

John von Neumann Faculty of Informatics**Institute of Information Systems****Address: Bécsi út 96/B, H-1034 Budapest, Hungary****Tel.: +36-1-666-5520****Fax: +36-1-666-5522****E-mail: szeidl@bmf.hu****Website: <http://www.nik.hu/iri>****Head of Institute: László Szeidl****1 Introduction****Institute of Information Systems**

The Institute of Information Systems is responsible for the theoretical background, standards, implementations, security, management, operation, core applications and the system level interoperation of the information infrastructure.

Activities pursued by the Institute include teaching of the core curriculum, providing specializations in the Technical Informatics B.Sc. and the Information Technology Engineer M.Sc. level education, writing books, practical guides, articles, conducting research work and cooperating with a variety of industry partners. The institute operates 4 Competence Centers and 7 laboratories with a 22-strong resident staff.

Structurally, the Institute operates three departments with 4-8 staff members in each. Curricular course groups, specialized modules, competence centers and laboratories are assigned to these departments.

Departments:

- Applied Information Technology Department
- Information Systems Department
- Mobile Information Technology and Artificial Intelligence Department

2 Educational Profile

Applied Information Technologies Department

The department is responsible for developing, coordinating and teaching courses pertaining to hardware elements in information systems. These courses are offered to all Technical Informatics students.

Course groups: Digital Technology, Electronics, Digital Electronics, Control Engineering.

The department is responsible for the Informatics System Engineering specialization.

Motivated by a lack of technical experts in the economy, this specialization was launched 6 years ago, and its successful operation demands regular upgrades to technical devices as well as a highly skilled teaching staff.

Specialization courses include LAN and WAN Technologies, Internet Technologies, Operation of Computer Networks, Institutional IT Security in Practice.

Core subjects are supplemented by several optional courses, including Data and Voice Cabling, Wireless LAN Networks, UNIX Systems, Network Security Systems, Network Operating Systems, Small Office and Home Office Information Systems, IP Telephony Systems.

For a long time now, the team has been actively working in researching and developing devices and methods for practical training in order to improve problem solving skills. These fields include:

- Simulating electronic systems
- Simulating electromechanical systems
- Simulating the operation of network systems

Results obtained from this activity are directly incorporated in the daily routine and utilized by other educational institutes as well.

Lab Background Support

The courses described above share a common laboratory infrastructure. Three laboratories are equipped with computers and other, significantly more expensive and sensitive devices.

Information Systems Department

The department is responsible for developing, coordinating and teaching courses pertaining to the theoretical operation and cooperation of hardware and software elements constituting the information infrastructure.

Course groups: Elements of Information Systems, Computer Networks, Computer Architectures, Operating Systems, Information Security Basics.

The department is responsible for the Information Security specialization.

Focusing on the elements, the structure and the operation of secure information systems, this specialization covers the security issues in computer systems and their elements, computers and their components, operating systems, network components, protocols and applications. It provides information to students regarding preventive measures against attacks, corrective measures after attacks and methods of investigation that helps the exploration of the attacks. It explains the design and implementation of security protection systems that rest on the enterprise information infrastructure and human resources.

Specialization courses include Security of Operating Systems and Applications, Introduction to Information Systems Auditing, Computer Network Security, Enterprise Level Information Security Design, Enterprise Level Information Security in Practice.

Mobile Information Technology and Artificial Intelligence Department

The department is responsible for teaching core courses to all Technical Informatics students.

Course groups: Introduction to Informatics, Theoretical Foundations of Informatics, Theoretical Foundations of Intelligent Systems, Laboratory for Intelligent Systems, Processor Level Programming.

The department is responsible for the Mobile Informatics and Embedded Intelligent Systems specializations.

Specialization courses in Mobile Informatics include Mobile Informatics, Programming Languages of Mobile Systems and E-commerce.

Specialization courses in Embedded Intelligent Systems include Embedded Systems, Sensor-based Systems, Biometric Identification Systems, RFID-based Identification Systems.

Lab background support

The group supervises two large computer labs (Nokia, Intel) and two smaller computer labs (Assistive Technology and Mobile Informatics R&D).

