

**EXTENSIONS TO THE**  
**SEVENTH SIX-MONTHLY PERIODIC REPORT**

**Front page**

- **Full name of the Centre of Excellence**

**Számítástechnikai és Automatizálási Kutató Intézet MTA SZTAKI**

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Institute SZTAKI as a Centre of Excellence**
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Communication Technology, Intelligent Automation**
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## EXECUTIVE SUMMARY

The Commission requested an extended report on the progress covered by the Workpackages, in addition to the reports given in the SEVENTH SIX-MONTHLY REPORT. Our previous reports covered the Workpackages of the Contract's Technical Annex, P-A, WP-B, WP-C, WP-D and of WP-E.

We had APPENDED the Technical Annex with a copy of the former set of 34/12 Workpackages to show the large area of efforts and disciplines of the Institute. The Commission's request is met by the present EXTENSION of report, showing and detailing the efforts and results referring to the numbered Workpackages listed in the Appendix of the contract's Technical Annex.

The present material lists the results of each WP-s, (WP 1 to WP 12), and where appropriate, further materials and documents are added – as supplements – attached to this bounded document. All the documents are available on the Institute's web-pages as well [www.sztaki.hu/sztaki.coe/](http://www.sztaki.hu/sztaki.coe/), while our Institute's homepage is [www.sztaki.hu](http://www.sztaki.hu).

To allow for easy referencing at several items, the URL-s are also given at the comments.

We are confident that the reports submitted earlier give a more detailed picture for those evaluating the reports. Please remember that this document is, basically, additional information on our work, and also the descriptions within WP-A to WP-E must be taken into account, as PRIMARY mapping of the activities.

As foreseen at the time of the CoE proposal preparation, during the years elapsed from the beginning of the project, essentially all the themes had increased in significance, and some new disciplines have also emerged. Our presence in the Hungarian and European research palette is well-known and well-respected.

Due to the increasing respect, there are some research and development areas where our Institute could seed large Hungarian and some important international projects. The interdisciplinary new Bio-Informatics area was one of such seeding success, while launching the National Mobile Innovation Centre with our efforts gave a positive impetus to the whole Hungarian and neighbouring area. The Knowledge Centre for automotive-informatics was

another point of gravity on the Hungarian palette where new industrial and academic partnerships are going to flourish within the next few years.

We are proud to state that 3 new research areas have been initiated, partially due to international motivations, partially by re-organising our research resources.

The 3 new disciplines bring significant results, as demonstrated in WP +13, WP +14 and WP +15.

**Activity progress reports WP 1 to WP 12**

**and additional WP 13, WP 14 and WP 15**

**Work package number and title: WP1**

***Exploitation and dissemination, travels, workshops, conferences,  
Project Management & co-ordination,***

- D 1.1.: Periodic Progress Report, +12 months  
Preliminary exploitation and dissemination plans
- D 1.2.: Periodic Progress Report, +24 months  
Report on exploitation and dissemination
- D 1.3.: Periodic Progress Report, +36 months  
Report on exploitation and dissemination
- D 1.4.: Final Report, +36 months

The activities under the WP A, B and D parts were detailed in each periodic progress report.

In addition to the planned activities, further important international conferences and world congresses were and are organized by the Institute. The WWW World Congress, the World Science Congress (2002, 2005) etc., the CIRP Conference in 2004, the IMECO Conference in 2005, the IEEE CNN, the GRID –DAPSYS IJCNN (900 participants) events and many other ones.

Some areas where our international activities can be seen well:

- We have an increasing number of referenced scientific publications and valuable citations,
- Key scientists are offered high positions in international scientific federations or technology areas, such as IFAC, IFIP, IEEE, CIRP, EUREKA, MANUFUTURE, GRID, UNESCO...
- most Hungarian and some foreign universities invite leading scientists from our Institute to take part in higher education activities,
- government agencies require our competences, and need our consulting,
- EU Commission offices and DG-s invite our experts for high-level program preparations, and many for proposal and project evaluations,
- we are getting more active in participating at the 6<sup>th</sup> Framework Program, having several dozens of project proposals submitted and having several successful proposals, more and more international partners invite us for participating in their consortia.

A list of educational activities, list of Ph.D. students (almost 75), membership details, together with the yearly list of publications and citations are given in the supplement of WP 1, since the Seventh Progress Report did not contain them.

**Work package number and title: WP 2**

***Advanced multimedia system architectures  
and educational and training courseware applications for infrastructure,  
adoption of video-conferencing infrastructure to support enhanced co-operation means***

D 2.1: Report on implementation and exploitation, statistics

WP B reports reflected the multimedia and video-conferencing events. The Institute has installed video-conferencing equipment at several of its meeting rooms, so by now, all three main buildings have at least one environment equipped with up-to-date video-conferencing installations. The research laboratories frequently use these facilities when having national and international scientific and management sessions. There were also events, such the High-Speed-Cutting HSC international scientific contest and conference events, organized by Austrian, German and Hungarian scientific and educational partners.

Important scientific events, such as the WORLD CONGRESS ON SCIENCE, or the National IST forum, were broadcasted as live video among several cities.

Also, significant research is being performed on multimedia and streaming video. A preparation of a virtual laboratory and a long-term exchange of scientists were achieved with the University of Klagenfurt. Ph.D. shared courses are under implementation. Advanced multimedia research for industrial purposes was initiated and developed within a cooperation with the Bucharest University, by receiving/exchanging visiting scientists.

Regarding the 4<sup>th</sup> period:

e-Learning Database Management System

We enhanced our e-learning database management system, which is one of the base tools to be applied in e-learning globalisation and localisation centre. First, training materials were produced and stored with the help of the portable e-learning database and new automatic export/import modules were added to ensure the portability of the training materials within the educational framework.

Regarding the 5<sup>th</sup> period:

e-Learning glocalisation centre

We continued the project supported by the Ministry of Education to establish an e-Learning globalisation and localisation centre. We concluded the basic research for the project, formed the meta-database and prepared the technological, organisational and business model. We are developing a system with Dual XML-SQL database for flexible storing the training materials.

Regarding the 6<sup>th</sup> period:

Advanced on-the-job e-training solutions in e-business for SMEs (Adonis)

We successfully concluded the Adonis project that runs within the framework of Leonardo da Vinci programme. Seven European institutes and organisations participate in it. The main aim of this project was the production of basic modules for interactive training of staff and company heads of SMEs in Tourism, Cultural Industry and related sectors by means of the ADONIS environment.

Regarding the 7<sup>th</sup> period:

ADMS - adaptive distributed multimedia server

We co-operated with the Klagenfurt University in the area of development of adaptive distributed multimedia server (ADMS). We participated in the configuration, in the placement of server components in the network. We selected, adapted and implemented algorithms in order to find a proper place in the network for the multimedia server nodes in order to enhance the QoS parameters of the streaming video and increase the number of clients which still may be served.

#### Research methods

- studying the scientific literature
- applying international standards
- using graph theory, algorithm theory and combinatorial optimization
- applying new technologies to eLearning and video-conferencing

#### Results and achievements -

##### **Global Conference Network**

We finished the project entitled “Global Conference Network” on video conferencing. The Global Conference Network project aimed at establishing a distributed, multi-lingual, multimedia conferencing system. System GCN (Global Conference Network) of the project establishes audio and video connection between the parties independently of their linguistic skills and location. System GCN is based on the Internet, the ISDN system, and an audio-video ring that is based on standard IEEE 1394. Participants of different mother tongues - through interpreters using the services and equipment of the interactive GCN system - are able to conduct discussions.

##### **HUBUSKA-Networking Centres of High Quality Research on Knowledge Technologies and Applications**

We started this FP6 ACC-SSA project to promote the co-operation of educational and research institutes in area of knowledge technologies and their applications in e-Learning, and to accelerate the dissemination and application of the research results in the member and associated candidate countries.

The current cooperation between the partner institutions is enhanced by means of visits, working meetings and joint workshops for presenting and analysing their research outcomes, experiments and best practice solutions. The project will increase the societal impact of research results in the field of knowledge technologies, such as semantic web techniques, data and web mining, multiagent technologies, embedded intelligence approaches etc. It will exploit the educational potential of the embedded intelligence applications and the integration of web, digital TV and mobile technologies.

