having the
appropriate background, especialy those coming from other areas
as chemistry, economics, biology, ecology, etc. In concrete
cases then only simple and approximate optimization schemes were
applied which did not always provide the desired optimal solution
or decreased its efficiency.

Second aspect concerns, at least till recent time, the principal
lack of adequate computer facilities to deal with optimization
problems. This affected both, experts aiming to provide powerful
software and end-users who moreover expected some kind of support
from those experts. As a rule, the computational burden, when
dealing with resulting nonlinear two-point boundary-value
problems [40, 42], often limited also prototype solutions of
relatively simple optimal control problems to a rather narrow
group of researchers [4, 24] and did not stimulate and motivate
enough followers in applied areas. In this respect it is
necessary to realize that only themost powerful microcomputers,
e. g. of AT 486-33 series, can nowadays copewith this problem.
There is also no doubt that further real-worldapplications will
require efficient high-end workstations runing under
UNIXoperating system seemingly using object-oriented C++
programming language[35]. Further step forward is possible when
parallel computational schemesbe developed and implemented.

The indicated disillusion of the potential users of optimization
techniques is also due to somewhat one-sided and non-critical
interpretation of "optimization" as being able to solve most of
existing problems. On the one hand, optimization issue is
inherited in practically any rational behaviour, ranging from
simple alternative selections to decision-making in complex
environment. And as such it should be also treated, i. e. in the
overall context not overestimating its role. On the other hand,
as certain degree of optimization cannot be avoided, there is an
urgent and challenging requirement to provide and improve the
respective tools in moreuser-ready form.

One can expect that some previous results will be "rediscovered"
due to the new dimensions in computational techniques. Highly
integrated user-friendly environments with extensive graphical
support will bring many deep theoretical achievements to broader
community of users in various applied areas. The respective
decision support systems [36] will thus play central role in this
process of knowledge and information management.

If such trend should include also optimal control area, several
preliminary steps must be fullfilled, e. g. unification of

existing numerical algorithm and development of new ones, implementation of the approprriate graphical modules for visualisation of results, input/output date management, etc. As an example let us mention Optia system [19, 20] for treatment of mathematical programming problems (parameter optimization).

However, critical issue seems to be the need of availability of various derivatives of problem describing functions in most known and powerful techniques. Recent effort in the field of the so-called "automatic differentiation" in [24, 27] seems to offer computationally attractive and efficient solution. Derivatives are produced automatically based on the given procedure for original function. Efficient implementation requires object-oriented programming language enabling also operator overloading (Ada, C++). It is worth to note that this topic re-invented by computer scientists, has its roots in control theory, namely sensitivity analysis of systems [47]. Moreover, the sometimes preferred backward automatic differentiation scheme is obtained in a straight forwarded way from optimization of certain discrete systems [1]. For optimal control problem analogous "tabelar" procedure is described in [32].

As can be concluded from numerous publications, the concept of multiobjective (vector) optimization [44] have become of considerable importance also in the case of dynamic systems [33]. In general, the treated reality is mostly multiobjective and single objective formalism (scalarization) is only its simplification. Multicriterial setting of optimization problems causes principal conceptual difficulties, e. g. mostly accepted Pareto solution (nondominated, noninferior) is nonunique and additional mechanisms are developed for rational reasoning over such solution set, e.g. aspiration level [46] or satisfying trade-offs [38] approach. Let us note that further step in this direction is the subject of the so-called differential games [8, 9]. The user-oriented environment for multicriteria optimal control problems therefore concentrates most of current achievements in the area of optimal control theory and algorithms (to single out one Pareto point), multicriteria decision analysis (to provide necessary trade-offs), and advanced computer implementation (transferrable, C++ programming language).

Resulting prototype system can serve as "generic" sample for more specialized and problem-oriented modifications. Besides its primal significance as result of interdisciplinary effort, its importance can be seen also in many-sided educational aspects.

One should understand that this new quality of treatment is accompanied by the indicated shift of "basic research" denotation as dictated by increasing computarization of all kinds of human activity. The novel approach promoting the computer culture must reflect this fact by merging distinct areas of research. In turn, it will provide positive stimuli for further needs in any

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involved particular area.

Project Background Analysis

The area optimal control is followed by the investigators for
nearly two decades. They constitute a compact team with
reasonable background experience. In the past they paid
attention to theoretical [6, 7, 13 - 15], numerical [8, 9, 11],
and implementation [10, 12, 17, 21] aspects of parameter
optimization, discrete-time and continuous-time optimal control.
This experience has been used also in a number of applied
projects in ecology [43], immunology [18, 29], flight control
[16] and aircraft engine behaviour analysis [22, 23]. Recently
own research tool denoted as Optia system [19, 20] for parameter
optimization problems has been suggested and implemented within
the grant No. 27505 extending also for the next year. This
provides a fairly good starting position for the intended
activity. Observe that large-scale mathematical programming can
be also a competitive alternative when dealing with optimal
control problems [25, 43].

The investigators has at their disposal several AT 386-33 with
coprocessor and AT 486-33 personal computers which make it,
thanks to the speed of calculations, possible to investigate the
possibility of uniform interactive treatment of optimal control
problems. Moreover, within few months there will be also access
to the new network of HP 720 workstations (at least ten times
faster), so no hardware lack is expected. In addition, it will
be necessary to select the right software tool, most probably
X-Windows. Most programming will be realized in C++. For
development of a graphical module it will be necessary first to
analyse availability of a toolbox, e. g. Halo Library, or public
domain, resp. shareware, software for its implementation and only
then start with own development.

Investigators have a number of close and informal contacts with
many leading scientist in this area, with whom the new results
and ideas are confronted and evaluated and who partly contributed
to the development of the existing Optia system. Recent
discussions with many of them revealed the need for the kind of
activity proposed in the project. In alphabetical order it
concerns: M. C. Bartholomew-Biggs and L. C. W. Dixon from the
Hatfield Polytechnic, Y. G. Evtushenko from Computer Center
Acad. Sciences in Moscow, O. Feichtinger from Technical
University of Vienna, I. Johnson, formerly with NASA, C.
Lemarechal from INRIA, M. J. D. Powell from the University of
Cambridge, K. Schittkowski from the University of Bayreuth, A.
Tits from University of Maryland, and finally A. Zilinskas from
the Institute of Mathematics and Cybernetics in Vilnius. In this
way the access to the latest related information is guarenteed in
spite of the existing difficulties with wider subscription of
scientific journals and books of western origin.

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Supporting Circumstances

The field of optimization is one of basic topics pursued in the Institute of Information Theory and Automation. It can be expected that it will receive institutional support also in the future as optimal choice or decision-making processes, especially from the point of view of applied aspects, are of growing importance in the existing economic conditions and resource limitations. Practical impacts of the project outcome can positively influence interest of industrial and other users and possibly to raise additional funds for this kind of research continuation in the future.

Application aspects of the proposed project are evident as its outcome can significantly influence use of optimal control methodology in many applied areas. Of the same importance is the verified circumstance that quite a number of high schools and universities can be interested in such optimization system and to have such unique and efficient education tool at their disposal for various teaching purposes. Moreover, active participation of at least 2 doctoral students on the project is scheduled.

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Curriculum vitae

Born in Prague, Czechoslovakia, on December 31, 1946. After
passing a university study of control theory and computer scier
at the Department of Electrical Engineering of the Czech
Technical University in Prague. Ing. degree (corresponds to
M.S.E.E. or Dipl.-Ing. degrees) in Electrical Engineering with
Honors in 1970. During the university studies individual English
and German classes finished by passing the State Examinations in
1967 and 1969, respectively. Additionally also the State
Examination in typing in 1965. In 1968 an opportunity to spend
part of practical university training in FRG.

