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Process Automation Laboratory .......................................................................... AU – 18
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Electro–Optical and Sensor Systems Laboratory ............................................. AU – 32

INSTITUTE OF ELECTRONICS ............................................................................ EL – 1
Digital and Information Systems Laboratory ..................................................... EL – 4
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INSTITUTE OF POWER ENGINEERING .............................................................. PE – 1
Electrical Machines Laboratory .......................................................................... PE – 4
Buildings of the Faculties of Engineering of the University of Maribor
Faculty of Electrical Engineering and Computer Science in the front (a view from the west side)

Photo: Gerhard Angleitner
Faculty of Electrical Engineering and Computer Science

Dean:
Prof. Dr. Ivan Rozman

Institute of Automation
Head:
Prof. Dr. Karel Jezernik

Institute of Computer Science
Head:
Prof. Dr. Viljem Žumer

Institute of Electronics
Head:
Prof. Dr. Bogomir Horvat

Institute of Informatics
Head:
Prof. Dr. Ivan Rozman

Institute of Power Engineering
Head:
Prof. Dr. Ivan Zagradišnik

Institute of Robotics
Head:
Prof. Dr. Karel Jezernik

Institute of Mathematics and Physics
Head:
Prof. Dr. France Brešar
until Oct. 31, 2001
Prof. Dr. Vitodrag Kumperščak
from Nov. 1, 2001

Institute of Telecommunications
(under preparation)
Head:
Prof. Dr. Bogomir Horvat
Foreword

One of the basic aims of the Faculty of Electrical Engineering and Computer Science in Maribor (FERI) is to become both a locally and internationally recognised scientifically creative organisation with quality educational courses. This is why efforts are primarily focused on producing new horizons in the fields of electrical engineering, computer science, information science, telecommunications, and media communications and then to transfer this knowledge to the Slovenian and International areas. In addition, fundamental research work at FERI has also initiated further applied projects that have led to many successful practical implementations.

This faculty's mission is carried out by individual institutes, whose duty it is to take care of complementary scientific disciplines. Our institutes are formulated according to the particular needs of certain educational processes both at university and higher professional levels of study. There are eight different institutes at the FERI: Institute of Automation, Institute of Electronics, Institute of Power Engineering, Institute of Telecommunications, Institute of Robotics, Institute of Mathematics and Physics, Institute of Computer Science, and Institute of Information Science. These institutes are further divided into laboratories, each being responsible for development and educational activities as a whole in their scientific fields. They also have complete financial autonomy. These laboratories totalling 28 take care of specialized domains within similar research and development activities. Their autonomy is only partial. Whilst institutes should be headed by full professors, the heads of laboratories can be more junior professors.

FERI ranks among the so-called research faculties, which is also evident from the structure of its income. The amount generated by research activities has for several years been as high as 40% of total income. About 50% of this amount comes in a so-called programme-project scheme from the Ministry of Education, Science and Sport of the Republic of Slovenia. The remaining 50% is earned by international project collaboration, in particular by the European Fifth Framework, and also by work in applied and development projects for various contractors in Slovenia and abroad. Other bilateral international projects are quite numerous, although their financial effect is rather low. This is in accordance with the purpose of these projects being mainly a support for the contacts and mobility of researchers from different countries.

The management of FERI is convinced that the Faculty's present scientific orientation has proven successful, therefore it will spare no effort to promote these lines of activities, especially in order to make FERI better known and distinguished within the European Union as well as in other countries of the world. Above all, it supports participation of the Faculty members in international project teams and in all kinds of successful collaboration with business partners.

Dean Prof. Dr. Ivan Rozman
STUDY PROGRAMS, OPTIONS AND CONCENTRATIONS

Undergraduate studies

The Faculty of Electrical Engineering and Computer Science offers two separate types of study programs, each leading to a different type of degree: university and professional one. Three study programs with several options are offered towards the university degrees and two study programs towards professional degrees.

The university-degree study program in Electrical Engineering includes the following options:

- Automation with concentrations in:
  - Production Automation
  - Process Automation

- Electronics with concentrations in:
  - Industrial Electronics
  - Computer Electronics

- Power Engineering with concentrations in:
  - Electrical Power Engineering
  - Electric Controls
  - Electromagnetics

- Mechatronics with concentrations in:
  - Communications
  - Regulations
  - Instrumentation
  - Actuation
  - Embedded Systems
  - Programmable Tracking Systems

The option of Mechatronics is interdisciplinary, supported by the Faculty of Electrical Engineering and Computer Science and by the Faculty of Mechanical Engineering. Also the computer science students are eligible for this option after the first two years completed in computer science.