The project partners are as follows:

- MTA SZTAKI (HU)
- IMI BAS (BG)
- IIT BAS (BG)
- Klagenfurt University (AT)
- Novitech (SK)

Web: <http://www.hubuska.com/>

##### **KNOSOS - New Media Knowledge Village for Innovative e-Learning Solutions**

Specific results of this Leonardo project: 1/ New Media Knowledge Village, containing at four local centres of expertise in the form of applied software

systems running on existing computer and communication infrastructure of the partners. 2/ Methods for pedagogical use of integrated web and interactive TV technologies. Proposal of a unified standard for vocational training using digital TV Anytime-Anywhere devices. 3/ Distributed repository (multimedia database) of information resources and re-usable training materials in the field of integrated web and digital TV technologies. The training materials are developed in English and the partner languages (when found necessary). 4/ Curricula in the field of digital TV technologies for professionals and/or students with various backgrounds, covering at least 12 modules for different training levels. 5/ Experimental use and evaluation of the project vocational training facilities with representatives of the primary target groups from the partner institutions or from institutions, expressed interest to project results.

Web: <http://knosos.music.tuc.gr/>

### **CHIRON**

We started this Leonardo project whose aim is to develop reference material presenting and analysing research outcomes, experiments and best practice solutions for new forms of e-learning, based on integration of broadband web-, digital TV- and mobile technologies for ubiquitous applications in the sector of non-formal and informal life-long learning. The ubiquitous learning activities deal with materialization of personalised life-long learning on-demand for all, anywhere, anytime. They require new organisational structures and relations between learning at educational institutions, in workplace, at home, at social venues, on the move etc. Ubiquitous learning /u-learning/ as a concept may potentially be viewed as a ‘next-generation’ e-learning.

Web: <http://semioweb.msh-paris.fr/chiron/>

### **Software Development: Standardized Content Management Systems**

We developed “SZTAKI SCORM eLibrary” for the management of standardized SCORM compatible courseware. After logging in to the web-based portal the user may view and navigate courseware packages using the built-in SCORM Viewer. It is also possible to download the courseware packages in different formats after successful authentication. The eLibrary also contains a number of import modules facilitating the conversion of HTML based courseware into standard format. eLibrary is being widely used at different universities for the management of standard-based eLearning courseware and it is also the technology platform of the central courseware repository of Higher Education.

<http://elearning.itc.hu/elearning/en/elibrary/?lang=en>

### **Adonis - Advanced on-the-job e-training solutions in e-business for SMEs**

We successfully finished the Adonis project that runs within the framework of Leonardo da Vinci programme and seven European institutes and organisations participate in it. The main aim of this project was the production of basic modules for interactive training of staff and company heads of SMEs in Tourism, Cultural Industry and related sectors by means of the ADONIS environment.

<http://www.adonisproject.hu/>

### **eLearning globalisation centre**

We finished the project supported by the Hungarian Educational Ministry to establish



an eLearning globalisation and localisation centre.

The objective of the project Glocalisation was to support one of the promising segments of the Hungarian content industry, the production and "glocalisation" of multimedia-based computer training materials. Glocalisation is a nickname for localising foreign courseware and globalising that is adapting to foreign language environment Hungarian language courseware. In the interest of realizing this objective we developed a SCORM compatible glocalisation system in the framework of the project. The system was tested through a pilot training program.

### **ePresentation Player**

We developed a useful software tool for the support of academic education, videoconference archives and distance learning. It is able to synchronously play the digitised video and the slideshow of a presentation. We created a web interface for the application. It is able to show different file formats: e.g. RealMedia and Windows media formats are implemented.

### **ADMS - adaptive distributed multimedia server**

We co-operated with the Klagenfurt University in the area of development of adaptive distributed multimedia server (ADMS). We participated in the configuration, in the placement of server components in the network. We selected, adapted and implemented algorithms in order to find a proper place in the network for the multimedia server nodes in order to enhance the QoS parameters of the streaming video and increase the number of clients who still can be served.

### **e-Leaning forums**

We successfully organise the series of e-Learning forums where participated the representatives of the developers of e-learning frameworks (Cisco, Oracle, IBM, Microsoft, Hewlett-Packard, WebCT, Sun Microsystems), and complex e-Learning projects and academic applications were introduced.

<http://elearning.itc.hu/elearning/hu/rendezvenyek/forum4/>

<http://elearning.itc.hu/elearning/hu/rendezvenyek/forum5/>

<http://elearning.itc.hu/elearning/hu/rendezvenyek/forum6/>

### **Selected publications**

Tibor Szkaliczki and László Böszörményi:

Incremental Placement of Nodes in a Large-Scale Adaptive Distributed Multimedia Server,

In: Proceedings of International Conference on Distributed and Parallel Systems (DAPSYS 04), September 19th-October 22nd, 2004, Budapest, Hungary,

Series: The Kluwer International Series in Engineering and Computer Science, Eds: Zoltán Juhász, Péter Kacsuk, Dieter Kranzlmüller,

Kluwer Academic Publishers, September 2004, Vol. 777

Download: <http://143.205.180.128/ITEC/Publications/pubfiles/pdffiles/2004-0072-TSAL.pdf>

Ottó Hutter, István Simonics, Balázs Wagner and Terézia Sárváry  
Standard-Based eLearning Solutions in Higher Education

In: Proceedings of 3rd International Conference on Global Research and Education in Intelligent Systems (INTER- ACADEMIA 2004),

September 6-9, 2004, Budapest, Hungary, Vol 2, pp 467-475

Download: <http://elearning.itc.hu/elearning/en/kutatas/docs/interacad.pdf>

Balázs Goldschmidt and Tibor Szkaliczki and László Böszörményi:

Placement of Nodes in an Adaptive Distributed Multimedia Server

In: Proceedings of the 10th International Euro-Par Conference, 31th August - 3rd September 2004, Pisa, Italy

Series: Lecture Notes in Computer Science, Eds: Marco Danuletto, Marco Vanneschi, Domenico Laforenza,

Springer Verlag, August 2004, Vol. 3149, pp. 776-783

Extended version: Technical Reports of the Institute of Information Technology, University Klagenfurt, TR/ITEC/04/2.06.

Download: <http://143.205.180.128/ITEC/Publications/pubfiles/pdffiles/2004-0005-BGAT.pdf>

Hutter Ottó, Simonics István:

Az eLearning szabványok szerepe a felsőoktatásban

Kutatás-fejlesztés-innováció, "30 év Győrben" jubileumi tudományos konferencia

Széchenyi István Egyetem, Győr, 2004. november 3. 405-413. oldal

Download: <http://elearning.itc.hu/elearning/en/kutatas/docs/gyor-sztaki.pdf>

Danail Dochev, Radoslav Pavlov, Ottó Hutter, István Simonics, Polyxeni Arapi:

VIRTUAL CAMPUSES - from global architecture to local solutions

EDEN 2004,

Budapest, Jun 16-19

Download: [http://elearning.itc.hu/elearning/en/kutatas/docs/EDEN\\_paper\\_2004.pdf](http://elearning.itc.hu/elearning/en/kutatas/docs/EDEN_paper_2004.pdf)

Ottó Hutter, Terézia Sárváry, István Simonics, Balázs Wagner:

eLearning: Frameworks, Contents and Standards

Third EDEN Research Workshop,

March 4-6, 2004, Oldenburg (Germany),

Download: <http://elearning.itc.hu/elearning/en/kutatas/docs/oldenburg.pdf>

Ottó Hutter, Terézia Sárváry, István Simonics, Balázs Wagner:

e-learning standards in practice

In Proceedings of the Second International Conference on Multimedia and Information & Communication Technologies (m-ICTE2003),

December 3-6, 2003, Badajoz (Spain), pp.659-663

Otto Hutter, Istvan Simonics:

eLearning standards in the practice

2nd International Conference on Information (ICI-2),

7-9 October, 2003, Mansoura, Egyiptom

CIO Kézikönyv Handbook

Editor: Hutter Ottó

Menedzsment Kiadó 2003

Danail Dochev, Radoslav Pavlov, Ottó Hutter, István Simonics, Polyxeni Arapi:

Virtual Campuses - Architectures and Design Solutions

Problems encountered –

It was a little bit difficult to plan the necessary resources of the projects in advance and to schedule them correctly.

We have many different partners in the projects and the project proposals. Problems were encountered in the co-ordination; for example it was a little bit difficult to get the necessary documents and products in time from all the other partners.

Conclusion ----

We could successfully participate between 2001 and 2004 in several domestic and international projects in the area of multimedia and video-conferencing. We successfully applied our own developed e-Learning library to different educational applications. We introduced new technologies in e-Learning, such as digital television.

**Work package number and title: WP 3**

***Analogic CNN (Cellular Neural Network) theory, algorithms  
and their application in medical diagnosis***

**Type of activity : CO, V1-4, WS**

D 3.1: Papers containing new analogic spatio-temporal algorithms.

D 3.2: The evaluation of the proposed CNN based diagnostic workstation providing fast, reliable filtering and feature extraction. The proposed methods help doctors to make correct diagnosis.