Competence Centers

Cisco Academy Training Center

The Applied Information Technology Department operates Cisco Academy Training Center, which was established in 1998. The director of the center is Dr. Gyula Fehér. Contributing staff members are Dr. Péter Broczkó, Dr. Gyula Fehér, Dr. Tamás Schubert, György Bitay, László Kóré, Krisztián Oroszi.

Objectives

The basic aim of cooperation is

- to ensure fast and direct access to the latest research results and technologies in networking for our own students, teachers and instructors from Central European countries,
- to make the highest level research, development and training activity possible by the creation of state-of-the-art laboratory background,
- to ensure the application and development of highly efficient teaching technologies, which allow students to acquire theoretical knowledge and real world problem solving skills necessary for engineering activity,
- for the activity of the Training Centre covering several countries, to create the framework of a wide international cooperation, which will also ensure for the College a European-level cooperation in the field of R&D and project funding,
- to prepare students and instructors for the acquisition of a whole range of widely acknowledged and highly evaluated professional qualifications.

Areas of Support and Cooperation

Active, bilateral professional work, in which Cisco participates by sharing their professional assets and by supporting the creation of the laboratory background necessary for efficient and high quality professional activity. On the other hand, Budapest Tech contributes by educational and development programs, by the training and retraining of Hungarian and foreign students and instructors in the field as well as by taking part in joint developments.

Center Activities

- Courses and programs currently offered:
 - Design and operation of small and medium networks: CCNA1-CCNA4
 - Design and operation of medium and large networks: CCNP1-CCNP4
 - Build and operation of workstations and network servers: IT1 and IT2
 - UNIX and Linux operating systems: UNIX
 - Design and operation of wireless local networks: Wireless LAN
 - Design and operation of security systems of network systems: Security1 and Security2
 - Design and operation of IP telephony systems: IP Telephony
- The duration of the courses are 80-100 hours, the languages are Hungarian and English.

- Participants of the training:

Students of Budapest Tech (full-time and evening training, postgraduate training)

Training and retraining of instructors from Hungarian and foreign educational institutes (altogether 16 countries)

Training and retraining of professionals from the Hungarian industry

Technology Platform

Three state-of-the-art laboratories, which allow to design, build, test and tune of real networks small, medium and large institutions in several cities. Complete network systems can be created and analyzed (LAN, WAN, Wireless, Security, IP telephony).

Plans

Introducing newly emerging professional fields in addition to keeping the already existing ones

Keeping the high professional quality of training

Increasing the number of course participants

Developing and introducing new educational methods, with special regard to increasing the scope of practice-oriented training of engineers

Nokia Competence Center

The Mobile Information Technology and Artificial Intelligence Department operates Nokia Competence Center, which was established in 1998. The director of the center is Dr. László Kutor. Contributing staff members are Dr. László Kutor, Zoltán Ladányi, and Zsolt Sziklai.

Objectives

It establishes a laboratory with the necessary state-of-the-art technology on which to build a curriculum for teaching mobile informatics and to conduct joint research.

Areas of Support and Cooperation

Since the onset of our professional cooperation, Nokia has provided almost 20 Million HUF towards the creation of the technological infrastructure.

Center Activities

Nokia provides continuous consultations to ensure that the mobile informatics teaching materials reflect the most current trends and technologies. Many of the students specializing in mobile informatics go on to conduct cooperative internships at Nokia. On their graduation, Nokia has hired numerous students.

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In May 2006, Budapest Tech's NIC signed a separate R&D agreement with Nokia for test development and automation. In the initial phase, NIC teaching staff, with plans to include students in the Master's and Ph.D. programs in later stages, conduct research.

Technology Platform

The 25-person laboratory equipped with IBM PC's with P4 processors and an additional 12-person development laboratory provide the basis for instruction in mobile informatics.

Plans

Continuous further development of the mobile informatics curriculum. Inclusion of students in R&D activities, including in the area of test automation.

Symantec Information Security Competence Center

The Information Systems Department operates Symantec Information Security Competence Center, which was established in 2005. The director of the center is Dr. Tamás Schubert. Contributing staff members are Dr. Tamás Schubert, Póserné Valéria Oláh.

Objectives

The training of the theory and practice of the information security gathers more and more ground in the basic and specialist education in the institute. Because of this, the faculty launched a special BSc specialization module, called Information Security in the autumn of 2006 and plan to introduce an IT Engineer MSc training with an Application Management specialization, where the security questions get high priority. For these goals, we need world standard level security devices and software solutions that are upgraded for several years. Most of these devices are available in a computer laboratory by the support Symantec.