University-degree studies last nine semesters and include lectures, exercises, and practical placements in industry. The first two years are the same for all options.

The professional higher education program in Electrical Engineering comprises the following options:

- Automation with concentrations in:
- Process Automation
- Robotics

- Electronics with concentrations in:
  - Industrial Electronics
  - Computer Electronics

- Power Engineering with concentrations in:
  - Electrical Power Engineering
  - Systems Technology
  - Structural Technology
  - Telecommunications

Professional higher education programs last six semesters consisting of lectures and exercises, and an additional semester of practical placements in industry. The first year of studies is common for all options.

Electrical engineering is also offered as a combined interdisciplinary university-degree study of electrical engineering with economics. It is organised by the Faculty of Electrical Engineering and Computer Science and by the Faculty of Business and Economics in Maribor. The duration of studies is eight semesters with about 2/3 major subjects given in electrical engineering and 1/3 major subjects in business and economics.

Graduates of electrical engineering with economics are qualified to proceed with their studies towards masters or PhD degrees either in electrical engineering or in business and economics.

The university-degree study program in Electrical Engineering with Economics includes the following options:

- Automation
- Electronics
- Power Engineering
Electrical Engineering Studies

University degree studies

PhD

3rd and 4th Year

Masters degree studies
- Electrical Engineering
- Electronic Vacuum Technology

2nd Year

1st Year

University degree

Undergraduate studies
9 semesters
- Automation
- Electronics
- Power Engineering
- Mechatronics

Matura Examination
(an external examination)

Studies to professional higher education degrees

University degree

Undergraduate studies
6 semesters of studies and 1 semester of practice in industry
- Automation
- Electronics
- Power Engineering
- Telecommunications

Final examination
(an internal examination)
The university-degree study program in **Telecommunications** consists of two years of study with common fundamental subjects and two additional years with a variety of electives. Therefore, the studies last eight semesters and include lectures, exercises, and practical placements in industry.
The university-degree study program in Computer and Information Science includes the following options:

- Software with concentrations in:
  - Systems
  - Engineering Informatics
- Information Science with concentrations in:
  - Business Information Systems
  - Process Information Systems

University-degree studies last nine semesters and include lectures, exercises, and practical placements in industry. The first two years are the same for all options. After the first two years in computer science studies, students can continue in the mechatronics option within the electrical engineering program.

The professional higher education program in Computer and Information Science comprises the following options:

- Software
- Information science
- Logic and systems

Professional higher education programs last six semesters consisting of lectures and exercises and an additional semester of practical placements in industry. The first year of studies is common for all options.
Computer and Information Science Studies

University degree studies

PhD

3rd and 4th Year

Master degree studies
- Computer and Information Science

2nd Year

1st Year

University degree

Undergraduate studies
9 semesters
- Software
- Informatics Science

Matura Examination
(an external examination)

Studies to professional higher education degrees

Professional higher education degree

Undergraduate studies
6 semesters of studies and 1 semester of practice in industry
- Logic and Systems
- Software
- Informatics Science

Final examination
(an internal examination)
In 2001, a new university studies programme of **Media Communications** was accepted at the national level. The curriculum is going to be covered interdisciplinary and co-ordinated by the Faculty of Electrical Engineering and Computer Science of Maribor. The first year of studies begins in the academic year 2002/03. The students in senior years will be able to specialise in **RTV Production** and **Interactive Graphic Communication**, while the total duration of studies will be eight semesters. The title received after a successful completion with a diploma work will be a Media Communicologist with University Diploma.
Graduate Studies

Graduate studies basically aim at the acquisition of in-depth theoretical and applied knowledge enabling the prospective graduate to carry out independent and creative research in various technical sciences.

Masters degree and PhD studies

In 2001, masters degree and doctoral studies were organised as shown in the two preceding diagrams.