D 3.3: Organising a workshop on analogic CNN computing technology.

D 3.4 Developing teaching materials, multimedia materials and organise video-conferencing to show the capabilities of this new type of computing

In the field of Analogic Cellular Wave Computers and Info-Bionics, the visits and the subsequent collaboration has been very successful. The five researchers in this field have made the following contributions and results.

We have developed a collaboration with Dr. Ronald Tetzlaff in the field of epilepsy forecasting and related prediction algorithms. The subsequent IEEE conference on Cellular Neural Networks and their Applications (CNNA 2002) in Frankfurt, organized by Dr. Tetzlaff, was the next step of collaboration, followed by a book and related Journal Special Issue, edited by Dr. Tetzlaff.

We are about to send a proposal to the EU FET direction in collaboration by Dr. Tetlaff and Dr. Marco Gilli.

Dr. Marco Gille has been with us several times. In addition to the joint project we have just mentioned, we have developed with Dr. Gilli a joint Course in Nonlinear Dynamical Systems, we have since that time successfully taught twice at the Faculty of Information Technology, Pazmany, Budapest as well as Dr. Tamas Roska gave lectures in Torino on CNN Technology and analogic cellular wave computing.

Dr. Nick Bottka has contributed to a new direction of research in SZTAKI (Laboratory of Analogic and Neural Computing), namely "tactile sensing". One of the impact had been a successful project in making a small tactile MEMS array, in a consortium with Pazmany University and the Research Institute on Technical Physics and Material Science, Budapest.

Carlos Manuel Matas contributed to our collaboration between the Microelectronics Research Institute of Seville, CNM, Spain. Both institutes had been active in the EU project DICTAM, resulting also two spin-off companies, Analogic Computers Ltd. in Budapest and AnaFocus Ltd. in Seville.

Dr. David Lopez Villarino has been active in developing wave type CNN algorithms. In particular, he has contributed to a bigger program on echocardiographic video clips analysis. A major publication has also been a result.

**Benefits**

As mentioned in the results, the benefits were mutual, and mostly resulted in on-going collaboration, joint research grants, and, in one case, joint graduate courses.

**Overall conclusion**

Four of the five visits resulted in an on-going research collaboration. The program offered unique assistance to us to attract important researchers from Europe for longer time. The impact is immense, a continuation is proposed.

Prof. Roska initiated a Hungarian INFO-BIONICS Virtual Laboratory to join the Hungarian efforts and to invite international partner institutions, other laboratories. This has been successfully launched with other Universities.

D3.1. list of publications on analogic spatio-temporal algorithms.

## **Work package number and title: WP 4**

*Supercomputing centre and corresponding workshops, conferences, mutual visits*

**Type of activity : WS, CF, V1, CO, demonstrations**

- D 4.1: Operational version of the 29-node beowulf cluster, +6 months
- D 4.2: Graphical programming environment for the beowulf cluster, +12 months  
Proceedings of the 7<sup>th</sup> EuroPVM/MPI Conference  
Proceedings of the 3<sup>rd</sup> Austrian-Hungarian WS on Distributed and Parallel Systems
- D 4.3: Specification study of the Hungarian metacomputing testbed, +18 months  
Special issue in the New Generation Computing Journal
- D 4.4: Operational version of the Hungarian metacomputing testbed, +36 months  
Proceedings of the DAPSYS'2002

The Laboratory of Parallel and Distributed Systems of SZTAKI plays a leading role in the research of cluster and grid technologies in Hungary.

## **Projects**

LPDS participates in the EGEE project as the Central-European Regional Training Centre of EGEE and contributes to the NA4, NA3, NA2 and SA1 WPs. The web page of the training centre (both Hungarian and English) can be found at:

*<http://www.egee.hu>*

LPDS leads the Grid Middleware WP of the European SEEGRID project.

LPDS is a partner in the EU CoreGrid and GridCoord projects, too.

## **Activities**

The activity of the laboratory focused on the following areas:

1. Development of the P-GRADE Portal
2. HunGrid infrastructure: Adaptation of the EGEE Grid infrastructure and extension of it with the P-GRADE Portal and with the Mercury monitoring system. Installation of a server machine with P-GRADE Portal to access the EGEE Grid.
3. SZTAKI Desktop Grid system for SETI-like applications
4. Development of the integrated P-GRADE Grid program development environment combining our diverse results. Supporting long running parallel programs in the ClusterGrid with checkpointing mechanism in P-GRADE.
5. Collaboration with the UK e-science OGSA testbed project
6. Development of the JiniGrid prototype system
7. Specification of the collaborative version of the P-GRADE Portal
8. Dissemination and teaching of the Grid technology all over Hungary
9. Participation at international Grid forums

### **1. Development of the Portal version of P-GRADE**

A new portal has been developed for enabling easy access to Grid services of P-GRADE (named therefore as P-GRADE Portal). It allows a user by using a web browser to graphically design a workflow, to upload it to the portal server, to download her Grid certificate to the portal server, to execute the workflow in the Grid with the Grid certificate, to monitor and visualise the status and progress of the workflow and its components, to let the portal automatically deliver input and output files to the right places for the workflow execution. The P-GRADE Portal gives much easier way to create complex workflows and to execute them in the Grid.

The portal has been connected to several Grid implementations:

- first generation Grid system: Hungarian ClusterGrid,
- second generation Grid: Hungarian SuperGrid, LHC Grid (EGEE, SEE-GRID projects and HunGrid infrastructure)
- third generation Grid: UK OGSA Testbed

It became the official portal of the SEE-GRID project.  
P-GRADE Portal is publicly available at <http://www.lpds.sztaki.hu/pgportal/>

## 2. HunGrid Grid infrastructure

The largest European Grid project, the EGEE (Enabling Grid for E-scienceE) has currently the largest Grid infrastructure with more than 9000 processors. In contrast to the current infrastructure of the Hungarian ClusterGrid, EGEE is available 24 hours a day and it also includes storage elements to store very large databases and files.

Together with the RMKI (Institute for Particle Physics), the EGEE/LCG-2 has been adapted and installed in Hungary, which is a major step in promoting Grid culture in the country. The connection of the resources of RMKI, SZTAKI, ELTE and KKKI (Institute of Chemistry) forms the current HunGrid infrastructure but it will be extended soon at the University of Veszprém and University of Szeged.

HunGrid is an extension of the EGEE infrastructure. New elements are the P GRADE Portal and the Mercury monitoring system. HunGrid can be accessed and used conveniently and easily by the portal. Mercury allows the monitoring of the performance of the applications.

<http://www.lcg.kfki.hu/?hungrid&hungridgeneral>

## 3. SZTAKI Desktop Grid system for SETI-like applications

To create a Grid system that can be easily deployed at research and educational institutes and that enables to harvest the idle computational power of the PCs there, we have created a specific Grid system for applications that are similar to the well-known SETI@home project. We have studied this topic, tested BOINC in our laboratory. The SZTAKI Desktop Grid (SZDG) has been established and running since June 2005. Currently, more the 2000 PCs are contributing computational resources from all over the world. The application has been provided by the Computer Algebra department of ELTE, looking for binary number systems.

SZDG home page: <http://szdg.lpds.sztaki.hu/szdg>

SZDG introductory pages: <http://www.lpds.sztaki.hu/desktopgrid/>

## 4. Integrated P-GRADE for Grid program development

In the previous year we have achieved several results related to Grid programming, but those results were available only in different prototypes:

- checkpointing in P-GRADE
- Integration of P-GRADE with the Condor job management system
- Integration of P-GRADE with Globus-2-based Grids
- MPICH-G2 code generation within P-GRADE
- Prototype of a workflow development system in P-GRADE

This year all results have been integrated into a stable and robust P-GRADE software that can be used by the whole Hungarian Grid community (P-GRADE version 8.3). The system now supports several different configurations of the available computational hardware from single computers through clusters to general Grid infrastructures:

1. Desktop configuration
2. Dedicated cluster configuration
3. Non-dedicated cluster configuration
4. Condor Grid configuration
5. Globus Grid configuration with batch execution mode
6. Globus Grid configuration with interactive, MPICH-G2 execution
7. Thick workflow configuration
8. Thin workflow configuration

An installation program has been developed for the easy installation and configuration of the rather complex P-GRADE environment. The installer asks for the available configurations and checks whether they are properly working. Provided, that system administrators install the necessary software needed for a given configuration, a user can easily install and configure P-GRADE. The P-GRADE 8.3 version is publicly available with a 30-days trial licence at

<http://www.lpds.sztaki.hu/index.php?load=pgrade/registration.php>

The next task was the extension of P-GRADE with checkpointing mechanism for the Hungarian ClusterGrid infrastructure, which allows saving the state of long running parallel programs in the ClusterGrid (which is active only at nights) and continuation of them the following night.