Since 1970 with the Institute of Information Theory and
Automation of the Czechoslovak Academy of Sciences in Prague.
First as a full-time CSc. student in 1970-1973. Candidate of
Science (CSc.) degree (corresponds to Ph.D. or Dr.-Ing. degrees)
in Technical Cybernetics in 1974 and Assistant Researcher
position in the institute. Thesis devoted to discrete optimal
control problems and multistage games. These results, including
the investigation of vector (multicriteria) optimization
problems, were subsequently published and further developed in a
number of papers. For these scientific achievements three times
(1975, 1976 and 1977) Award of the Board for Technical
Cybernetics and in 1980 the Academy Prize for Young Scientists.

In 1979 appointed Senior and in 1986 Principal Researcher. Since
1986 also Head of the Department of Nonlinear System Theory in
the Optimal Control Section of the Institute, and Project Leader
of one of the State Basic Research Program projects dealing with
nonlinear system optimization and decision-making. Responsible
Investigator for several contracts with industry involving the
development and implementation of theoretical results in the form
of certain decision support systems featuring appropriate
user-friendly environments (e. g. Optia system for the solution
of mathematical programming systems, Golem system for
computer-aided development and testing of aircraft engines). The
Golem system received Academy Prize in 1989. Currently preparing
the thesis for Doctor of Science (DrSc.) degree, where the
achieved results in the field of optimization of general
nonlinear discrete-time systems will be summarized. These
results were also the topic of the invited plenary lecture during
the IFIP Conference on System Modelling and Optimization held in
Tokyo in 1987.

Since 1985 appointed the member of the Czechoslovak Committee for
IFIP and of the Technical Committee 7 (System Modelling and
Optimization) of the IFIP. Regular member of the International
Program Committees of the biannual conferences of this body.
Since 1991 secretary of the Czechoslovak Committee for IFIP.
Regularly invited to participate in program committees of
meetings devoted to multicriteria optimization and decision
support. Member of the Editorial Board of J. on Global
Optimization and J. on Optimization Methods and Software.

During research activities published as author or co-author over 100 papers in scientific journals and conference proceedings. They are mainly devotedto optimal decision-making methodology for static and dynamic situations. Practical applications and implementation of the corresponding results are described in more than 60 internal research reports. The results dealing with simulation of recovery dynamics in immunology (including also AIDS disease) are widely recognized and cited.

Participation in several exchange research programs abroad. In 1972 spent 3months in the Institute of Mathematics in Moscow at the department of Academician L. S. Pontrayagin, and in 1973-74 took part in Optimal Control Semester at Banach International Mathematical Center in Warsaw. Later, in 1980-81 visiting on several universities in the U.S.A., and in 1984 in England. Recently considered as one of potential candidates for Methodology of Decision Making project-leader in the International Institute of Applied System Analysis.

Primal interest devoted to the implementation methodology of the latest achievements in the field of optimization theory in the form of auser-friendly environment in order to bring this area of applied mathematics closer to practical applications and to fill the existing applicability gap when using sophisticated decision-making schemes. Development of high level decision support systems for intelligent optimization (expert features) in decision-making and control and the use of automatic differentiation schemes for higher efficiency. Wide international contacts in this respect: Computing Center of the USSR Acad. Sci. (Moscow, Irkutsk), Univ. of Bayreuth (FRG), Univ. of Cambridge (UK), Univ. of Maryland (College Park, USA), Institute of Mathematics and Cybernetics (Vilnius, USSR) etc.

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Graduated: Faculty of Numerical Mathematics, Moscow State University
Scientific Degree (CSc.): Institute of Information Theory and Automation
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Fidler, J.
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Research Areas: numerical methods for mathematical programming and optimal control (development, implementation), modelling of dynamical systems

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Graduated at Technical University Brno in 1969, Ph.D. in 1980 for digital systems diagnosis. Since 1969 is working at dpt. of Computer Science and Engineering, TU Brno as research and development worker, later as a teacher of digital design, diagnosis and reliability, digital computers and computer architecture. Since 1976 acted as a member of Central professional group for diagnosis in electronics, organizing seminars and conferences in Fault-Tolerant Systems and Diagnostics. He designed several minicomputer interface boards for interfacing floppy disc unit, chain printer, and terminal computer and developed some small peripherals as magnetic card and marked card reader.

His research area now are linear-feedback shift registers modelling, as aliasing probability and data compression analysis, and Markov chain reliability analysis, and boundary scan improvements. Functional models are available.

Shortened list of publications:

Drabek V.:   Fault-tolerant interconnection networks, proc.int.conf. Fault-Tolerant Systems and Diagnostics IX, Brno, 1986, pp.51-57

Drabek V.:   Byte-error detection codes, proc.2nd International school MICROCOMPUTERS'86, Bierutowice, 1986, pp.67-75

Drabek V.:   Error correction code for CD record, dig. workshop Microprocessor diagnosis VII, Luhacovice, 1986, pp.122-125

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Born 1948 in Prague. He was educated at the Faculty of
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researchat the Faculty of Mathematics and Physics. His PhD
thesis on algebraic methods in fuzzy logic was published as a
series ofpapers in the Zeitschrift f. Math. Logik u. Grundlagen
der Math., 1979.

In the years 1977-1990 he was employed in the R&D Division of the
Semiconductor Plant, CKD Corporation in Prague, first as a
researcher and later as a senior researcher and research
groupleader. His work was related to industrial process control
systems using PDP-11 computers and special PLC's produced at the
plant. He was responsible mainly for the design and
implementation of software development methods and tools. He
initiated and supervised several software projects including

  - a hard real-time operating system DEIMOS for process
    control that included a multitasking symbolic debugger and
    other maintenance facilities;

  - a structured superset of PDP-11 assembly language with
    parallel process synchronization and communication
    primitives related to DEIMOS executive;

  - process control device drivers for DEIMOS and RSX-11M;

  - software support for a token ring, including a
    specification language for network configuration and data
    flow description;

- program tools and runtime support for man-machine interaction in process control systems (animated technological schemata, screen forms, production log and status reports);

- remote device sharing software for heterogenous LAN's.

The resulting products were used in several large distributed control systems, including a medium section rolling mill, a continuous steel casting machine, cement works, and gas transport pump stations.

>From 1984 he has been a member of the program committee of an annual Czechoslovak conference SOFSEM that serves as a regular meeting place for experts working in theory and practice of computing. In 1990 he entered the Computer Science Department of the Faculty of Mathematics and Physics where he is responsible for software engineering education and research.

Topics of interest:

- software engineering methods and tools;
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- parallel and distributed systems.

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               Charles University Prague, 1984
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Research Interests

Database Systems - data semantics and conceptual modelling,
query languages, lambda calculus as a tool for data
modelling, integrity constraints;
Data organization - tree and hashing methods, signature
methods, data compression;
Information retrieval - (full)text databases, vector
models, semantic nets in text modelling.

Professional Experience

Assistant Professor, Department of Computer Science Charles
University Prague, June 1982 to present.

Visiting Consultant, Computer Center of the Technical
Univerity, Prague, 1983 to present.

Visiting Scientist, Institut of Computer Science,
Czechoslovak Academia of Sciences, 1986 - 1991

Head of Information Systems Division, Institute for
Computation Techniques, Technical University of Prague,
February 1974 to February 1982.

Research Assistant, Institut for Computation Techniques,
Technical University of Prague, April 1974 to January 1976.

System Programmer, Institute for Computation Machines,
Prague, September 1971 to March 1974.

Stays: Institut f^Ar Informatik, Universit^Dt Stuttgart,
December 1978 to February 1979.

Dipartimento di Informatica e Sistemistica,
Universita "La Sapienza", Roma, April 1988 to June
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Professional Societies

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Professional Activities

Member of the International Working Group (WG19)
"Distributed databases", 1983 - 1987.
Member of the International Working Group (WG25) "Problems
and Integration Tools in Information Systems",
1997-1990.
Member of the Program Committee, Int. Conference on
Engineering Information in Data Bases and
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Referee: Zentralblatt fuer Mathematik
          ACM Computing Reviews
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          '90, Berlin, 1990.

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Main Publications

A. Journals and Conference Proceedings

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Pokorny, J.: Logical Problems of Information Systems. Tanulm nyok Studies 203/1988, Hungarian Academy of Sc., Budapest, 1988, 83-96. (in Russian).