Three graduate programs are currently being offered:

**Electrical Engineering** including the following options:
- Automation
- Electronics
- Power Engineering

**Electronic Vacuum Technology**

**Computer and Information Science**

For every graduate student entering the first year of studies, their supervisor selects the following:
- the courses that the student will attend and the exams the student will complete
- a research project that will be individually assigned to and conducted by the student

The student must collect a minimum of 120 credits during the first two years. Out of this total, 75 credits must be awarded for the examinations, while 45 credits must be awarded for the reports completed on their individual research projects. For every passed exam and publicly presented report on individual research projects, the student is awarded 15 credits.

Terms for Progress

The terms of inscription to the postgraduate studies are specified by the Statute of the University of Maribor and by annual public calls. Other obligations of the students are depicted by labels 2 through 5 in the graphical presentation of university-degree studies.

2—Minimum of 30 credits.

3—The student must pass all the exams during the first two years and present the reports on their individual research work with a minimum average grade of 9 (out of 10).
According to the “Regulation of Habilitation Procedure for University Teachers, Scientific Workers and Co-workers” valid at the Faculty of Electrical Engineering and Computer Science, the student's bibliography must be awarded a minimum of 2 points, based on their scientific research activities.

Additionally, a recommendation letter from the student's doctoral studies supervisor is requested.

4—According to the “Regulation of Habilitation Procedure for University Teachers, Scientific Workers and Co-workers” valid at the Faculty of Electrical Engineering and Computer Science, the student's bibliography must be awarded a minimum of 2 points, based on their scientific research activities.

5—During the third year of study, students must report on their research work at twice, and during the fourth year once a year. This totals in 45 credits. Additional 75 credits must be awarded for a successful presentation and defence of doctoral dissertation.

According to the “Regulation of Habilitation Procedure for University Teachers, Scientific Workers and Co-workers” valid at the Faculty of Electrical Engineering and Computer Science, the student's bibliography must be awarded a minimum of 5 points, based on their scientific research activities. At least 1 point must be awarded for publishing research findings in the journals cited in the INSPEC database.

Masters degree studies are research oriented and include introduction to research, the development of students’ capacity for research work in individual scientific fields and disciplines, and the study of subjects providing in-depth and broad knowledge of subjects needed for the preparation of a masters thesis.

Throughout the program of study, students can use laboratories and the computer infrastructure of the Faculty of Electrical Engineering and Computer Science as well as other engineering faculties at the university. Studies leading to masters degrees grant the graduates a professional title of a Master of Science in Electrical Engineering or a Master of Science in Computer Science.

PhD research is carried out in research laboratories; a more detailed description of these programs is given in the continuation of this report. Research teams consisting of doctoral students and graduate students for individual areas of research are commonly formed. Some research teams include participants from several laboratories. International contacts developed through the teams are especially important for doctoral students, because this is the only way for them to take part in the international transfer of knowledge and exchange research achievements. Some of our doctoral students carry out part of their research abroad and even have co-mentors in other countries.

We believe that creativity, openness, peer support, and reciprocity are the bedrock of any academic co-operation. Therefore the Faculty of Electrical Engineering and Computer Science regularly hosts foreign undergraduate, graduate, and postdoctoral students. Our new organisation of doctoral studies also leads to a greater compatibility with other universities making it easier for student exchange and mobility.
STUDENT RESEARCH GRANTS

In 2001, the Faculty of Electrical Engineering and Computer Science continued to fund individual student research projects. According to internal regulations, undergraduate and postgraduate students can submit their proposals for innovative projects which cannot be financially supported within other established funding schemes. Only non-labour costs are eligible and the supported projects must be finished within 10 months.

After the call in May 2001, eleven proposals were submitted, and ten of them passed the review process and were given the requested financial support. The following projects will have to be completed by May 2002:

- Igor Jaušovec, Kosta Kovačič, *Compatibility of the Smart Media cards and the GPS system*
- Matjaž Golič, *A 32-bit logic analyser with optional two-channel analogue signal acquisition and display of the measured quantities on a PC using the USB interface*
- Mateja Verlič, Boštjan Gajsler, *EvoRaS—Evolution-based recognition and search in medicine—a simulation tool*
- Dejan Skrivalnik, *Solar V-concentrator for increasing the output power of solar modules*
- Saša Jevtič, *iB (intelligent Bug) six-leg neuron robot*
- Matej Črepinšek, *Implementation of the META evolution approach in the METATSPGA II tool (evolution algorithms, automated knowledge collection)*
- Sašo Sršen, Bojan Pavšič, *Optimisation of production processes based on computer simulations*
- Goran Gerlič, *GenCompiler—Genetically programmed compiler*
- Franc Gerenčer, *GemmaCAD 2—geometric plotter based on constraints*
- Damir Medenjak, Filip Potočnik, Matjaž Kvas, Janez Kitak, *MIKRO—A portable computer*