#### **5. Collaboration with the UK e-science National Grid Service**

Besides six british partners, SZTAKI is the only non-british partner involved in the UK e-science OGSA testbed project (NGS, National Grid Service) to examine the applicability of the OGSA standard. Here we are exploring how the P-GRADE Portal can be integrated with the newest Grid technologies, and this work may bring appreciation to the Hungarian Grid developments within Great Britain that supports the e-science R&D in Europe the most.

<http://www.cpc.wmin.ac.uk/ngsportal/index.php>

Another effort was to integrate our portal with the GEMLCA technology of the Wesminster University to deploy legacy applications on the Grid without any modification to the existing code.

<http://www.cpc.wmin.ac.uk/gemlca>

#### **6. Development of the JiniGrid prototype system**

To support Java programs and also to explore the possibilities in the service-oriented Grid technology, we have been working on the Jini-based JGrid system together with University of Veszprém. JGrid is based on different technologies than other Grid implementations therefore, the portal had to be severely redesigned.

<http://www.lpds.sztaki.hu/index.php?load=projects/current/ikta5-089.php>

#### **7. Specification of the collaborative version of the P-GRADE Portal**

One of the highest potential in workflow applications is the support for collaborative work, where different Virtual Organisations (VO) can dynamically join and share their computational power for the execution of a common large Grid application. This is a brand new topic in this field. We have specified the collaborative version of the P-GRADE Portal where the current editor must be modified for collaborative editing of an application and its execution on the dynamically organised collection of VOs.

#### **8. Dissemination and teaching of the Grid technology in Hungary**

Our laboratory is working on the widespread of the Grid technology all over in Hungary that, besides the infrastructure developments, includes the education. LPDS as the Central-European Regional Training Centre of EGEE plays active role in providing Grid trainings in the CE and SEE regions. Members of LPDS have given Grid tutorials at various international conferences and run Grid courses at several universities in Hungary.

The major event was the organisation of the Regional EGEE Grid Summer School in 2005.

<http://www.egee.hu/grid05>

We also held Grid tutorials in 2004 at the joint conference of DAPSYS and EuroPVM/MPI in Budapest and at the University of Szeged, and in 2005 at the University of Veszprém, University of Kaposvár and University of Debrecen. We have created the program “Proposal for a nationwide Grid program” together with the partners of the Hungarian Grid Competence Center.

#### **9. Participation at international Grid forums**

P-GRADE and P-GRADE Portal have been successfully demonstrated at the Supercomputing'04 conference and exhibition in Pittsburgh and at project meetings of the EGEE and SEEGRID projects. Our participation in the EGEE and SEEGRID projects enabled the realisation of the HunGrid infrastructure. We have collaborations in the UK e-science OGSA testbed project as well as with the Reading University. The EU-CoreGrid project is a network of excellence project for the research in next generation grids while the GridCoord project aims to coordinate the research and educational activities of different countries in Europe.



**Work package number and title: WP5**

Promoting the development of a research network in modelling multi-agent systems

**Type of activity : CO , WS, VR, V1, V3, V4**

D 5.1: Annual Progress Report and Report on the web site, +12 months

D 5.2: Annual Progress Report and Report on the web site, +24 months

D 5.3: Annual Progress Report and Report on the web site, +34months

Each Progress report referenced the activities of WP5.

**Objectives:**

The main objective of this WP is to support several mutual visits to and from research groups in Europe, working in modelling multiagent systems, to promote the development of the field, to elaborate new concepts and methodologies, to prepare project proposals for the 5th Framework Programme, and to strengthen and build personal contacts.

**Research methods:** The research was performed by using both standard proof methods and approaches of theoretical computer science, mainly formal language theory and novel, unconventional approaches, concepts, and tools developed under cooperation. The joint work was realized by personal consultations under the visits and workshops and by exchanging information regularly through email.

**Results and achievements:** In the frame of the project we obtained valuable scientific results, extended and strengthen our existing cooperation and launched new ones with several research sites in Europe, developing an informal, active research network. Moreover, we organized three international workshops which also served as useful forums for demonstrating the activities of the above community. As an impact of this work, our and other groups of the network together have successfully applied for joint grants in the corresponding research areas and our work also contributed to the successful functioning of the European Molecular Computing Consortium and the IFIP Working Group 1.2.

Our main scientific achievements can be summarized as follows:

We developed formal, generative models describing the problem solving capacity of the different systems, in syntactic terms, depending on the individual level of competence of the cooperating agents in different phases of the problem solving process and determined the correlation between the level of competence of the individual agents and the efficiency of the problem solving system. These results help in the proper design of languages for computer supported cooperative work, especially cooperative and distributed text or document processing. We also developed distributed accepting devices suitable for describing the joint behaviour of parallel functioning and communicating agents, formal tools for modelling dialogues and conversation. We successfully applied these and related ideas in bio-inspired computation, to describe the behaviour of multi-agent systems where agents represent living organisms and introduced and studied concepts in membrane computing modelling processes in cell-like architectures communicating with their environment.

**Problems encountered:** In the case of long term visits, due to the nature of the theoretical work, splitting the period into two parts (3-3 or 4-4- weeks) would have been more useful.

**Conclusion:** The project was very successful both from scientific point of view

and for extending and deepening the cooperation among the research sites in Europe working in the field of formal modelling multi-agent systems (including bio-inspired architectures) by tools of theoretical computer science, especially formal language theory. It was an essential help in establishing and developing a corresponding research network in Europe, that has been successfully realized.

### **Workshops held in the period:**

Workshop homepages:

<http://www.sztaki.hu/tcs/conferences.html>

[Grammar Systems Week 2004](#),

International Workshop, Budapest, July 5-9, 2004

Program chair: E. Csuhaj-Varjú

[Descriptive Complexity of Formal Systems](#), DCFS 2003,

5th Workshop, Budapest, July 12-14, 2003

Program Committee co-chair: E. Csuhaj-Varjú

[Annual meeting of the project MolCoNet](#), IST-2001-32008,

Budapest, November 29-30, 2002

Organizing chair: E. Csuhaj-Varjú

Meeting of the European Molecular Computing Consortium,

Budapest, November 30, 2002

Organizing chair: E. Csuhaj-Varjú

### **Publications of the workshops:**

1. Descriptive Complexity of Formal Systems, Budapest, July 12-14, Hungary.

**Theoretical Computer Science 330(2) (2005). Special issue.**

Guest editors: E. Csuhaj-Varjú and D. Wotschke.

2. Proceedings of Grammar Systems Week 2004, Budapest, Hungary, July 5-9, 2004.

Technical Report 2004/5, Theoretical Computer Science Research Group, Computer and Automation Research Institute, Hungarian Academy of Sciences, 2004.

Ed. by E. Csuhaj-Varjú and Gy. Vaszil.

Online version: <http://www.sztaki.hu/tcs/gswweek04/procpage.html>

3. Proceedings of the Fifth International Workshop Descriptive Complexity of Formal Systems, Budapest, Hungary, July 12-14, 2003.

Ed. by E. Csuhaj-Varjú, C. Kintala, D. Wotschke, and Gy. Vaszil. MTA SZTAKI, Budapest, 2003.

**Work package number and title: WP 6**

*High-performance symbolic computation -HPSC Resource Centre, HPSC network and courses,*

*Courses in financial mathematics*

**Type of activity CO, V2, WS, V1, other.**

D 6.1: A report on the operational resource centre +12 months

**Report on the Resource Centre**

The principal objective of the WP was to set up a Resource Center for high performance scientific computations. The centre was expected to contribute to scientific research as well as to education of professionals in the area.

An additional goal was to establish contacts in the wider European scene with laboratories and research groups having similar interest areas.

A further objective was to establish working contacts with nearby universities having related subjects on their curricula.

We planned also a minicourse as a concentrated means of disseminating our results.

**Research methods**

The research methodologies corresponded to the specialities of the problem domains. Theoretical studies laid the foundation of the work. Extensive experimentation and prototype-building is also relevant in this setting. The results are validated both by theoretical analysis (in particular the study of the complexity of the methods employed) and by evaluation of the practical performance and usability of the results. For example, our web search tool was tried by many people who offered extensive feedback, which has led to ongoing improvements and enhancements.

In most cases the main findings have been published in research articles, which -- through the refereeing process -- provided further validation and other useful feedback.