The accentuated goal of the launch of both specialization is the teaching the theory of secure IT infrastructure and to provide skill for designing and setting up it. By forming IT security engineers, we contribute to satisfy the demand of industry for this kind of specialists.

Areas of Support and Cooperation

Symantec Corporation supports the operation of the Center by supplying special appliances and continuously upgraded software applications.

Symantec Corporation ensures regular consultation and tutorial for the staff of the Center.

Center Activities

Teaching our full-time and evening school students in core and specialization curricula.

Technology Platform

25 high performance desktop computers

The appliances and software applications covers the following IT security fields: Intrusion-detection and protection, vulnerability analysis, early detection solutions, security management, firewall/VPN, virus protection against of SPAM and unwanted contents.

The appliances and software applications are eligible for design, implement, test and research secure IT infrastructure on enterprise level.

Plans

Include more contributors in the work of the Center.

Enrich the available appliances.

Prepare pattern configurations for education and research purpose.

Launch IT security courses.

HP Application Management Competence Center

The Information Systems Department operates HP Application Management Competence Center, which was established in 2006. The director of the center is Dr. Tamás Schubert. The contributing workmates are Dr. Tamás Schubert, Gergely Windisch, Balázs Csongrádi.

Objectives

The training of the theory and practice of application management and application service gathers more and more ground in the basic and specialist education in the institute. We plan to introduce IT Engineer MSc training with an Application Management specialization on the February of 2007 year. The practices of the special management subjects are built mainly on the HP OpenView software family. HP assists in the introduction of OpenView modules into the education with financial support and professional trainings.

Areas of Support and Cooperation

The help of HP includes financial support in the form of innovation and training funds, scholarships, professional trainings and preferential software licenses.

HP contributes in the construction of the OpenView software environment in the laboratory and the preparation of study materials.

HP helps the specialized training of our students by offering final thesis projects and consultation for them.

HP ensures continuous consultation and offers trainings for the staff of the Center.

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Center Activities

Building the infrastructure of the Center

Preparing the education of the Application Management specialization in the IT Engineer MSc forming by working out laboratory materials

Technology Platform

The available OpenView software modules are: Configuration Management, Identity Management and Network Node Management

Plans

The HP Application Management Competence Center wants to join the HP OpenView University Association program and participate in the research work of it.

Use and teach other OpenView software modules.

Include more contributors to the work of the Center.

Launch Application Management courses.

3 Research and Scientific Activity

Research activities and some publications which are connected to the work of the Operations Research and Applied Mathematics Research Group.

Statistical modeling of local daily meteorological time series and their simulational analysis. Analysis of extreme meteorological events, development of a new estimation method for extreme index

Dobi, I., Mika, J., Szeidl, L., Modeling Wet and Dry Spells with Mixture Distribution, Meteorology and Atmospheric Physics, 2000, 73, 243-256

Szeidl, L., Non-Normal Limit Theorem for a New Tail Index Estimation, Annales Univ. Sci. Budapest., Sect. Comp., 2004, N 24, 309-322

Investigation of limit theorems for non-linear stochastic models

Szeidl, L., Zolotarev, V. M. The Theory of Limit Theorems for Random Polynomials and Related Fields, Leaflets in Mathematics (ISSN 1416-0935), University of Pécs, 2003

Investigation of theoretical and practical problems concerning diversity of ecological systems

Izsák J., Szeidl, L., Quadratic Diversity: its Maximization can Reduce the Richness of Species, Environmental and Ecological Statistics, 2002, 9, 423-430

Ricotta, C., Szeidl, L., Towards a Unifying Approach to Diversity Measures: Bridging the Gap between the Shannon Entropy and Rao's Quadratic Index, *Theor. Popul. Biology*, 2006 (under publication)

Dynamical load analysis of utility vehicles from the point of view of designing for given employment of the vehicle

Berke, P., Michelberger, P., Nándori, E., Szeidl, L., Varga, F., Load History and Structure Analysis of Utility Vehicles, *Periodica Polytechnica, Transp. Eng.*, 2004, Vol. 32, N 1-2, 149-159