It is to be emphasised that Roman Čuk, a student of the 5th year of the Software major studies, was awarded, at the occasion of the Faculty Annual Celebration in November 2001, The Best Student Project Award for his project entitled *Determination of delineated rectangle to an arbitrary plane surface polygon*. The project was supervised by Assoc. Prof. Dr. Borut Žalik and successfully completed in 2000.
GRADUATES OF THE FACULTY OF ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

In 2001, the undergraduate students of the Faculty of Electrical Engineering and Computer Science could still complete their studies according to the old system at the junior college level. At the same time, two different types of studies are available now: those leading to university degrees and studies leading to professional higher education degrees. The number of 2001 graduates is given in the table below.

2001 Graduates

<table>
<thead>
<tr>
<th>Option</th>
<th>Junior college Level</th>
<th>Professional higher education degree</th>
<th>Undergraduate university degrees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical Engineering</td>
<td>21</td>
<td>69</td>
<td>26</td>
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<tr>
<td>Computer and Information Science</td>
<td>1</td>
<td>12</td>
<td>19</td>
</tr>
<tr>
<td>Electrical Engineering with Economics</td>
<td>–</td>
<td>–</td>
<td>20</td>
</tr>
</tbody>
</table>
16 masters degree students successfully defended their masters theses and 11 PhD students their dissertations.