**Results and achievements**

We have set up a centre of resources for high performance computing tasks, with strong tools for symbolic computation and fast processing of large amounts of data. With the support of the present CoE project we purchased a strong PC workstation and equipped it with a Linux platform together with the latest versions of the symbolic packages Mathematica and Magma. This machine operates now as host csillag.sztaki.hu.

It became apparent soon that this framework has to be enlarged to meet the computational demands, particularly for the data mining experiments and applications we reported on in connection with WP6. From our additional funds (contribution of the Laboratory and Hungarian computational infrastructure grants) we acquired five additional machines. The equipment have been integrated into the network of the Laboratory on the basis of a fast local area network provided by the Institute (milestone M1).

From the perspective of dissemination of our know how, this has been an important advance, as it allowed our students to work on full scale computational projects. In particular, we could support work on an experimental web search engine for Hungarian documents and the .hu Internet domain. The engine is in a testing phase now and it can be accessed at

<http://keres.sztaki.hu> .

This, and the related projects involved large instances of clustering, data compression and association rules mining.

Our results on clustering raised the interest of the largest Hungarian telecom company. It appears that the graph of phone calls can be processed and analysed by the tools developed by us. We think that this way we could put our expertise and the Resource Centre to the use of the wide Hungarian public. This line of activities will be strengthened in the future by enhancing our capabilities of statistical data processing.

Yet an other large and demanding computational task was focused on the implementation of the APRIORI algorithm for association rules mining. We experimented with the method and found several practical and theoretical improvements, as reported earlier. Our implementation was considered as one among the best in an international workshop on data-mining implementations.

Grobner basis techniques are among the most powerful methods in symbolic computation. We have found novel applications of this eminent tool. With the aid of Grobner bases we studied polynomial functions of finite subsets of affine spaces. The Resource Center allowed us to experiment with large input instances.

We found several partners in the European research community. The highlight of these was our admission into the RESQ project (IST-2001-37559) which unites some of the leading European groups on Quantum Computation. Several important papers have been written in this area, as described in the intermediate reports.

We have been quite active to teach courses on related subjects. These included high level undergraduate and graduate courses on algorithms, computational aspects of algebra, data mining, and web algorithms at the following universities:

Budapest University of Technology,  
Eotvos Lorand University,  
University of Szeged.

We developed lecture notes for some of these courses. In addition, we disseminated our results at several conferences and scientific meetings in the region.

Information about the scientific results (publication lists, online papers, tutorials) can be found at

<http://www.sztaki.hu/infolab/>

in particular at the homepages of the leading scientists of the subproject (A. Benczur, G. Ivanyos, L. Ronyai), and at

<http://www.ilab.sztaki.hu/websearch/>

<http://www.mit.bme.hu/~bodon>

<http://math.bme.hu/algebra/>.

## Conclusion

Concerning WP6, the work carried out has been outstandingly useful in a term longer than the duration of the project. It provided us an opportunity to learn new, leading edge methodologies, and use this knowledge and technical basis to join European efforts in several research fields in high performance computing, and applications.

**Work package number and title: WP7**

***Virtual Laboratory for IMS,(intelligent manufacturing processes and systems),  
corresponding networking, conferences (IEA/AIE-2001 and 10<sup>th</sup> IMECO TC-10) and  
mutual visits***

**Type of activity : CO, other, VR,CF, V1-**

D 7.1.: Yearly Report on activities, the virtual lab, travels, Conf. proceedings,+12 months

D 7.2.: Yearly Report on activities, the virtual lab, travels, Conf. +24 months

D 7.3.: Yearly Report on activities, the virtual lab, travels, Conf. +36 months

Virtual laboratories have been formed, and are under implementation, (see WP8 in details),

IMS initiative for Intelligent Manufacturing Systems has been a hot topic for the past 8 years, well before the Commission had set up its IMS related group to join the international IMS activities. We were the first to run an IMS international conference, and harmonize research ideas with the Japanese national program.

Agreements were negotiated for implementing Virtual Laboratoires in IMS, FMS themes with:

Prof. Monchaud, Rennes, France, University Bucharest, Romania, ICIM, Switzerland, Seibersdorf, Austria, University of Transport,Zilina, Slovakia, Univeristy of Patras, Greece.

A report had been given on the IEA /AIE conference, and in 2004 a major international conference on Digital Factories, a CIRP Workshop and an IMECO Conference were organized under this workpackage. See details under the Supplements.

Visits and travels were financed from other sources as this can be seen from the lists of publications.

**Work package number and title: WP8**

***Information systems for Extended and Virtual Enterprises, Holonic Manufacturing, Virtual laboratory, Visits to and from EU Research Centres, Membership and activity in PLANET network.***

**Type of activity : CO, VR, V1-4, other**

- D 8.1 Report on the installation of the virtual laboratory +12
- D 8.2 Report on HMS –related activities +24
- D 8.3 Report on PLANET activities +24
- D 8.4. Report on contacts and visits. +34 months
- D.8.5 Public course materials on intelligent planning and scheduling

The PLANET joint work had been reported earlier, based on an international working group being formed.

The Holonic Manufacturing Systems topics are continuously being managed, by the working groups preparing joint proposals and harmonized international events.

Dr. Wilfried Sihm (Fraunhofer Institute for Manufacturing Engineering and Automation ,IPA, <http://www.ipa.fhg.de>) and Dr. László Monostori (deputy directors of the IPA / SZTAKI) have set a common goal in which the research and development potentials of the two institutes are to be bundled together, in order to achieve benefits for European (specifically German and Hungarian) industrial enterprises. **The Virtual Institute for Production and Business Management (IPBM)** was founded on the 7th of May 2002 after a co-operation contract between both partners was signed - with the further goal of establishing a mutual legal entity.

Industrial-oriented research activities play a vital role in the development of a country. The Fraunhofer Gesellschaft, with its 57 institutes, is represented across Germany in over 40 locations and it is one of the leading organisations for technical and organisational innovation within Europe. Its application-oriented research directly benefits enterprises, which again benefits society as a whole.

The Fraunhofer Institute for Manufacturing Engineering and Automation (IPA, <http://www.ipa.fhg.de>) is located in Stuttgart, where it applies the fundamental idea of the Fraunhofer Gesellschaft within the areas of industrial production-oriented enterprises. Organisational and technological tasks are the major focus of the research and development activities. The principle goal of IPA projects is to determine and utilise automated as well as rationalisation potentials, in order to strengthen the international competitiveness while improving the workplace environment. This is achieved in conjunction with cost-effective and environmentally friendly production processes and products.

The Computer and Automation Research Institute, Hungarian Academy of Sciences in Budapest (MTA SZTAKI, <http://www.sztaki.hu>), owner of the prestigious title of “Center of Excellence” awarded by the EU, always attached significant importance to industrial projects. One of the traditionally successful areas of the Institute is the industrial – including manufacturing – automation, the novel paradigms of which can be summarised as production informatics and management.

A NETWORK for Virtual Laboratories:

The detailed “Virtual Research Laboratory for a Knowledge Community in Production” descriptions are in the supplement for WP8, and are accessible from: [www.vrl-kcip.org](http://www.vrl-kcip.org).

Several course materials had been developed on the topics of intelligent planning and scheduling, two are inserted in the supplement part.



**Work package number and title: WP9**

Group decision support systems (GDSS) in environmental protection (EP),  
Visits to and from centres for methodological studies in operations research and mathematical physics

Financial mathematics

**Type of activity : CO, VR**

D 9.1.: Progress Reports, +15 months

D 9.2.: Travel summary report, +18 months

D 9.3.: Progress Reports, +30 months

D 9.4.: Case studies, +36 months

D 9.5.: Joint publications, +36 months

Every colleague at the Laboratory of Operations Research and Decision Systems are members of the Hungarian Operational Research Society (HORS), founded in 1991, having nowadays about 100 members from all over the country.

Tamás Rapcsák, head of the Laboratory was one of the initiators of founding this significant society, and acted two times as the President. For the time being János Fülöp is the Secretary of the Society.

According to an important aim of the Society, namely, the harmonization of the common interest of the members, and asserting the same, several HORS members were elected members of the Operations Research Committee run at the Hungarian Academy of Sciences (besides the Mathematical Committee and the Informatics Committee). The President of the Operations Research Committee is Tamás Rapcsák.

Joint Publication list is in the Supplement.

**Work package number and title: WP 10**

***Digital Library Technology Research and Development Co-operation,  
Distributed Digital Library Infrastructure for Computer Science and Technology  
Knowledge Dissemination***

**Type of activity : CO, V1 , technology demonstration, implementation**

D 10.1: Shared workspace services establishment (+6 months) Word Wide Web technology-based groupware application providing shared workspace service and other supports for collaborative work is set up for information exchange and transfer purposes.