Pokorny, J.: A function: Unifying mechanism for entity-oriented database models. ENTITY-RELATIONSHIP APPROACH, C.Batini (Ed.), Elsevier Science Publishers B.V.(North-Holland),1989.

H#sek, D.,Pokorny, J.,V!tkov, G.: Interactive Synthesis of Relational Databases for Experimental and Scientific Data. J. New Generation Comp.Systems 2 (1989)3, pp. 257-268.

Pokorny, J.: Equivalence of conceptual models. Proc. Problems and tools of integration of information systems, KNVVT,WG-25, 1989, pp. 153-164. (in Russian)

H#sek, D., Pokorny, J.: Spreading activation methods in information retrieval - a connectionist approach. Proc. of The Int. Symposium on Neural Networks and Neural Computing NEURONET 90, Praha, 1990.

Pokorny, J.: Integration of functional, relational andlogical databases. Proc. of Intern. Conf. on Engineering Information in Data Bases and Knowledge Based Systems, TECHNO-DATA '90, Berlin, December, 1990.

Melichar, B., Pokorny, J.: Data Compression. Proc. of Conf. SOFSEM 91, Jasn pod Chopkom, 1991.

B. Books

Pokorny, J.: Computer Databases. Vyber a aktuality z vypocetn! techniky. Kancel rsk62 stroje, 1991. (in Czech)

Pokorny, J.: Database systems and their application in information systems. ACADEMIA, 1992. (in Czech)

Sokolowsky, P., Pokorny, J., Peterka, J.: Distributed database systems. ACADEMIA, 1992. (in Czech)

Dissertation

A Functional Approach to Conceptual Modelling. Ph.D. Thesis, Faculty of Mathematics and Physics, Charles University Prague, 1984.

Appendix B

Computer Science/Computer Engineering

HUNGARY

List of Projects

DIGITAL CIRCUITS AND SYSTEMS WITH SMALL REDUNDANCY AND
HIGH RELIABILITY

Sponsored by the National Scientific Research Fund (OTKA)

Project Leader:
    Dr. Endre Selényi, Professor
    Department of Measurement and Instrumentation Eng.
    Müegyetem rkp. 9, Budapest, H-1111, Hungrary
    e-mail: h2514el@ella.hu

Description of the project:

    The research project aims to survey and develop the
    structural methods of providing reliability. The starting
    points of this research are the so called self-checking
    circuits, and the related design methodologies, since these
    make distributed fault tolerance possible at relatively low
    redundancy level. The project considers both theoretical
    and implementational aspects. As a first step the structure
    of self-checking circuits applying linear codes will be
    elaborated, and later on a design method will be provided
    for implementing self-checking circuits in Field
    Programmable Gate Array (FPGA).
    Participants: Dr. Selényi, E., Dr. Pataricza, A., Várkonyi-
    Kóczy, A., Hegedüs, Z., Dankó, Z.

Publications:

    Selényi, E.: New Methods for Pseudoexhaustive Testing,
    Periodica Polytechnica. El. Eng. Vol. 31, No. 1-2, pp. 11-
    20, 1987.

    Pataricza, A.: Remarks on the Use of Reed-Solomon Codes in
    Signature Analysis. Microprocessing and Macroprogramming,
    The Euromicro Journal. Vol. 32, pp. 843-850, 1990.

    Selényi, E., Patricza, A.: Problems and Methods of Self-
    Test, From Theory to Prototype Workshop. Organised by Univ.
    of New Hampshire and TU Budapest, 1991..

FAULT DIAGNOSING OF INFORMATION SYSTEMS

Project leader:
Dr. Endre SELÉNYI professor
Department of Measurement and Instrumentation Eng.
Műegyetem rkp. 9, Budapest, H-1111, Hungary
e-mail: h2514sel@ella.hu

Description of the project:

Fault diagnosing is a decisive issue in installing complex, highly reliable systems, and a basic component of the different methods providing self-test and/or fault tolerance. The study of the functional fault model of electronic devices resulted in the extension of the validity range of the previously achieved results in self-test at system level, and fault diagnosing has been made suitable to handle intermittend faults as well. By combining the diagnostic model and algorithm with an expert system information systems having high performance fault diagnosing capabilities can be established.

Participants: Dr.Selényi, E., dr.Pataricza, A., dr.Sziray, J., dr.Nikolova, N.

Publications:

Jobbágy, A., Pataricza, A., Selényi, E.: Quality Control System for Biomedical Instrumentation. Proc. of the Annual International Conf. of the IEEE/EMBS. Vol.10, pp. 1233-1234. New Orleans, USA, 1988.

Nikolova, N.B.: System-level Hybrid Fault Diagnosability with General Test Invalidation. Periodica Polytechnica, El.Eng. Vol.35, No.1, pp.41-50. 1991.

Pataricza, A.: Remarks on the Use of Reed-Solomon Codes in Signature Analysis. Microprocessing and Microprogramming, The Euromicro Journal. Vol.32, pp.843-850, 1990.

Selényi, E., Pataricza, A.: Problems and Methods of Self-Test. From Theory to Prototype Workshop. Organised by Univ. of New Hampshire and TU Budapest. 1991.

SYSTEM ARCHITECTURE OF INTELLIGENT MEASURING INSTRU-
MENTS FOR COMPLEX MEASUREMENT TASKS

Project leader:
    Dr. Gábor PÉCELI professor
    Department of Measurement and Instrumentation Eng.
    Műegyetem rkp. 9, Budapest, H-1111, Hungary
    e-mail: h1063pec@ella.hu

Description of the project:

In this project - based on previous experience in
instrument development - a design procedure and
technology has been elaborated to provide support for
the realization of intelligent measuring instruments
and supervisory systems. This new tool set alleviates
the introduction of the application domain knowledge
into the computer. The practical utilization of this
software was started in 1989. Until now there have been
altogether 4 larger applications ranging from pharma-
ceutical plants to a steel work.

Participants: dr. Péceli, G., dr. Papp, Z., dr. Dobro-
               wiecki, T., dr. Tilly, K., Pataki, B.,
               Vadász, B., Kerese, I.

ASSOCIATIVE SIGNAL PROCESSING IN INTELLIGENT MEASUREMENT AND CONTROL SYSTEMS

Project leader:
    Dr. Gábor PÉCELI professor
    Department of Measurement and Instrumentation Eng.
    Műegyetem rkp. 9, Budapest, H-1111, Hungary
    e-mail: h1063pec@ella.hu

Description of the project:

The research program concentrates on the measurement and control problems of highly complex systems. These problems can be handled by applying special multi-level models. These models consist of the proper mixture of analytical, qualitative, and heuristic descriptions, and the corresponding rules of "switching over" from one to the other. The research works on one hand aims to elaborate the proper implementational methodology of such systems. Accordingly the project involves the development of programming tools, real-time execution environments, and networking. An other aspect of the research is the investigation of adaptive signal processing systems based on highly parallel, regular structure suitable for VLSI implementation. A completely new aspect of this research that adaptivity is considered both for parameters and structures. Within the project a cooperation has been started with Prof. János Sztipánovits (Vanderbilt University, Nashville, Tennessee) on the field of neural network controlled adaptive structures with special emphasis to measurement and control problems.

Participants: dr. Péceli, G., dr. Horváth, G., dr. Dobrowiecki, T., dr. Nagy, F., Pataki, B., dr. Tilly, K., dr. Tóth, Cs., Fehér, B.

Computer-aided high-level logic synthesis of VLSI ASIC structures based on the behavioural description

Project leader:

Dr. Péter ARATÓ professor (36 1) 166-7392
e-mail: h3662ara@ella.hu

Actual goals:

Starting from te behavioural description of a problem to be solved, a pipe-line data-flow datapath is to be optimised by a new scheduling algorithm. The aim of the optimisation is to obtain the minimal latency (restarting period) for a resource allocation definable in advance. The control structure is to ue designed from the behaviour specification.

Main results:

Algorithm for scheduling a pipe-line data-flow datapath.