### 2001 Masters theses

<table>
<thead>
<tr>
<th>Author</th>
<th>Date of defence</th>
<th>Title</th>
<th>COBISS number</th>
<th>Mentor</th>
<th>Co-mentor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enis AVDIČAUŠEVIĆ</td>
<td>August 31, 2001</td>
<td>Aspektno usmerjeno programiranje (Aspected-Oriented Programming)</td>
<td>6694934</td>
<td>Dr. Marjan Memik</td>
<td>Dr. Viljem Žumer</td>
</tr>
<tr>
<td>Srečko FRIDL</td>
<td>May 11, 2001</td>
<td>Standardizirana izmenjava podatkov v produktnem modelu ceste (Standardized Data Exchange in the Road Product Model)</td>
<td>6247702</td>
<td>Dr. Nikola Guid</td>
<td>Dr. Danijel Rebolj</td>
</tr>
<tr>
<td>Izidor GOLOB</td>
<td>March 29, 2001</td>
<td>Arhitekture podatkovnih skladišč (Data Warehouse Architectures)</td>
<td>6694678</td>
<td>Dr. Tatjana Welzer Welzer Drežovec</td>
<td>Dr. Ivan Rozman</td>
</tr>
<tr>
<td>Branko KAUCIĆ</td>
<td>October 12, 2001</td>
<td>Algoritmi vidnosti nad diskretnim modelom terena (Visibility algorithms on Digital Relief Model)</td>
<td>11549192</td>
<td>Dr. Borut Žalik</td>
<td>Dr. Nikola Guid</td>
</tr>
<tr>
<td>Robert KOVAČIĆ</td>
<td>June 2, 2001</td>
<td>Resonančni pretvornik z izmeničnim visokofrekvenčnim povezovalnim krogom (Resonant Converter Based on AC Tank Circuit)</td>
<td>6746390</td>
<td>Dr. Miro Milanovic</td>
<td>Dr. Bogomir Horvat</td>
</tr>
<tr>
<td>Author</td>
<td>Date of defence</td>
<td>Title</td>
<td>Mentor</td>
<td>Co-mentor</td>
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<tr>
<td>Iztok KRAMBERGER</td>
<td>January 18, 2001</td>
<td>Izgradnja merilnega sistema spektralnega analizatorja s fiksno nameščenimi fotodiodami (Construction of Spectral Analyzer Measurement System with Fixed Photo-Diode Array)</td>
<td>Dr. Mitja Solar</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boris KUPEC</td>
<td>September 12, 2001</td>
<td>Izgube v razdeljevalnih omrežjih (Losses in Distribution Networks)</td>
<td>Dr. Jože Voršič</td>
<td>Dr. Jože Pihler</td>
<td></td>
</tr>
<tr>
<td>Aleksander KVAS</td>
<td>October 10, 2001</td>
<td>Računalniška arhitektura s simultano večnitostjo (Parallel Computer Architecture using Simultaneous Multithreading)</td>
<td>Dr. Viljem Žumer</td>
<td>Dr. Milan Ojsteršek</td>
<td></td>
</tr>
<tr>
<td>Mitja LENIČ</td>
<td>June 15, 2001</td>
<td>Načrtovanje in implementacija programskih jezikov z uporabo večkratnega dedovanja atributnih gramatik (Design and Implementation of Programming Languages using Multiple Attribute Grammar Inheritance)</td>
<td>Dr. Viljem Žumer</td>
<td>Dr. Marjan Mernik</td>
<td></td>
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<tr>
<td>Boštjan LILIJA</td>
<td>April 9, 2001</td>
<td>Učinkovita raba energije (Eletric Energy Efficiency)</td>
<td>Dr. Jože Voršič</td>
<td>Dr. Božidar Hribernik</td>
<td></td>
</tr>
<tr>
<td>Author</td>
<td>Date of defence</td>
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<tr>
<td>Uroš NOVAK</td>
<td>October 5, 2001</td>
<td>Implementacija in uporaba procesorja XSLT za transformiranje objektov</td>
<td>6767382</td>
<td>Dr. Milan Ojsteršek</td>
<td>Dr. Viljem Žumer</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Implementation and Use of the XSLT Processor for Object Transformation)</td>
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<tr>
<td>Davorin OSEBIK</td>
<td>July 3, 2001</td>
<td>Adaptivna digitalna sita v strukturi porazdeljene aritmetike</td>
<td>6383382</td>
<td>Dr. Rudolf Babič</td>
<td>Dr. Bogomir Horvat</td>
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<td></td>
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<td>(Adaptive Digital Filter Implementation with Distributed Arithmetic Structure)</td>
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<tr>
<td>Tomaž ROMIH</td>
<td>December 11, 2001</td>
<td>Avtomatsko nastavljanje geometrijskih parametrov televizijskega aparata</td>
<td></td>
<td>Dr. Rajko Svečko</td>
<td>Dr. Žarko Čučej</td>
</tr>
<tr>
<td></td>
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<td>(Automated Set-Up of TV Set Geometric Parameters)</td>
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<tr>
<td>Alojz ROZMAN</td>
<td>November 24, 2001</td>
<td>Zasnova projekta avtomatizacije hidроelektrarn</td>
<td></td>
<td>Dr. Drago Dolinar</td>
<td>Dr. Bojan Grčar</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Automation Design for Hydro-Power Plants)</td>
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<tr>
<td>Roman TUŠEK</td>
<td>June 28, 2001</td>
<td>Regulacija procesov z velikimi časovnimi zakasnitvami</td>
<td>6511126</td>
<td>Dr. Rajko Svečko</td>
<td>Dr. Žarko Čučej</td>
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<tr>
<td></td>
<td></td>
<td>(Regulation of Processes with Long Delays)</td>
<td></td>
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<tr>
<td>Boris ŽITNIK</td>
<td>December 10, 2001</td>
<td>Snovanje modernih ozemljitvenih sistemov</td>
<td>6905878</td>
<td>Dr. Jože Voršič</td>
<td>Dr. Mladen Trlep</td>
</tr>
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<td></td>
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<td>(Design of Modern Grounding Systems)</td>
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<td>Author</td>
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<tr>
<td>Amor CHOWDHURY</td>
<td>January 15, 2001</td>
<td>Robustna sinteza regulacijskih sistemov z upoštevanjem perfomančnih kriterijev (Robust Synthesis of Control Systems with Consideration of Performance Criteria)</td>
<td>6494486</td>
<td>Dr. Rajko Svečko</td>
<td></td>
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<tr>
<td>Tomaž DOMAJNKO</td>
<td>March 2, 2001</td>
<td>Povečanje stopnje ponovne uporabe z uporabo vzorcev (Increase of the Reusability Level Using Patterns)</td>
<td>6090262</td>
<td>Dr. Ivan Rozman</td>
<td></td>
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<tr>
<td>Dušan DREVENŠEK</td>
<td>June 29, 2001</td>
<td>Optimiranje izkoriščanja servo pogona asinhronskim motorjem (Efficiency Optimizing of Variable Motor Drive with Induction Motor)</td>
<td>6491926</td>
<td>Dr. Karel Jezernik</td>
<td></td>
</tr>
<tr>
<td>Aleš HACE</td>
<td>January 19, 2001</td>
<td>Robustno vodenje elastičnih servopogonov (Robust Control of Elastic Servodrivers)</td>
<td>23353093</td>
<td>Dr. Karel Jezernik</td>
<td></td>
</tr>
<tr>
<td>Špela HLEB BABIČ</td>
<td>April 20, 2001</td>
<td>Odločitvena drevesa in mehke množice (Decision Trees with Use of Fuzzy Sets)</td>
<td>46469889</td>
<td>Dr. Peter Kokol</td>
<td></td>
</tr>
<tr>
<td>Alenka HREN</td>
<td>April 6, 2001</td>
<td>Robustno vodenje vrtilnega momenta asinhronskega motorja v servopogonih (A Robust Torque Control of an Induction Motor in Servo Drive)</td>
<td>6147350</td>
<td>Dr. Karel Jezernik</td>
<td></td>
</tr>
<tr>
<td>Author</td>
<td>Date of defence</td>
<td>Title</td>
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<tr>
<td>Janez KAISER</td>
<td>January 19, 2001</td>
<td>Discriminative training of parameters of hidden Markov models for continuous speech recognition</td>
<td></td>
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<tr>
<td>Dr. Bogomir Horvat</td>
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<tr>
<td>Gorazd LIPNIK</td>
<td>November 20, 2001</td>
<td>Optimisation of measurement line using a model of off-line determined errors</td>
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<td>Dr. Anton Jeglič</td>
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<tr>
<td>Vili PODGORELEC</td>
<td>October 2, 2001</td>
<td>Evolutionary decision forests - decision making with multiple evolutionary constructed decision trees</td>
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<tr>
<td>Dr. Peter Kokol</td>
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<tr>
<td>Mirjam SEPESY MAUČEC</td>
<td>December 18, 2001</td>
<td>Adaptation of statistical language models on context-specific discourse</td>
<td></td>
<td></td>
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<tr>
<td>Dr. Zdravko Kačič</td>
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<td>Milan ZORMAN</td>
<td>March 26, 2001</td>
<td>Hybrid approaches in machine learning</td>
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RESEARCH BY INSTITUTES AND LABORATORIES