D 10.2: Organization of a workshop to demonstrate the advantages of digital library technologies. (+18 months,)

D 10.3: Short courses of foreign experts (months 12, months 24)6

D 10.4: DDL Basic system establishment +6 months

The basic distributed digital library system is created and digital document content collection is initiated.

D 10.5: Advanced system services integration +12 months

New advanced services are added to the distributed digital library system. Session-oriented search and browse services are integrated and attached.

D 10.6: Digital document entities collection process (continuous)

Digitized document entities collection process is managed during the process. Partners search is carried out to foster the organization of a integrated network of digital repositories of computer science and technology knowledge.

D.10.4.-5-6 The DDL Basic system establishment based results are implemented within the EU project : STREEEM-On-the-fly. .It is in operation, and 28 radio stations, generating 1048 radio programs and integrated to feed the internet network based end-users. It incorporates all the broadcasting programs and library information as well. [www.Streemonthefly.com](http://www.Streemonthefly.com)  
radio.sztaki.hu

D.10.1. Shared workspace services had been prepared, and established at MATAV (T-Telecom) Hungarian company. The intraweb portal 's screenshot can be seen in the Supplement.

D 10.2 All through the years, Workshops and demonstrations were organized to disseminate the new digital library technology elements. List of workshops and project events are detailed under the Supplement pages.

EUTIST-AMI Workshop on Public Administration, 27th May, 2004, Budapest

EUTIST-AMI (EUropean Take-up of essential Information Society Technologies - Agents and Middleware) organizes a workshop on Public Administration on 27 May 2004, in Budapest, Hungary. The participation was free.

The largest event for this WP was the organization of the WWW. World Congress.

**Work package number and title: WP 11**

***Information System Technologies and Business Process Re-engineering Methods,  
Knowledge transfer and dissemination for quality improvement of software products and  
processes***

**Type of activity : CO, V1-4, WS**

D 11.1: Development of a Ph.D. course in database management and BPR methods,

D 11.2: Organisation of national workshops and seminars.

Increased communication between the partners,

Contribution to capacity building through attracting young researchers,

Enhanced participation in the 5th Framework Programme,

D 11.3.: Dissemination of the knowledge in software product and process quality improvement in Hungary and in the region (training courses, workshops, seminars, etc.); report

D 11.4. Ph.D. courses in software product and process quality improvement; report

D 11.5: Organisation of workshops and conferences; report

WP 11.1 11.2 11.3            DATABASE STRUCTURES

Book written by: János Demetrovics and András Békéssy.

Visiting scientists from Bulgaria contributed to several scientific results.

University courses are being held in each semester.

Quality assurance projects are initiated, and regular workshops are organized on Software technology elements. Several EU proposals were prepared and submitted.

See: Supplements.

**Work package number and title: WP12**

***Virtual laboratory for vision in the loop control experiments  
Intelligent road vehicle systems: modelling, detection and control  
Symposium and workshop organization  
Visits to from Research Centres***

**Type of activity : CO, CF, VR, other**

D 12.1.: Yearly Report, installation of the virtual lab. +12 months

D 12.2.: Yearly Report , use of the lab., +24 months

D 12.3.: Final Report , publications, report on the conference and travels +36 months

A virtual laboratory for intelligent road vehicle system research and vision of the loop control experiments has been formed and the corresponding installation work of the necessary equipment has been performed. The laboratory owns equipment and instruments such as an in-door positioning system based on machine vision, autonomous car models equipped with board computer, vision and inertial sensors, moreover a central supervision computer collecting and processing data obtained from the laboratory. The laboratory resources can be utilized remotely by using the appropriate internet protocols. The basic purpose of the laboratory is to support research and education, performing measurements and model experiments by researchers and students in both Ph.D. and undergraduate courses.

The main topics of research promoted by the laboratory can be summarized as follows.

*Control of traffic systems by communication networks, co-operative control technologies for fleet management:* This project concentrates upon the cooperative control of vehicle systems including groups of vehicles acting for a common goal as well as an ad hoc alignment of vehicles aspiring to fulfill their own goals, as well as those of the fleet. Basic research focuses on the most relevant problems of cooperative control design and the distributed control methods guaranteeing stable and safe operation in the presence of disturbances and modeling uncertainties. Clarifying the means of implementation both in terms of physical equipment and intellectual methods in the scope of applied research.

*Methodology and software tools for integrated braking, steering and suspension control in distributed real-time systems:* The aim of the project is to design integrated systems with braking, steering and suspension components. These components are crucial in enhancing transport safety and passenger comfort. The integration of control systems ensures the management of resources and it might also result in a fault-tolerant control solution. In the operation of autonomous control systems interactions or conflicts may occur. These difficulties can be handled in such a way that the effects of a control system on other vehicle functions are taken into consideration in the design process. However, this solution usually results in the high-complexity of the control systems. Another solution for the handling of conflicts is to design high-level control platforms.

*Fault tolerant system architectures:* The basic objective of the project is the analysis and synthesis of architecture design methods of on-board electronic control systems to enhance the reliability and safety of operations. The greatest potential lies in the replacement of mechanical backup systems by fault-tolerant electronic systems. These systems promise higher safety, and significantly more cost-effective solutions. No vehicle manufacturer has up to now introduced safety related x-by-wire systems without using a backup solution. Key elements of the project involve developing a C-By-Wire architecture for fault-tolerant electronic systems in vehicles, which is capable of controlling car functions such as steering

or braking without (mechanical) back-up with high reliability.

*Prevention of unintended lane-departure:* As a response to the large number of road accidents occurring due to lapses in drivers' attention, an automatic visual detection system to prevent unintended lane-departures has been developed in co-operation with Knorr-Bremse Ltd. A vehicle is equipped with digital cameras for monitoring lane geometry in real-time and detecting possible obstacles. The track of the vehicle is predicted by using velocity and steering angle signals from on-board sensors. Both the detected lane geometry and the predicted track of the vehicle are considered in decisions. A warning speech signal is sounded to the driver together with a message sent to the supervisor system. The supervisor can intervene in the vehicle's movement by using the drive stability control system (DSC) if there is no driver's activity and the duration of the lane departure is less than the reaction time of the driver. The intervention itself is carried out by using the brake system.

***Commercial vehicle fleet management system:*** The main objectives of the project are the elaboration of the theory and methods of intelligent supervision, control and communication systems installed on vehicles, and an associated information service system for fleet management. The development of the information service as part of the fleet management system that collects, analyses and evaluates data sent by individual vehicles extends the utility of the installed vehicle systems and represents a significant added value to its application. The system to be developed is coordinated around three main parties. One of them is the vehicle whose states of motion and cargo, road or traffic information can be downloaded either off-line or on-line, depending on the subsequent use of the data. The second is the fleet management center that evaluates these data, communicates them to the owner and, if necessary, based on the confirmative action of the vehicle owners, supervises the vehicle control systems. The third party includes the users (fleet or vehicle owners) who are interested in having the information provided locally on-line about certain traffic situations or road conditions.

*Establishment of the National Excellence Center:* The national research center of excellence named Advanced Vehicles and Vehicle Control Knowledge Center (AVVC) has been formed. The virtual laboratory performs his mission with close collaboration with this center of excellence.

*International Cooperations:* The research proposition for the all-European cooperation with European Research Network for System Identification (ERNSI) has been submitted, for the promotion of extensive collaborations with industry, public companies and research teams in other fields. In the framework of the national scientific collaboration between France and Hungary two research project propositions has been submitted. One of them is to propose a new design methodology for global chassis control of road vehicles, the other is to elaborate advanced methods for modeling and control of nonlinear systems encountered in the field of vehicle research. The cooperation with the Aerospace Department of the University of Minnesota led by Prof. Balas is fruitful for years.

*Visiting guests:* we have a solid tradition of exchanges and visits, which benefits both the students and the research progress. The visitor programs for the following persons have been organized.

- *Senane O., 2004, (Grenoble, France), Cooperation in chassis control*
- *Zin A., 2004, (Grenoble, France), Cooperation in chassis control*
- *Shinar 2004, (Technion, Israel Technical University), Predictive control*
- *Balas, G. 2004, 2005 (University of Minnesota, USA), Cooperation in LPV vehicle modeling and control*

- Kalman, R. E. 2004 (Zurich Technical University), *Support in mathematical system theory*
- Gissingier G. and M. Basset (MIPS/Mulhouse, France). *Cooperation in detection and estimation of vehicle dynamics*
- Van den Hof, P. 2004, (Delft University), *Cooperation in system modeling and identification*

**Publications:**

GÁSPÁR, P., I. SZÁSZI, J. BOKOR, *Reconfigurable control structure to prevent the rollover of heavy vehicles*, Control Engineering Practice, Vol. 13, No. 6, 699-711, 2005.