Algorithm for the resource allocation based on the behavioural description.

CAD of control units specified by input-output behaviour.

Literature:

Arató, P.: Specification and realisation of logic control procedures on the basis of prescribed input-output changes, PERIODICA POLYTECHNICA, El. Eng. Vol. 31. No. 3-4. 1987. p. 99-153.

Arató, P.: Design of microprogrammed control units using separate microprogram fields enabled by states, PERIODICA POLY-TECHNICA, El. Eng. Vol. 32. No. 2-4. 1988. p. 98-110.

Arató, P.: Logic synthesis of special-purpose hardware structures based on a pipelined dataflow model (submitted for consideration to IEEE Transaction on Computer, 1990.)

Measurement and processing of visual information

1. Project leader:

Dr. István LOVÁNYI Assistant Prof.
Department of Process Control TU Budapest
H-1111 Budapest Műegyetem rkp. 9.
Phone: (36) 1 1667-392 Fax: (36)1 1852-658

Actual goals:

Our recent interest is focused on some new elements of Industrial Informatics as follows:
. real-time industrial vision
. quality control based on digital picture processing
. multimedia applications in CIM
. intelligent signal sensing and processing.

Within these fields, sensing, transmitting, storing and real-time processing of visual information has a key role. Integration of the visual information with other type of information sources is equally emphasized.

In the frame of the "Filiére Francophone" at the TU Budapest we cooperate with two french universities (INSA de Rennes, Université de Technologie de Compiégne).

Main results:

Completing research and teaching activity we realized vision systems mainly for industrial diagnostics:
. Real-time vision system for defect detection on moving materials (applications in textile and metal industry).
. Image processing system and intelligent data base for interactive evaluation of industrial radiographs.

Literature:

[1] I. Loványi - Á. Nagy: Développements en vision industrielle dans le Laboratoire d'Automatique de l'Université Technique de Budapest. CONCEPTIMA, 9-11. Oct. 1991. Nancy, France

[2] Loványi, I.: Architectures of real-time robot vision systems". 10th Joint Symposium Tokai University-Technical University Budapest, Tokyo, Japan, 1986, pp. 57-69.

[3] Loványi, I. - Nagy Á.: "Industrial real-time vision applications". Rennes Sister Cities Computer Science Research Centers Workshop, IRISA-Rennes, April 17-19, 1991, pp. 92-103.

[4] Loványi I. - Nagy Á.: "Real-time high resolution image processing system for industrial quality control". Preprints of the Symposium for Advanced Meassurements Methodes in Quality Control, May 17, 1990 Krems, Austria, pp. 79-85 (in German)

Project leader: Dr. Béla LANTOS Associate Professor
        Department of Process Control Technical University Budapest
        H-1111 Budapest Müegyetem rkp. 9.
        Phone: (36) 1 1667-392   Fax: (36) 1 1852-658

Actual programme: The purpose of the project is the research of the theory and implementation of advanced robot control combined with vision systems using intensity and distance image processing.

Main results:
- Development of a simulation environment for advanced robot control design using computed torque technics, hybrid position and force control, selftunig adaptive control and fuzzy control implemented on a multitransputer system.
- Convergence test of robot identificaton for SCARA and PUMA robots using the method of Slotine and Li.
- Development of 3D vison systems based on the principles of triangularization and active light.
- Development of distance image processing software based on the method of Oshima and Shirai, Faugeras and artifical intelligence.

List of publications:

[1] Lantos, B.: "Robot control". Hungarian Academic Press, 1991 (in Hungarian).
[2] Lantos, B.: "Simulation environment of robot control design". Preprints IFAC Symposion on Robot Control SYROCO'91, Austria Vienna, 1991, pp. 417-422.
[3] Lantos, B. - Csala, P.: "Convergence test of selftuning robot control". Preprints AUTOMATION'92 Conference, Budapest, 1992, pp. 402-413.
[4] Loványi, I.: Architectures of real-time robot vision systems". 10th Joint Symposium Tokai University-Technical University Budapest, Tokyo, Japan, 1986, pp. 57-69.
[5] Loványi, I. - Nagy.Á.: "Industrial real-time vision applications". Rennes Sister Cities Computer Science Research Centers Workshop, IRISA-Rennes, April 17-19, 1991, pp. 92-103.

[6] Loványi I. - Nagy Á.: "Real-time high resolution image processing system for industrial quality control". Preprints of the Symposium for Advanced Meassurements Methodes in Quality Control, May 17, 1990 Krems, Austria, pp. 79-85 (in German)

[7] Levi, P. - Vajta, L.: "A 3D vision system". Procedings of the NATO Workshop on Intelligent Robot Sensors, Barcelona, Spain, October 1987, pp. 123-131.

[8] Levi, P. - Vajta, L.: "Combined 2D and 3D robot vision system in sensor devices and systems for robotics". In Casals, A. ed. NATO ASI Series, F32, Springer Verlag, 1989.

[9] Várkonyi, B.: "The geometrical design of triangulation based laser range finders". Research report of the Research Center Informatics of the TU Karlsruhe, Germany, 1988. pp. 1-36.

[10] Várkonyi, B. - Nitezki, P.: "An object oriented software development frame for image processing: The Raster Picture Laboratory". Research Report, FZI Karlsruhe (Germany), 1989, pp. 1-11.

[11] Lantos, B.: "Algorithmen für die Verarbeitung von Abstands-bildern zur Regelung von Robotern". Forschungsbericht der FZI Karlsruhe, 1987, pp. 1-70.

[12] Major, Gy.: "Transputer based distance image processing using the method of Oshima-Shirai". Diplom Thesis, TU Budapest, 1991 (in Hugarian).

[13] Fehér, T.: "Distance image processing using transputers". Diplom Thesis, TU Budapest, 1991 (in Hungarian).

[14] Beck, U.: "Abstandsbildverarbeitung und Mocellanpassung unter Benützung von Transputern". Diplomarzeit, Universität Karlsruhe (Germany), Fakultät für Informatik, 1991 (prepared at Dept. Process Control, TU Budapest, as visiting student).

COMPUTER GRAPHICS AND APPLICATIONS GROUP

BME, Dep. of Process Control

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Budapest, XI Műegyetem rkpt. 11

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Email:h1509szi@ella.uucp

STAFF:

Head: P. Risztics Ph.D.

Scientific staff: 4

Postgraduate students: 3

AREAS OF SCIENTIFIC WORK:

Computer graphics, data-structures, realistic shading technics, high speed ray tracing, radiosity methods, graphics terminal and subsystem design, animation, geometric modeling, surface and terrain modeling, CAD, user interfaces, object-oriented approaches to graphics, hardware design for real-time image synthesis.

LATEST PUBLICATIONS:

[1] Márton, G.- Risztics, P. - Szirmay-Kalos, L.:
Quick Ray tracing exploiting ray coherence theorems
7th Symp. on Microcomputer Appl., Budapest, 1992

[2] Márton, G.- Risztics, P. - Szirmay-Kalos, L.:
Ray coherence between a sphere and a convex polihedron
Computer Graphics Forum, North Holland, June, 1992

[3] Dobos, B.- Risztics, P. - Szirmay-Kalos L.:
Fine-grained parallel processing of scan conversion with i860 microproc.
7th Symp. on Microcomputer Appl., Budapest, 1992

CONCISE REPORT ON RESEARCH

1. RESEARCHING AREA:

Analysis and Synthesis of Computer Network Protocols. Protocol Engineering. Formal Methods for Specifications and Implementation of Computer Network Protocols. Approaches to Automatic Implementation of Computer Network Protocols.

2. CONTACT PERSON:

Name: Dr. Jozsef Harangzo
Title: Associate Professor
Phone: 166-4011 Ext. 2579
e-mail: h1678har@ella.uucp

3. AIMS OF THE ONGOING RESEARCH:

To develop a formal approach that is appropriate for synthetising executable program modules from standardized specifications. To implement the MMS application level protocol for manufacturing automation and process control;

4. RESULTS:

A new approach based on object-oriented programming methodology was developed to implement standardized application level protocols specified by ASN.1 and informal meas. As an example, a subset of the MMS protocol was implemented till now. A conference paper and a dissertation is based on this result. A more detailed examination of the new approach and additional implementation examples are under further research.