Determining the canonical form of polytopic models playing an important role in control theory and the numerical reconstruction of the model

Péter Baranyi, László Szeidl, Péter Várlaki: Numerical Reconstruction of the HOSVD Based Canonical Form of Polytopic Dynamic Models, in *Proc. of IEEE 10th International Conference on Intelligent Engineering Systems (INES 2006)*, London, United Kingdom, June 26-28, 2006, pp. 196-201, ISBN 1-4244-9708-8, IEEE Catalog Number: 06EX1430

The Microarchitecture of Superscalar Processors

Participants: Dr. Dezső Sima DSc, Dr Péter Brockó CSc, Miklós Kozlovszky and Árpád Miklós.

Research Objective

Advances in IC technology - enabling an exponentially growing number of transistors per chip - and continuously broadening of the application areas, such as multimedia, 3D, mobile applications, gave rise to a massive evolution of the microarchitecture of superscalars. Due to the speed and diversity of this evolution the assessment of the introduced design alternatives as well as the identification of related trends became an extraordinary complex task. For this reason, our research aims at spanning the design space of relevant subtasks of superscalar microarchitectures and based on that at the assessment of chosen design options and recognizing relevant trends.

Research Topics

- The design spaces of instruction issue, branch processing, instruction shelving, and register renaming,
- Deterministic features and limiting factors of the evolution of microarchitectures,
- The design spaces of multicore and multithreaded processors, and investigation of their potential application areas.

Research Results

In the previous years we identified and published the design spaces of instruction issue, instruction shelving and register renaming. Also we pointed out and

published the deterministic features of the evolution of microarchitectures. In subsequent research we spot on the limits of the evolution of single core superscalars arising from the efficiency, the thermal and the skew wall. The associated results are now prepared for submission for publication.

Recent research is focused on multicore, multithreaded processors, in particular we are concerned with their design spaces, on the other we investigate the application potential of these class of processors first of all for 3D pattern recognition and server applications.

Related Publications

- [1] Dezső Sima: Decisive Aspects in the Evolution of Microprocessors, *Proc. IEEE*, Vol. 92, No. 12, 2004, pp. 1895-1926
- [2] Árpád Miklós, Dezső Sima: VSIM – A Superscalar CPU Simulator, in Proc. of IEEE 3rd International Conference on Information Technology Based Higher Education and Training (ITHET 2002), Budapest, Hungary, July 4-6, 2002, pp. 561-572, ISBN 963 7154 07 8
- [3] Dezső Sima: The Design Space of Register Renaming Techniques, *IEEE Micro*, Vol. 20, No. 5, 2000, pp. 70-83
- [4] Dezső Sima: The Design Space of Shelving, *Journal of Systems Architecture*, Vol. 45, No.11, 1999, pp. 863-885
- [5] D. Sima, T. Fountain, P. Kacsuk: *Advanced Computer Architectures, A Design Space Approach*, Addison-Wesley Press, Harlow, etc., 1997, p. 766, revised edition 1998, p. 766 old

The Utilization and Impact of the Research Results

Previous research results were summarized and published in [5]. This book is still being used at more than 100 universities in more than 30 countries as a reference book for lectures held on computer architectures.

Related publications, especially the journal paper [3] are widely referenced, for instance in the literature given in recent Computer architecture courses at the Stanford University or the Carnegie Mellon University.

Furthermore, the research results are used in our Computer science and engineering BSc program, in the Computer architecture lectures, as well as in the course Advanced computer architectures held for PhD students at the Faculty of Electrical Engineering and Informatics at the Technical University of Budapest.

Partly owing to the research results achieved and the existence of our Intel Competence Center, we became invited to join the European Multicore Consortium established by Intel, among well-known prestigious universities, such as the Cambridge University, the Technische Universität München or ETH Zürich.

Ambient-assisted Living**Research Objective**

To develop tools and applications that will improve the quality of life and support increased independence of the elderly with reduced capabilities and the handicapped.

Research Topics

- Informatics support for the visually and hearing impaired. Mobile telephones equipped with machine speech for the visually impaired.
- Informatics to support independent living of the elderly.
- User-friendly local information service for the visually impaired using RFID and mobile telephone technology.
- Methodologies for effective teaching of the handicapped in the use of modern information technologies.