GÁSPÁR, P., I. SZÁSZI, J. BOKOR, *The design of a combined control structure to prevent the rollover of heavy vehicles*, European Journal of Control, No. 2, 2004.

GÁSPÁR, P., I. SZÁSZI, J. BOKOR, *Design of robust controllers for active vehicle suspension using the mixed  $m$  synthesis*, Vehicle System Dynamics, Vol. 40, No. 4, 193-228, 2003.

NALBANTOGLU, V., J. BOKOR, G. BALAS, P. GÁSPÁR, *System identification with Generalized Orthonormal Basis Functions: An Application to flexible structures*, Control Engineering Practice, Vol. 11, No. 3, pp. 245-259, 2003.

RÖDÖNYI, G. BOKOR, J. *Uncertainty identification for a nominal LPV vehicle model based on experimental data. Joint conferences of 44th IEEE Conference on Decision and Control and European Control Conference ECC, 12-15 December 2005, Seville, Spain*

Z. FAZEKAS, A. SOUMELIDIS, J. BOKOR., T. PÉNI, G. RÖDÖNYI. *An inexpensive indoor self-positioning system for mobile platforms with web-camera. Joint Hungarian-Austrian Conference on Image Processing and Pattern Recognition (HACIPPR 2005 - OAGM 2005/KÉPAF 2005) 11-13 May 2005, Veszprém, Hungary*

RÖDÖNYI, G. BOKOR, J. *Identification of an LPV vehicle model based on experimental data for brake-steering control. 16th IFAC World Congress, Prague, Czech Republic, 2005*

## **WP +13+WP14+WP15: NEW LABORATORIES FOR NEW DISCIPLINES:**

### **WP13: Department of Telecommunication and Geoinformation**

Computer and Automation Research Institute  
of the Hungarian Academy of Sciences  
(MTA SZTAKI TTO)

#### The Mission

The Department of Telecommunication and Geoinformation has been established in early 2003 to focus on emerging interdisciplinary IT-applications derived from the synergy effects of two cutting-edge technologies: telecommunication and GIS.

In our efforts to cope with this challenge we are building up national and international co-operations with partners from the education, research, service and industry sectors. We are concentrating on European co-operation, mainly in the framework of the EU Research and Development programs, where we have set up several partnerships.

A special focus has been placed on the coming Galileo service: the European satellite navigation system starting in 2008 will outperform the present GPS and open a wide range of new possibilities for applications in every sector. Our department is so far the only Hungarian participant in the preparatory efforts with the aim to stepwise establishing a competence centre for Galileo.

#### Projects

Digital processing and mapping of graphical data from archaeological excavations

As partner of the Budapest History Museum, we process geodesic data from the archaeological excavations performed by the Museum in the past four decades. The data are inserted into the digital map of Budapest in a vectored form, enabling further scientific processing by the archaeologists, as well as providing public information via the web-site of the Museum.

IT activities in connection with the Roman Frontiers' international archaeological conservation

Two thousand years ago the frontier line of the Roman Empire ran from today's Scotland, across the Continent along the Rhine and Danube Rivers, to the Middle East, and across North Africa. The remnants of the frontier can be found in several countries, which proudly conserve and display them to the public. In a joint effort of seven European countries, the Roman Frontiers will get World Heritage status within the coming years, which requires setting up a co-ordinated management, conservation and PR framework.

Our department participates in this international co-operation by taking on the IT-related tasks: creation and maintenance of the Roman Frontiers' web-portal, organisation of site registration databases, exploiting different platforms, etc.

#### Vehicular Remote Tolling (VeRT)

The European Union will launch new quality satellite navigation, the Galileo system, by 2008. In a series of preparatory projects under the umbrella of the Galileo Joint Undertaking, the behaviour and use of the future service are being exploited. We are participating in the VeRT consortium to study the possibilities and the use of Galileo for road tolling, parking and other related services.

The VeRT project envisages the creation of an overall system model as well as the design and realisation of a working demonstrator.

Our work performed here focuses on the user management part: the creation of the architecture for the final system, and the development of the pilot system.

#### CityGuide

CityGuide is a joint project of our Institute with the tourism offices of 3 Hungarian cities (Pécs, Eger and Sopron). The project aims to develop a PDA-based information service for tourists offering a wide range of historic, cultural and practical information. Equipped with a satellite navigation receiver, the PDA guides you to the monument selected and displays information material – text and pictures – as well as acoustic information. When entering a museum, the device leads you through the exhibition and offers explanations about the exhibits. The system also contains an integrated GIS database enabling navigation in and around the city for both pedestrians and car drivers.

In a pilot project, tourist offices will lend interested tourists PDA devices equipped with CityGuide software and experiences by the users will also be processed in the course of the project.

#### Technical study and design of a broadband communication network

In the framework of a national programme to provide an up-to-date communications infrastructure in rural areas of Hungary, we have prepared a technical study for building up a broadband backbone that will combine fibre and cutting-edge wireless technology in the East-Hungarian region.

Following the acceptance of the study, we currently provide professional advice to the network design team and back the project management.

#### The Kronoscope project

Our department has developed the Kronoscope - a device that lets the viewer look into the past. It was developed for the Budapest History Museum. The Kronoscope looks similar to a standing revolving telescope for tourists, but it shows the virtual ancient buildings over the actual Roman ruins at the Museum of Aquincum, Budapest, where it has been installed in April, 2005. Visitors to the ruin-park can walk through the ancient remains and stop at one of the Kronoscopes to see the buildings before them in reconstructed form. Turning the device to the left and right, all the buildings in view rise above the ruins in actual size and perspective. Two Kronoscopes are in operation at present in the Museum, but there are plans to expand their number to 8.

Further installations as well as the extension of the functions are in development.

The establishment of the Telecommunication and Geoinformation Department opened a way for dedicated efforts towards a very promising synergy between the mobile communication and location information which shall be, according to forecasts, a decisive market factor within the next ten years. Driven by the European Union's Galileo programme, exact and reliable location information will become cheap and commonly available in the mobile devices. Our department's goal is to exploit new application areas which will likely emerge by combining these two technologies.

With this aim, we have built up ties with the Galileo Concessionaire, a support agreement has been signed with the Eurily consortium' leading company, Finmeccanic, and a co-operation agreement with Alenia Spazio, Roma.



The department is participating in the VERT (Vehicular Remote Tolling) project, running under the support of the Galileo Joint Undertaking, Brussels. Most important project partners are: Alenia Spazio, Roma; Edisoft, Lisbon and Sinelec, Torino.

An other international co-operation is the Roman Frontier project, now running under EU's Culture-2000 framework, led by Scottish Heritage, Edinburgh. There are participant bodies (heritage authorities and regional museums) from Germany, Austria, Slovakia, Croatia and Rumania. Our activity focuses here on establishing a common IT infrastructure with webportal, common database access and - in the longer range - a visitor information system.

**WP +14:  
APPLIED MATHEMATICS LABORATORY  
MACHINE LEARNING AND HUMAN COMPUTER INTERFACES RESEARCH  
GROUP**

Head: Csaba Szepesvári

Introduction

The ML-HCI research group was formed in January 2004 with the goal to strengthen the presence of SZTAKI in the fields of machine learning and the research of advanced, machine learning based human-computer interfaces.

The main topics of the group are reinforcement learning, learning in games, large scale machine learning on Grids and applications of the methods and algorithms of machine learning in various disciplines related to human-computer interaction, such as natural language processing, computer vision, or speech and sound processing. During the year 2004 the group did research on reinforcement learning, control & filtering, learning in games, supervised feature extraction and search techniques used in artificial intelligence. During the year the group was involved in a number of seminars. Notably, a weekly a seminar on Markovian Decision Problems and their solution methods was started. During 2004 two grants were awarded to the group: One in the field of natural language processing and another one in conducting research on efficient machine learning on Grids.

The plan for 2005 is to expand the group with new members, start some courses at the partner universities. In addition, we plan to build up a strong international presence by cooperating with partners of mutual interest.

Reinforcement Learning, Control and Filtering

(L. Kocsis, Cs. Szepesvári, P. Torma, W.D. Smart)

Learning in Games: An Omaha Hi-Lo Poker program was developed to serve as test bench for learning algorithms. We have introduced a general-purpose algorithm, RSPSA, for tuning game parameters [1\*]. RSPSA combines Simultaneous Perturbation Stochastic Approximation (SPSA) with Resilient Backpropagation (RPROP). The experiments in poker have shown that the new algorithm can improve a game-playing program significantly, and the method proved to be competitive with alternative tuning algorithms.