5. Publications:

Zs. Kovacs. J. Harangozo:
A new Approach to Implementing a MAP Application Protocol
Automation 92 Conference. Budapest, 1992.

TITLE OF PROJECT:

Formal design methodology for distributed resources control

PROJECT LEADER:
NEMETH, Gábor, Associate Professor
Department of Telecommunication
2 Sztoczek, Budapest, H-1111, Hungary
Tel: (36-1)-166-5824
Fax: (36-1)-166-5824
Tlx: 225-93 muegy h

KEYWORDS:

Distributed systems, Formal models, Resource allocation, Multi-processors

DESCRIPTION OF THE PROJECT:

Theoretical problems of modelling distributed systems, based on the data flow structural and abstract functional description with step-wise refinement and using the notions of ordering in time with logical and physical clocks, and causality.

Formal models for the cooperation of concurrent processes.

Mapping of the logical graph into the physical graph.

Illustration of the theoretical results by developing loosely and tightly coupled multiprocessor systems used in maintenance and operation subsystems of extensive carrier networks.

RESULT:

Integrated design model and environment for distributed resource control algorithms.

Operation and maintenance subsystems based on procedural level data flow architecture used in 8/34/140 Mbit/sec fiber carrier country-wide network.

MEANS:

6 engineers (with PhD)
Cooperation with the University of Innsbruck
Industrial Funds

BASE PUBLICATION:

G. Németh, "Formal design methods for distributed resource control algorithms", Proc. Applied Informatics '92, Innsbruck, 1992

Institute of Informatics

Director: Prof. Ferenc Schipp

Departments

Department of General Computer Science: Prof. László Varga
Department of Numerical Analysis: Prof. Ferenc Schipp

Teaching

The Institute of Informatics offers programs leading to three degrees: Computer Science - undergraduate level, Computer Science - graduate level, Computer Science - post-graduate level. These programs are constantly being updated in order to reflect current research in the field. All programs emphasize a combination of theory and practice. Students are prepared for tackling problems requiring profound knowledge of mathematics with the aid of computers. The undergraduate program provides students with a broad education in Computer Science in combination with specialized work in computer and information processing techniques, programming languages, data structures, information retrieval, operating systems, compiler design, etc. Students learn the theory as well as the methodologies and techniques in the development and implementation of computer systems. Having finished the program students may seek employment at software hauses, industry, computer manufacturers, or any organization that uses computers for research or production purposes. They will be also well prepared to pursue studies for a graduate degree in computer science. The graduate program is an advanced degree intended to provide students with the knowledge and skills necessary to hold professional positions oriented toward the development of large scale programming systems of computer systems. Students graduated with this degree are able to carry out research work in computer science, to direct the work in computer centers etc.. The post-graduate program is a continuative education giving an opportunity to graduated students to specialize in matters of current interest in this field of research developing so fast. Individual curricula for english-speaking students currently is offered.

Research

The main areas of research and the senior scientists working in the respective field are summarized below.

General Computer Science

Programming methodology
Programming methodology, data type specification, type correctness, specification of shared abstract data types. Artificial intelligence, expert systems.
Senior scientists: Prof. László Varga, Assoc. Prof. László Kozma, Assoc. Prof. Katalin Varga Pásztorné, Assoc. Prof. Pál Töke.

Efficiency and complexity of algorithms.
Computer networks, abstract models of protocols and services of distributed systems. Complexity of symbol sequences. Investigation of algorithms of overlapped memories.
Senior scientists: Prof. Antal Iványi

Automata theory

Investigation of R-fuzzy automata, generalizations. Petri-nets, super-nets. Mathematical modelling of computer behaviour.

Senior scientists: Assoc. Prof. Anna Orosz Bagyinszkiné, Assoc. Prof. László Hunyadvári.

Data bases

Concepts of data modelling. Relational network and hierarchical models.

Senior scientists: Prof. János Demetrovics, Assoc. Prof. János Szelezsán

Number theory

Investigation of multiplicative, additive number theoretical functions. Generalized number systems and functional equations.

Senior scientists: Assoc. Prof. Keresztély Corrády

Institute of Informatics

Director: Prof. Ferenc Schipp

Departments

Department of General Computer Science: Prof. László Varga
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Senior scientists: Prof. Antal Iványi

Automata theory

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Senior scientists: Assoc. Prof. Anna Orosz Bagyinszkiné, Assoc. Prof. László Hunyadvári.

Data bases

Concepts of data modelling. Relational network and hierarchical models.

Senior scientists: Prof. János Demetrovics, Assoc. Prof. János Szelezsán

Number theory

Investigation of multiplicative, additive number theoretical functions. Generalized number systems and functional equations.

Senior scientists: Assoc. Prof. Keresztély Corrády

Address: Dr. Jozsef Sziray
           Head of Dept.
           Computer Research and Innovation Center,
           P.O. Box 19, 1251 Budapest, Hungary
Telephone: (36-1) 202-13-33, Telefax: (36-1) 201-77-73
Telex: 22-5381

RESEARCH AND DEVELOPMENT ACTIVITIES:

Since its establishment in 1969, SZKI has conducted intensive R & D activities in Computer-Aided Design (CAD) concerning digital electronics. The field of activity of our department, the Design Automation Laboratory, has also belonged to this area.

The department has developed several complex program systems, where each development has been based on original research results. These program systems (projects) belong to the following areas:

1) High level hardware-description language and its compiler, as well as a logic simulator at the register-transfer level, and at the functional level.

2) Automatic test design and fault simulation for logic circuits at the gate level and functional level (circuits with complex logic elements). This system (DIAS) also includes high level languages and their compilers for tact description and functional description of logic modules.

3) In the field of logic testing, we have also developed a complex software for a computer controlled test equipment.

4) We have also drawn artificial intelligence in our research topics: thus far we have worked out a detailed software concept of an expert system for controlling our test design program DIAS.

FUTURE PLANS:

1) Studying the hardware and software features of fault-tolerant computers.

2) Participation in the development of an on line transaction processing (OLTP) system which is based on a fault-tolerant, high performance computer.

PUBLICATIONS:

1) J. Sziray: Test calculation for logic networks by composite justification, Digital Systems Laboratory, Stanford University, Technical Note No. 129, Stanford, California, November 1977.

2) J. Sziray: A test calculation algorithm for module-level combinational networks, Digital Systems Laboratory, Stanford University, Technical Note No. 130, Stanford, California November 1977.

3) J. Sziray: Test calculation for logic networks by composite justification, Digital Processes, Vol. 5, No. 1-2, pp. 3-15, 1979.

4) J. Sziray: A test calculation algorithm for module-level combinational networks, Digital Processes, Vol.5 No. 1-2, pp. 17-26, 1979.

5) J. Sziray: Calculation of logic tests by composite justification, IFIP Working Conference on "Reliable Computing and Fault-Tolerance in the 1980's".)Invited paper), London, September 1979.

6) J. Sziray: A functional level test calculation concept for digital networks, Electronic Design Automation Conference, Proceedings, pp. 231-235, Brighton, September 1981.

7) J. Sziray: A survey on the concepts of functional level test generation, Fault-Tolerant Systems and Diagnostics Conference. (Invited paper), Proceedings, pp. 15-24, Brno, September 1981

8) J. Sizray: Functional level test calculation fault simulation for logic networks, Discrete Simulation and Related Fields, (Edited by A. Javor), pp. 223-234, North-Holland Publishing Company, Amsterdam, 1982.

9. J. Sziray, Zs. Nagy; TESTART: A test-description language for digital circuits, X-th IMEKO World Congress, Prague, April 1985.

10. L. Máté, Zs Nagy, J. Sziray: An expert system for test generation of digital circuits, International Conference on Artificial Intelligence, Proceedings, pp. 124-126, Varna, September 1986.