The Faculty of Electrical Engineering and Computer Science is registered with the Ministry of Science and Technology as a research organisation incorporating 13 research units.

1. **Computer Architecture and Languages Laboratory**
   
   Research unit head: Prof. Dr. Viljem Žumer
   
   The research unit consists of the Computer Architecture and Languages Laboratory staff.

2. **Institute of Electronics**
   
   Research unit head: Prof. Dr. Bogomir Horvat
   
   The research unit consists of the staff of the Digital and Information Systems Laboratory, Electronic Systems Laboratory, Microcomputer Systems Laboratory, and Digital Signal Processing Laboratory.

3. **Institute of Automation**
   
   Research unit head: Assoc. Prof. Dr. Boris Tovornik
   
   The research unit consists of the staff of the Systems and Control Laboratory, Signal Processing and Remote Control Laboratory, Process Automation Laboratory, Measurements Laboratory, and Electro-Optical and Sensory Systems Laboratory.

4. **Institute of Robotics**
   
   Research unit head: Prof. Dr. Karel Jezernik
   
   The research unit consists of the staff of the Power Electronics Laboratory, Industrial Robotics Laboratory, and Kinematics and Simulations Laboratory.

5. **Applied Electromagnetics**
   
   Research unit head: Prof. Dr. Božidar Hribernik
   
   The research unit consists of the staff of the Applied Electromagnetics Laboratory and Fundamentals and Theory of Electrotechnics Laboratory.

6. **Electrical Machines Laboratory**
   
   Research unit head: Prof. Dr. Ivan Zagradišnik
   
   The research unit consists of the Electrical Machines Laboratory staff.
7. **Electromechanical Systems Control Laboratory**

Research unit head: Prof. Dr. Drago Dolinar

The research unit consists of the Electromechanical Systems Control Laboratory staff.