Autonomous Driving: The aim of inverse reinforcement learning (IRL) algorithms is to recover an unknown reward function using behaviour traces of an expert. The learnt reward function can then be used for finding a policy by means of some reinforcement learning algorithm, the main underlying assumption being that this allows for better generalizations to unseen situations than if a policy were learnt directly from the expert traces. We have investigated IRL algorithms for controlling cars in simulated environments. Initial experiments show that the learnt policies can often perform better than the ones learnt by imitation, though the algorithms seem to be sensitive the features used as the basis of learning.

Markovian Decision Problems, Control and Filtering of Stochastic Systems: Q-learning is one of the best known reinforcement learning methods. Yet, it's convergence properties when used in conjunction with function approximators are largely unknown. We have proposed a modification of the gradient based Q-learning algorithm and proved that the modified algorithm converges with probability one to the neighborhood of the optimal Q-function [1]. This is the first known generic result for the convergence of Q-learning for continuous

state-space Markovian Decision Problems. We have continued our work on filtering of non-linear stochastic systems. Our main focus is on particle filtering and systems where observations are noisy, but the level of this observation noise is much lower than the level of noise of the dynamics. In this situation, paradoxically, the canonical particle filter (SIR) performs very poorly. We have proposed a two-stage particle filter that was shown both analytically and experimentally to outperform previous particle-filter modifications aimed to solve this paradox [2].

#### Machine Learning

(A. Kocsor, K. Kornél, Cs. Szepesvári)

Feature Extraction Methods: We have proposed a supervised feature extraction method aimed at uncovering the ‘principle manifold’ underlying classification and/or regression problems [3,4]. The method has been tested on several standard datasets and was shown to outperform alternative feature extraction methods (e.g. PCA, LDA). The new method successively identifies ‘important’ components using a deflation approach: in each step it aims to find the maximally informative direction in a deflated space.

#### Artificial Intelligence

(Cs. Szepesvári)

Search: We have defined a new class of search problems and have given an algorithm that solves this problem [5]. The performance of the new algorithm was tested on a real-life domain (segmentation of character strings). The new problem is called the “Shortest Path Discovery Problem”. The problem is to find the shortest path in a weighted graph where the costs of the edges are initially unknown, but the algorithm may query the cost of the edges. It is assumed that querying the cost of an edge is expensive and the aim is to find the shortest path with the minimum number of queries.

#### PUBLICATIONS 2004

Refereed Conference Papers:

[1] SZEPEŠVARI, CS. – SMART, W.D.: Interpolation-based Q-learning, In: ICML-2004, 2004, pp. 791-798.

[2] TORMA, P. – SZEPEŠVÁRI, CS.: Enhancing Particle Filters Using Local Likelihood Sampling. European Conference on Computer Vision, ECCV’2004, pp. 16--27

[3] KOCSOR, A. - KOVACS, K., SZEPEŠVARI, CS.: Margin Maximizing Discriminant Analysis, In: ECML/PKDD-2004, 2004, pp. 227-238.

[4] SZEPEŠVARI, CS. - KORNEL, K. – KOCSOR, A.: Kernel Machine Based Feature Extraction Algorithm for Regression Problems, In: Proceedings of the 16th European Conference on Artificial Intelligence, ECAI’ 2004, 2004, pp. 1091-1092.

[5] SZEPEŠVARI, CS.: Shortest Path Discovery Problems: A Framework, Algorithms and Experimental Results, In: AAI-2004, 2004, pp. 550-555.

Submitted journal publications:

[1\*] KOCSIS, L. – CS. SZEPEŠVARI: Universal parameter optimisation in games based on

SPSA, submitted to Machine Learning Journal, Special Issue on Machine Learning and Games.

## GRANTS, AWARDS

Project title: Unsupervised modelling of natural languages and applications in office environments

Supervisor: National Office for Research and Technology  
Cs. Szepesvári  
Fixed duration contract, NKFP 2/051/2005  
Duration: 2005-2007

Project title: Next generation data-mining using high-performance parallel distributed systems

Supervisor: Agency for research fund management and research exploitation (KPI)  
Cs. Szepesvári  
Fixed duration contract, GVOP AKF, GVOP-3.1.1.-2004-05-0145/3.0  
Duration: 2005-2007

## APPENDIX 1

Ph.D. students:

Szamonek, Z.: Unsupervised language learning (2004-)  
Eötvös Loránd University, Budapest, Faculty of Natural Sciences,  
“Computer Science” Ph.D.program, Supervisor: Cs. Szepesvári

## APPENDIX 2.

### SCIENTIFIC AND OTHER ACTIVITIES

European Journal of Artificial Intelligence (Cs. Szepesvári, 2001-)

Program Committee Membership at International Conferences (2004): International Conference on Machine Learning, Neural Information Processing Systems, Nineteenth National Conference on Artificial Intelligence (AAAI-04).

## **WP +15: Cognitive Vision Research Group**

The Cognitive Vision Research Group was established on the 1st of December 2003. The head of the research group is Peter Baranyi Ph.D. Further members of the group are 4 Ph.D. students and 3 undergraduate students. Currently 2 Ph.D. students have a long term (1.5 years) research scholarship at the Hashimoto Laboratory (that is in very close co-operation to the research group) of the University of Tokyo and one has scholarship at Norwegian University (NTNU).

### Research Topics:

1) The objective of our research group is to study the cognitive vision functions and processes of the human brain, understand how these cognitive processes interact with each other to solve complex tasks as object recognition. The network of interacting artificial cognitive process models can be used to build up a system that is similar to the human brain in its characteristics and behavior, as well as in its structure. Furthermore, the artificial cognitive processes can be used to build up a system that is quite different from the human brain, but is still able to solve special tasks. Our research activities focus on cognitive object recognition, localization and representation.

2) Stabilization of complex non-linear dynamic systems via TP model transformation and linear matrix inequalities. In this regards we are focusing on computer aided design, new dynamic model representations capable of involving new aspects of dynamic information. The second topic seems to be rather far from the first one, however cognitive processes can be viewed as a complex dynamic systems in many cases. Their stabilization is necessary.

### Publication activity:

During this 1.5 years the head of the research group published 12 international journal papers (with cumulative impact factor 7.3) and more than 10 conference presentations (two plenary lectures) in the topic of nonlinear control theories. He also gave two invited seminars at the University of Tokyo, Japan, and NTNU, Norway. The Ph.D. students published 2 international journal papers and more than 10 conference presentations, and one invited seminar at the NTNU, Norway. The research group had R & D exhibition desks on industrial days in Japan and Norway with rather nice impact.

### Honors and Awards:

Head of the research Group: János Kemény Prize given by John von Neumann Computer Society, Hungary (2005) / Research Prize of the Computer and Automation Research Institute of the Hungarian Academy of Sciences (2005).

Research students: Pro Scientia Gold Medal Prize, Budapest, (2005) / Nuffic Huygens Award of the Royal Netherlands (2004) / Youth Prize of the Hungarian Fuzzy Association (2004) / Youth Prize of the Computer and Automation Research Institute of the Hungarian Academy of Sciences, (2005) / National Undergraduate Research Activity, 1st prize, (2005) / Undergraduate Research Activity of BUTE, 1st and 3rd prizes, Budapest, (2003) / Master's thesis 1st prize of the Pro Progressio Foundation, Budapest, (2004) / Master's thesis 1st prize of the Scientific Association for Infocommunications, Budapest, ( 2004) / "Prize for Excellent Master's Thesis" prize of the Foundation for the Technological Progress of the Industry, Honorable Mention, Budapest, (2004) / 2 Japanese Government (Monbusho) Research Scholarships (2004-2006), / CEEPUS Scholarship to Kraków University of Technology, Kraków, Poland, (2004), Scholarship of the Norwegian Research Council to Trondheim, Norway, (2004),

Further Activities:

The research group has initiated and organized the foundation of the ITM Norwegian and Hungarian Laboratory involving (Universities NTNU, BME and research institutes SZTAKI, PPM). The group took part in more than 10 conference organization committees.

# **SUPPLEMENTS for WP 1**

# **SUPPLEMENTS for WP 2**



# **SUPPLEMENTS for WP 3**

# **SUPPLEMENTS for WP 4**

# **SUPPLEMENTS for WP 5**

# **SUPPLEMENTS for WP 6**

# **SUPPLEMENTS for WP 7 and WP8**

# **SUPPLEMENTS for WP 9**

# **SUPPLEMENTS for WP 10**

# **SUPPLEMENTS for WP 11**



# **SUPPLEMENTS for WP 12**