11) J. Sziray: The test-design program system DIAS, The First Hungarian Custom Circuits Conference, Proceedings, pp. 303-309, Gyöngyös, May 1987.

12) J. Sziray, Zs. Nagy, L. Máté: An expert system for test design of digital circuits, MTA-SZTAKI Studies, No. 202/1987, pp. 195-208, Budapest, September 1987.

13) T. Sipos, A. Patricsa, J. Sziray: An artificial intelligence application in fault-oriented algorithms, 5th Symposium on Microcomputer and Microprocessor Application, Proceedings, pp. 147-155, Budapest, 1989.

14) T. Sipos, A. Pataricsa, J. Sziray: A path-ordering principle for test calculation algorithms, 12th International Conference on Fault-Tolerant Systems and Diagnostics (FTSD-13), Proceedings, pp. 243-250, Varna, June 1990.

15) J. Sziray, Sz. Nagy: A hardware-description language for test generation, Hardware and Software Design Automation, (Edited by A. Nunez), pp. 525-530, North Holland Publishing Company, Amsterdam, 1991.

Budapest, March 30, 1992.

RELIABILITY MODELING GROUP

BME, Dep. of Process Control   Tel: 361-166-5011/2583

Budapest, XI Müegyetem rkpt. 11   Fax: 361-1852-658

H-1111   Email:h1509szi@ella.uucp

STAFF:

Head: P. Risztics Ph.D.

Scientific staff: 3   Postgraduate students:2

AREAS OF SCIENTIFIC WORK:

`odeling of complex electronic systems, Markovian state space methods, performance and performability modeling, analysis of complex process control systems, application oriented approach in dependability modeling, reward models, software reliability, fault-tolerant systems, system diagnosis, computer aided reliability evaluation.

LATEST PUBLICATIONS:

[1] Risztics, P. - Szirmay-Kalos, L.:
Modeling and optimal design of large-scale, real-time computer systems
2nd Intl. Conf. on Soft. Eng., Cirencester, UK, 1989

[2] Horváth, T. - Risztics, P. - Szirmay-Kalos, L.:
RELCONT: Hierarchical analysis of process control systems
RELECTRONIC Conf. Proc., Budapest, 1991

[3] Risztics, P. - Szirmay-Kalos, L.:
Qualitative approach for the design of computer systems
7th Symp. on Microcomputer Appl., Budapest, 1992

[4] Risztics, P. - Szirmay-Kalos, L.:
Continuous performance-reliability modeling of computer systems
7th Symp. on Microcomputer Appl., Budapest, 1992

COMPUTER ENGINEERING IN CONTROL SYSTEMS

Project leader:

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Department of Process Control, TUB
H-1111 Budapest, MÜegyetem rakpart 9.
Phone: (0036)-1-166 7392
Fax:(0036)-1-185 2658
E-mail: h4244kon@ella.hu

Actual goals:

- To find relevant specification and implementation models for control systems
- To find methodologies for developing intelligent distributed control systems with defined response time and reliability
- To develop an object-oriented environment for developing control systems applications

Main results:

- An object based methodology but without really tools for control systems engineering

- Some reusable software component for dedicated real-time control systems based on low-cost simple hardware components (real-time kernel, comunication subsystem, operator interface for 8 - 16 bit microprocessors and microcontrollers)

- Application of the methodology and the components in some dedicated control systems (e.g. in color video matrix scoreboard control, in production control systems of bread factories, etc)

Publications:

Kondorosi,K. László,Z.:
A Standard Software Component for Dedicated Microcomputer Systems
μP '89 Sixth Symposium on Microcomputer and Microprocessor Applications, Budapest, October, 1989.

Kondorosi,K. László,Z.:
Object Oriented Design of Real-Time Systems
2nd Joint Austrian-Hungarian Workshop on Education & Research in Software Engineering, Budapest, June, 1991.

Kondorosi,K. László,Z. Megyeri,J.:
Models for Software Engineering and a Methodology for FIR-90 Software Development
Study for the Research Center for Physic of the Hungarian Academy of Sciences. Budapest, 1989, (in Hungarian)

More than hundred local databases are providing services. The main Information services (such as DIALOG, ORBIT, Data Star, STN, IAEA, Pergamon Infoline, Questel, ESRIN, ECHO) can be accessed by X.25 connection. Thanks to the political changes in Hungary, since 1990 the EARN and the ASTRA services are also accessible.

Now the program is entering its second phase, its present infrastructure may be the basis for further developments during the period 1991-1994.

The circle of users will grow considerably. While maintaining the already popular and familiar services, their scope will be widened. Our objective is to achive the level of the developed countries.

The program will coordinate our human and financial resources, it will help the complex Hungarian academic and research community to join international projects, to improve scientific relations, to enhance the level of education.

THE CONCEPT OF THE NEW PHASE OF THE IIF PROGRAM

The basic development concepts will focus on the progress of information technology and the possibilities for Hungary in purchasing the newest hardware equipments and software tools.

The political changes in our country resulted in considerable decrease of the COCOM limits. The IIF System expects support as a part of the assistance programs of developed countries (EEC, the World Bank).

A significant amount of large capacity workstations and host computers will appear on the individual research sites. A wide variety of network components are already available for those computers, and components corresponding to the International standards (OSI) will also appear. Accordingly, in the next phase of the program, the extended IIF System will be based on equipments available on the market. Instead of developing them by our own, our task will be the proper selection of the necessary equipments and their integration into the Hungarian user environment.

BASIC DEVELOPMENT CONCEPTS

Data network

The IIF network should be based on the public packet switched data network. The number of institutions connected to it will be over 500.

For enhancing data transmission speed, 9.6 kbps leased lines should be used, the number of 64 kbps interfaces will be over 25.

More than 25 UNIX based regional LANs will be developed, and we expect several thousand interconnected PC-s.

The introduction of the INTERNET technology is highly recommendable, therefore an IP router must be installed for each regional LAN.

Hungary would like to be connected to the European backbone networks (like IXI) and run X.400, OSI CLNS and IP over X.25.

Regional centers and wide area network

Regional centers are to be built in the main universities and research institutes, in UNIX environment. The LAN-s should consist of one or two servers, 5-10 workstations and 10-30 terminals. The regional centers will be EUnet or EARN nodes. (The first installation will be financed by the EEC and the World Bank.) Optical cable based LAN are being built. ETHERNET will run over the cables, but FDDi and DQDB are planned.

The wide area network interconnecting the regional centers will be based on a virtual non volume charged packet switched network service of the Hungarian Telecommunication Company.

Electronic mailing

The services of the present e-mail system (ELLA) will be improved by integrating ELLA into the EUnet, EARN systems and introducing the CCITT X.400 and X.500 message handling and directory services.

Database services

Further online databases with Hungarian, English or German language are to be developed. More libraries should provide online service.

EDUCATIONAL AND TRAINING PROGRAMS

In the coming phase of the IIF program more attention must be given to the users' training and to the education of the technical staff.

Users' training

The users' training will be carried out in a hierarchical way. We estimate the number of users over ten thousand by the end of 1993. After the professional training of the staff at the regional centers users will be instructed by the staff.

Topics

- basic knowledge for using the PC-s
- word processing systems
- how to use e-mail
- basic knowledge for using online database services
- how to use teleconferencing systems

Professional training for the technical staff

Thanks to the political changes there is no more need for equipments developed by our own. But the large variety of the available resources requires experts on system design, integration and installation. The technical staff must be familiar with the most up-to-date information network services in Europe and in the USA:

- unified open network services according to the ISO-OSI regulations,
- unified user interfaces
- connections to international databases
- new possibilities for cooperation with international research networks.

Special efforts should be taken to master the usage of the unified standards in electronic mailing, directory services, interactive access, file transfer services. It is very desirable to apply network management methods to the IIF network. The services characterizing the cooperative systems should be established and widely used.