Research Results

Development of the first Hungarian speaking application for Symbian based mobile telephones. More than 100 blind users have participated in the test of the pilot program that 'reads' text messages out loud.

Mobile Informatics Tools and Applications**Research Objective**

General research in modern mobile informatics systems and their application.

Research Topics

- Continuous improvement of the curriculum and teaching materials for the
- specialization in mobile informatics.
- Development of Mobile Traffic Information Service
- Research and development in test automation for Nokia

Research Results

More than 100 students have graduated in mobile informatics as their field of specialization. The vast majority are currently employed by companies involved in the development of mobile applications or service providers

Embedded Intelligent Systems**Research Objective**

Research in embedded intelligent informatics systems.

Research Topics

- Continuous development and updating of the curriculum and teaching materials for the specialization in embedded intelligent informatics systems.
- Automatic control of robotic airplanes: (a) Identification of development guidelines and methods for cost reduction in further development; (b) Development of a user friendly control system to reduce learning time; (c) Application of special control mechanisms for risk reduction in operating robot airplanes.

Automatic Object and Person Identification

Research Objective

Comprehensive research in techniques for automatic object and person identification. Applied research in effective use of information technology.

Research Topics

- PhD topic: ‘Technical Informatics Challenges in the Field of Automatic Object and Person Identification’
- Research in the area of RFID: (a) Development of RFID-based inventory system for use in Hungary; (b) Development of monitoring information technology systems for Facility Management using state-of-the-art technology; (c) Comprehensive research in application of RFID technology (Innovation research grant); (d) Research under EU6 Framework Program: FP 6 „StoLpaN” Turning NFC-enabled mobile handsets into multifunction terminals with bi-directional interaction between the NFC chip and wireless communication channels.
- Biometric Personal Identification: Development of automatic personal identification system based on visual and dynamic handwriting characteristics.

Related Publications

E. Tóth, T. Nagy, L. Kutor: Development of an Autonomous Reliable High Quality Signature Verification Device, *Research & Development Division, Ministry of Education*, <http://www.om.hu/IKTA>, 2003

László Kutor, Zoltán Ladányi: Problems and Solutions in Dynamic Signature Authentication, in *Proceedings of IEEE International Conference on Computational Cybernetics, ICC 2006*, Siófok, Hungary, August 29-31, 2003, pp. 211-214, ISBN 963 7154 17 5

Medical Informatics

Research Objective

Development of a 4-dimension medical imaging system. The research project aims to develop the hardware and software system necessary to produce three-

dimensional digital images during an entire medical operating process and to generate a 3D interactive reconstruction as it evolves over time.

Related Publications

A. Balogh, M. C. Preul, L. Kutor, M. Schornak, M. Hickmann, P. Deshmukh, R. F. Spetyler: Multi-layer Image Grid Reconstruction Technology: Four Dimensional Interactive Image Reconstruction of Microsurgical Neuroanatomic Dissections, *Operative Neurosurgery*, February 2006, Vol. 58, pp. 157-165

The History of Informatics and Information Technology

Research Objective

Preservation and historical analysis of a comprehensive collection of information storage devices, most important elements of information technology and electronic components.

Research Results

Creation of a unique collection of irreplaceable artifacts documenting the historical stages of development of modern-day informatics.

The collection is a rich depository of human creativity and functional design.

Buffering and Performance Optimization in All-Optical Networks

Nowadays optical communications spectacularly conquer data networks. Electrical signals used in transmission gradually roll back, and optical signal based communication extends rapidly. In case of optical networks, the main key points of packet switching and routing are how to read and process the routing information from the packet, how to delay the packets in optical domain and how to resolve contention happening in the network. Nowadays optical switches and routers are working with optical-electrical-optical (O/E/O) conversion to handle the issues mentioned previously. DWDM (Dense Wavelength Multiplexing) technology can work on a few Tbps as traffic speed within one optical link. Such amount of data traffic can not be processed real time by conventional electronics. To overcome the speed barrier of electrical elements in active network nodes, one should use special technologies.

We can eliminate the optical-electrical conversion of the full packet, if we are using short labels containing the routing information. Labels can be submitted on a sub carrier wavelength, parallel with the original packet. This packet submission technology called SCML (Sub carrier Multiplexed Label) [1]. In case of SCML packet can remain in the optical domain and only the constant size labels should experience optical-electrical conversion. Processing labels instead of full packets cost measurable time, however this solution is far more effective comparing to other processing techniques. One of my main research area is the performance evaluation of SCML based optical networks.[2] My second field of interest is the contention resolution within optical switches. Signal buffering is a real challenge

in optical domain. Contention occurs, when the packets are being switched, and two or more packets are trying to leave the switch on the same wavelength of one port at the same time.

Contrary to electrical buffers, in the optical domain only limited solutions are available to store packets. To explain it simple, light can not be stopped, otherwise information lost occurs. The lack of optical RAMs is the key problem, however there are some solutions (e.g.: slow light, signal buffering in optical delay lines) to solve this issue. [3]

In case of optical delay lines, besides the effective scheduling, also the size and attenuation of the complex buffer structure are important optimization parameters. To evaluate different buffer architectures (e.g.: tandem, parallel, shared) made from optical delay lines, one can use semi-Markov (regenerative) processes for modeling. The aim of such analysis is to find key parameters in the models and increase the performance of the system. One can use also special system elements and solutions in the model, such as tunable lasers, deflection routing, and shared buffering. With the evaluated models the scheduling algorithms optimization of the system is also possible. For the research different applications are used such as discrete event simulators (omnet++, ns2), and general simulators: Matlab-Simulink, and LabView.

This research project is part of the Ph.D. work of Miklos Kozlovszky.

- [1] Optimalizált SCML alapú csomagküldés optikai hálózatokban, Kozlovszky M., Dr. Berceli T., Dr. Bíró J.; HTE05, Budapest, 2005. május
- [2] Subcarrier Multiplexed Label (SCML)-based Routing within a Packet Switched Optical Network, M. Kozlovszky, G. Kovács, T. Berceli; PWCOM2005, Gothenburg, Sweden, June 2005
- [3] Optical Delay Buffer Optimization in Packet Switched Optical Network, M. Kozlovszky, T. Berceli, CSCS2006-The Fifth Conference of PhD Students in Computer Science, Szeged, Hungary, June 27-30, 2006

Controlling Aircrafts Operated without a Pilot

Currently, those robot aircrafts which are the part of the system or are just before the setting into the system are very expensive, but their area of use is a very type-specific.

The appropriate elaboration of governing principles and methods could decrease technological costs during the development work. Therefore, the starting costs of developed robot aircrafts could be decreased, and this could give opportunities for their use in a broader area.

The handling of the modern control systems (robot systems) is a very complex task, it should reflect the governing principles of the age and demands highly qualified operators. At the same time, in many military areas there could be re-

quest for the cheap and commonly operated aircrafts, so the operators with the middle level of qualification or even one person could deal with the local tasks (for example, with the local reconnaissance). The working out an operating system with the 'users and personnel' approach will speed up the practical use of the robot aircrafts. But all this at the same time fulfils the conditions which are necessary for the piloting of the aircraft whilst in contrast with the traditional systems, the operating surface is common, the system and structure of data input reflects the user's approach, and not a technical one.

The use of robot aircrafts is a risky thing. The damage which could be caused by the possible breakdown depends on the damaged area (for example, if robot aircraft slams to the dangerous industrial region or plant or densely peopled area etc), and also on the size of the aircraft and its construction. The special drive train could decrease the operational risk of the robot aircrafts.

The Aims of the Research

To define those correspondences of mechanics, aerodynamics and flying technique in view of which it will be possible to design the most adequate flying robot constructions.

To define those translate functions, which could finely fit in the possibilities (capacities) of the modern computerizations, and at the same time possess the appropriate regulative characteristics.

To design and to achieve a complex unit which is directed by robot and which could be used in a flexible way in the different small-sized territorial and aeronautic vehicles.

To define the building technology of such a robot aircraft, by the help of which it will be possible to create the test aircrafts in a cheap and quick way and so thus make their research and expansion easier.

To design and build such an aircraft without pilot, which in the case of its damage does not cause sufficient property damage or human injuries.

To justify the principles and relationships which were defined, building several aircrafts without pilot for the demonstration purposes to make possible the demonstration of their different novel abilities (for example, cost-saving aeronautic reconnaissance, quick analysis, sending of consignment with highly precise dispatch, etc).

This research project is part of András Molnár's PhD work.