CONNECTIONS TO INTERNATIONAL NETWORKS AND ORGANIZATIONS

The following international connections have been established:

EARN   European Academic Research Network

EUnet   European UNIX Network

HEPNET   High Energy Physics Network

Connections to be realized in the near future:

IFDO

Internet   USA Research Networks

NSFnet

COMPUTER RESEARCH ACTIVITIES AT THE
KFKI RESEARCH INSTITUTE FOR MEASUREMENT AND COMPUTING TECHNIQUES

Organization:

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Department of Information Technology
Head of department: dr. István Erényi

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The main Research activities of the Department are directed towards some of the advanced topics of information technology.
Goals of the Department have been to study and develop new

- methods e.g.:
    parallel processing
    application/algorithm oriented architectures
    vertical migration
    emulation by microprogramming
    simulation

- applications e.g. in the field of:
    scientific computation
    space research
    industrial quality control
    protocol engineering

- devices   e.g.:
    special purpose systems
    image processing application systems
    application programs for parallel processing.

Cooperation with universities and academic research institutions:
For supporting R&D and education activities in these fields, the Department together with the Technical University of Budapest established the following centers:

      - Center for Parallel Computing
      - Center for Simulation Methodology
      - Communication and Protocol Test Center.

The department is partially supported by grants of the Hungarian Academy of Sciences and partially works under contracts with government agencies (e.g. State Office for Technical Development, Hungarian Science Foundation, Ministry of Industry), application oriented companies, and manufacturing companies.

R&D activities of the Department have been carried out by the following groups:

Parallel Processing, Massively Parallel Computer Group

- Parallel software engineering
- Fine grain algorithms and architectures for special purpose processing
- Matching algorithms and architectures
- Implementing Prolog on distributed memory multicomputers
- Research on concurrent object oriented languages
- Research on application of massively parallel systems built on the base of associative processors
- Developing parallel task libraries.

Image Processing Group

- Image processing software tool-kit development
- Measuring the lean/fat ration in minced meat
- Textile fabric inspection
- Remote diagnostics
- Processing for microscopy images in medical and biological applications
- On board image processing system on Venus-Halley spacecraft
- Comet and instrument simulation system for Halley mission
- Image processing system for satellite pictures
- ARGUS Image Processing Workstation, an open ended general purpose system

Simulation Group

- Elaboration of methods and development of simulation systems
- Mapping real systems into simulation models
- Enhancement of the effectiveness of simulation experiments
- Applying methods of AI in simulation

Protocol Group

- Consultant system for protocol engineering
- Conformance test system for X.25
- Software package for protocol modeling.

'Computers for disabled persons' group

- Development of methods helping blind persons
- Computer based aids to support blind persons' activities.

The Information Infrastructure Program (IIF) for Research,
Development and Higher Education
1991-1994

INTRODUCTION

The IIF is a program supported by the National Committee for Technological Development (OMFB), the Hungarian Academy of Sciences (MTA), the (Hungarian) National Science Foundation and the Ministry for Public Education, for establishing computer network based information services for Hungarian universities, research and development institutions, and higher education.

The first phase of the IIF program started in 1986. The design goal was not only to set up a computer network but to provide Information and communication services as well. The Hungarian computer facilities became obsolete that time, while purchasing any type of modern telecommunication systems was impossible due to the COCOM regulations during the period 1986 - 1989. The majority of our resources were spent on the acquisition of intelligent terminals /PC-s/, LAN-s, the design and development of the packet switching communication system. Integrating the end systems to the packet switching network required many efforts as well.

The first phase of the IIF program has been successfully implemented. All the important universities, academic institutions and some large companies joined the IIF system.

A network based information system is at the disposal for several thousands of users. The system is based on international- and de facto standards (X.25, XXX, UUCP) guaranteeing the interaction with international networks.

The following services are provided:

- National e-mail service with connection to EUNET (ELLA)
- Bulletin board services (ELF)
- File transmission services (PETRA)
- Full screen access to databases.

Computer Science/Computer Engineering

POLAND

List of Projects

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Education: Lomonosov University, Moscow, USSR
            Victoria University, Manchester, UK

Degrees: M.Sc. 1960
            Ph.D. 1962
            D.Sc. 1966

Employment: Computation Centre, Polish Academy of Sciences
(1961-1972)

            Work on astronomical and space computations; early
            compilers and operating systems, design of data
            bases; design of software architecture for
            commercially produced computers (mainframes).

            Union of Polish Computer Manufacturers MERA
            (1972-1977)
            Head of Software Research, responsible for the
            design of large database systems and for
            implementation of OS/360 on a Polish-made RIAD
            mainframe (EC1030-32)

            Warsaw University, Institute of Informatics (1977-)
            Professor of Computer Science, Director (1977-1982)

            Imperial College, London, UK (1983-1987)
            Visiting Professor in the Department of Computing.

Professional and Learned Societies:

    *   The Fellowship of Engineering (British Royal Academy of
        Technology): Foreign Member (1991)

* British Computer Society: Fellow (1974), Distinguished
  Fellow (1989)
* Polish Informatics Society: President (1981 - 1987),
  vice-President (1990-)
* International Federation for Information Processing:
  Secretary of the Working Group on Algol (1962-1968)
  Founding Member of the Working Group on Programming
Methodology (1969)
  Programme Chairman of the World Computer Congress 1977
(Toronto)

Managing Editor of Information Processing Letters (North Holland)

Main Editor of Acta Informatica (Springer Verlag)

Author of more than 100 paper and 7 books on computing,
programming, software and CS education (published and/or
reprinted in the USA, UK, USSR, Germany, Scandinavia, Latin
America and Poland)

Invited lectures in USA, UK, USSR, Germany, The Netherlands,
Spain, Brasil, Argentina, Canada, Australia, Finland, Sweden,
Denmark, Jugoslavia, Bulgaria.

Consultant to various national and international bodies,
including: UNIDO mission for microelectronics to ECWA (Middle
East) region (1983) and subsequent Kuwai meeting (1984); UNDP
mission on Regional Software Centres to Tunisia and Egypt (1988);
Imperial Software Ltd.,UK, (1986-1987) development of CASE tools;
Bank PKO BP (1991) IT strategy; Software Factory Project (CEC)
(1991).

Current Research: Software Engineering (specification methods
software process and its support technology), novel approaches to
real-time systems, programming for behaviours.

Some recent publications:

1. Time considered irrelevant for real-time systems. BIT 28
(1988), 473-486

2. Calculus for software development. In: LOGISTICS - where
ends have to meet (C.F van Rijn, Ed.), Pergamon Press, 1989, pp.
184-197.

3. Timing considerations will damage your programs, or how to
trade clock for chips. Proc. Joint University of Newcastle/Tyne
and ICL International Seminar (B.Randell, Ed.), 1989, pp. VIII.0
- VIII.17

4. The quest for timeless specifications leads to non-stepping automata. In: Beauty is our Business. A Birthday Salute to E.W.Dijkstra.(W.H.J.Feijen, D.Gries, N.van Gasteren, J.Misra Eds.), Springer Verlag, 1990, pp.399-409

5. On specification of multiprocessor computing. Acta Informatica 27 (1990) 685-696.

6. Prescribing behaviours. In: Images of Programming (D.Bjorner, V.Kotov Eds.) North Holland, 1991; also Theoretical Computer Science 90 (1991) 119-125.

7. On starvation and some related issues. Information Processing Letters 37 (1991), 171-174.

8. Invisible Laws and Public Myths of Programming (Invited lecture at Euromicro 91, Vienna). Microprogramming and Microprocessing 32 (1991) 1-4.

9. Extending the computing paradigm. Structured Programming. 13 (1992), 1-9.

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Short Curriculum Vitae

a) Academical degrees, affiliations and positions
Ph.Degree 1973 "Effectivity problems of Algorithmic Logic"
Hab.Degree 1978 "Programmability in fields"
Vice Director of Institute of Informatics, 1981-1984
Vice Dean of Faculty of Mathematics, 1984-1987
Postgraduate studies in Blaise Pascal Institute, Paris, 1969
Visiting professor of IASI CNR Rome, 1982, 1984
Visiting professor of Cean University, 1988
Visiting professor of TUNS University, Halifax, Canada, 1990

b) The most recent publications:

1. On inheritance rule in object oriented programming, in Advanced Programming Methodologies, APIC ser. N.30 , Academic Press, 1989, pp. 141- 164.

2. Loglan-88, Report on the programming languages, LNCS 414, Springer Verlag, 1990, coauthor.

3. Analysis of algorithms and data structures, monogr., Addison-Wesley,1991, coauthor.

c) Areas of interest:

1. Analysis of algorithms and data structures (design of efficient algorithms, probabilistic analysis of algorithms, data structures and the methods of their implementation).

2. Implementation methods of programming languages (compilers, run-time systems, garbage collection algorithms, optimalization).

3. Object-oriented programming (methodology and methods of object-oriented programming, inheritance, concurrency in OOP).

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1. Education: MS Degree (1974), Ph.D. Degree (1975), Habilitation (1982), Professor Degree (1991).

2. Positions held at the University of Warsaw: Assistant Professor (1974-84), tenured Associate Professor (1984-90), Full Professor (since 1990).

3. Administrative positions at the University of Warsaw: Associate Director of the Institute of Mathematics (1985-87); Associate Director of the Institute of Informatics (since 1991).

4. Long term visits to other universities (at least six months): RWTH Aachen (1978/79), MIT and Boston University (1981), Washington State University, Pullman (1984/85, 1988/89).

5. (Grants) Participation in NSF grants as a senior researcher (every year after 1988), Polish KBN grant, a leader of 'Warsaw' site in ESPRIT BRA Working Group (7232) "Common Foundations of Functional and Logic Programming".

6. An Editor of the following journals: Information and Computation (since 1983), Fundamenta Informaticae (since 1983), Mathematical Structures in Computer Science (since 1990), Theoretical Computer Science (since 1992).

7. A member of Program Committee: "Model Theory and Algebra in Comp. Sci." (Hungary'84), "Logics of Programs" (USA'85), "Logic in Computer Sci. LICS" (Great Britain'88), "Heyting Conference on Math. Logic" (Bulgaria'88), "Logic and Algebra in Programming" (USSR'89), "Trees and Algebra in Comp. Sci. CAAP" (France'92), "Logical Foundations of Comp. Sci." (USSR'92)

8. Invited talks at international conferences: Mathematical Foundations of Computer Science (1986, 1990), Congress of Mathematicians od GDR (1990), Computer Science Logic (Italy'92).

9. A member of the Steering Committee of IEEE Symp. Logic in Computer Sci.LICS, since 1990.

10. Participation in international conferences: presenting a paper (ca 30), without a paper (ca 15).

11. Research interests: type theory, lambda calculus, semantics of polymorphism, functional programming, logics of programs, program verification, computational power of programming languages, complexity issues in logic, finite model theory.

Some publications:

1. "Floyd's principle, correctness theories and program equivalence" (co-authors: J. A. Bergstra and J. V. Tucker), Theoretical Computer Science] 17 (1982), pp. 113--149

2. "Unbounded program memory adds to the expressive power of first-order programming logics" Information and Control Vol. 60 (1984), pp. 12--35

3. "On the power of nondeterminism in Dynamic Logic", (co-authors: P. Berman and J. Y. Halpern) Proc. of the International Colloquium on Automata, Languages and Programming (M. Nielsen and E. M. Schmidt eds.), LNCS 140, Springer Verlag 1982, pp. 48--60

4. "Some relationships between logics of programs and complexity theory (co-author: P. Urzyczyn) Theoretical Computer Science Vol. 60 (1988), pp. 83--108

5. "A simplified proof of DDL<DL", Information and Computation vol.81 (1989), 1-12

6. "Logics of Programs", (co--author D. Kozen) in: (J. van Leeuven, ed.) Handbook of Theoretical Computer Science, Vol. B, Formal Models and Semantics, Elsevier Science Publ. and The MIT Press, 1990, pp. 789--840.

7. "Computational Consequences and Partial Solutuions of a Generalized Unification Problem" (co--authors A.J. Kfoury and P. Urzyczyn) Proc. 4th IEEE Symp. Logic in Computer Science, Asilomar, CA (1989)

8. "The undecidability of the semi-unification problem", (co-authors A.J. Kfoury and P. Urzyczyn), Proc. 22nd ACM Symp. Theory of Computing, Baltimore 1990, pp. 468-476.

9. "An analysis of ML typability", (co-authors A.J. Kfoury and P. Urzyczyn), Proc. 15-th Colloquium on Trees in Algebra and Programming, CAAP'90, Arnold (ed.), LNCS vol.431, Springer, 1990, pp. 206-220.

10. "Type reconstruction in finite-rank fragments of the second-order lambda--calculus", (co-author A.J. Kfoury), Proc. 5-th IEEE Symp. Logic in Computer Science, Philadelphia 1990, pp. 2-11.

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Education: M.Sc. 1980 Warsaw University, Institute of Informatics
           Ph.D. 1989 Warsaw University, Faculty of Mathematics

Employment:
  1980-1984 Postgraduate studies at the Institute of
            Mathematics of the Polish Academy of Sciences.
            1984-1985 adiunkt, Computer Science Dpt, Aarhus
            University, Denmark
  1985-1986 Computation Center, Warsaw University
  1986-1991 adiunkt, Institute of Informatics, Warsaw University
  1991-1992 visiting professor at Zaragoza University, Spain
  1992 -   Institute of Informatics, Warsaw University

SCIENTIFIC ACTIVITIES:

     In 1980-1991 I worked on the theory of concurrent systems.
     My area of interest concerns concurrency (Petri Nets,
distributed algorithms). I have done some research in analyzing
Petri nets properties and applications of nets to specification
of computer systems.
     Methods of the structure theory of nets turned my attention
last time. Statical analysis of nets and algorithms for
determining net behaviour are at my current research.

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I have been involved also in some programming projects concerning problem solving in medicine and in public transport (in cooperation with the Italian Research Centre CRISS -Torino). These projects concerned the areas of image processing and network flows problems. (1986-1990).

I am heading a project on the Associative String Processing. Tools for simulation of SIMD ASP computer are under construction and a research in methodology of ASP programming is in progress. The project description follows the document.

I gave several courses for students at Warsaw and Aarhus Universities in the field of Theoretical Computer Science, including Temporal Logics, Probability Calculus, Graph Theory, Data Structures, Petri Nets, Rudiments of Computer Science, Programming Languages.

I am the President of the Program Council of the ComputerScience Students' Circles in Poland.

TALKS GIVEN ABROAD:
    (2) Courses for students at the Aarhus University (Denmark).
    (2) Talks at the international conferences:
        -VIIIth European Workshop on Applications and Theory of
         Petri Nets, 1987, Zaragoza, Spain
        -Mathematical Foundations of Computer Science, 1990,
         Banska Bystrica, Czechoslovakia
    (1) Course on Trace Theory at Zaragoza University (Spain)

Recent publications:

1. "Generalizations of Liveness and Fairness Properties" - Aarhus University DAIMI Report No 194, Aarhus 1985.
2. "A Proposition of Generalization of Liveness and Fairness Properties" Proceedings of VIII European Workshop of Applications and Theory of Petri Nets", Zaragoza (Spain),1987
3. "On Weighted T-systems", (together with J.M.Colom, M.Silva, E.Teruel), Research Report GISI-RR-92-04, Dpto.Ing.Electrica e Informatica, Universidad de Zaragoza, 1992; to appear also in LNCS as Advances in Petri Nets 1992.
4. "On Weighted P-systems" (together with M.Silva, E.Teruel), Research Report GISI-RR-92-09, Dpto. Ing.Electrica e Informatica, Universidad de Zaragoza, 1992;

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13. ABSTRACT (Maximum 200 words)

This report describes impressions of the Author and provides a preliminary assessment of the status of computer science/computer engineering research and education in Central Europe (Czechoslovakia, Hungary, and Poland). It is based on visits made by the Author to each capital city. Ideas for possible American-Central European cooperation are outlined, including a plan for organizing a series of three workshops that would advance the state-of-the-art in high-performance computing.

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