8. **Computer Graphics and Artificial Intelligence Laboratory**

Research unit head: Prof. Dr. Nikola Guid

The research unit consists of the Computer Graphics and Artificial Intelligence Laboratory staff.

9. **Institute of Information Science**

Research unit head: Prof. Dr. Ivan Rozman

The research unit consists of the staff of the Information Systems Laboratory and Database Technologies Laboratory.

10. **Systems Software Laboratory**

Research unit head: Prof. Dr. Damjan Zazula

The research unit consists of the System Software Laboratory staff.

11. **Power Engineering Laboratory**

Research unit head: Assoc. Prof. Dr. Jože Voršič

The research unit consists of the Power Engineering Laboratory staff.

12. **Institute of Mathematics and Physics**

Research unit head: Prof. Dr. France Brešar

The research unit consists of the Applied Mathematics Laboratory staff.

13. **System Design Laboratory**

Research unit head: Assoc. Prof. Dr. Peter Kokol

The research unit consists of the System Design Laboratory staff.
PROGRAMME UNITS

Since 1998, the Faculty of Electrical Engineering and Computer Science has been registered with the Ministry of Education, Science, and Sport as a research organisation incorporating 9 programme units. Since 2000, a full programme scheme financial support is given to the units. A thorough review of their scientific contributions and technical and expert contents must be presented every year. Short overviews for 2001 are gathered in the sequel.

1. Information Systems

Programme unit head: Prof. Dr. Ivan Rozman

This programme unit consists of the staff of the Information Systems Laboratory and the Database Technologies Laboratory.


The importance of technologies that enable the exchange, processing and storing of data in arbitrary form is increasing with the complexity of information systems, development of information society and Internet computing. Multimedia information systems that enable easy information exchange and are often tightly connected to real-time systems are also becoming increasingly important.

Our goal is the development of methodology for formal definition and the continuous improvement of software development processes. Experiences in cooperation with partners lead us to a developed methodology, which – together with knowledge in the development of quality systems – provides for an integrated environment for software development. Research in the area of quality and process modelling headed towards the upgrade of previously developed SoPCoM methodology – Software Complexity Model. The model was tested in practical projects. Additionally, a tool was developed for methodology support, process modelling and complexity assessment. Our experiences in the process modelling of a software development process are the basis for a model for the introduction of a quality management system in an information society. In this model, the description of tasks is compatible with the SoPCoM model that can be used to assess the complexity of the tasks. Process modelling is also included in the 5th framework project TEAMWORK. The basic goals of this project are twofold: firstly, the testing of the NQA method for process modelling and secondly, the testing and upgrading of software for document flow within a process. In the area of software development, we paid special attention to the definition of an object-oriented process for software development. Fundamental research from this area was used in the assessment of technologies for the component-based development of object-oriented Internet applications by using UML, distributed objects CORBA, Java, JavaBeans, Enterprise JavaBeans, object-relational databases and object brokers. We investigated the possibility of ensuring successful usage of object technology and component-based development in the area of modern Internet applications, usage of component-based models for the integration of new and
legacy systems and the introduction of successful reused mechanisms. The main characteristic of the integral support environment tool for the software development process is its roots in research work; it offers clear, unambiguous presentation of the software development process and is a basis for simple and successful process improvement. The tool offers complexity calculation for each task, transitions and of the whole process model.

We continued with research in the real-time systems development area according to their increasing importance. We set a formal framework: with our two projects, an applicative and a fundamental one, integral development of embedded control system and reliability of the embedded control systems. We will join the methods within this framework, so that the development of an embedded control system is integral, in both software and hardware parts, with the final goal: more reliable, safer and easier to maintain systems. We cover the area of holistic approach to the development and verification of software architecture and hardware and fault-resistance.

We continued with research into the development of optimal data warehousing architectures and pointed out the most common mistakes in building the data warehouse in practice. We conducted research in the area of knowledge discovery in databases and efficiency of classification algorithms. We also paid special attention to data security and data quality. We investigated the possibility of data models reuse in the area of intelligent medical systems.

The last of the more important areas of our research work includes research in the area of intelligent systems. In this area we developed a method of rule extraction from fuzzy neural networks. The connection of artificial neural networks with fuzzy logic enables the construction of learning algorithms that are superior over classic neural networks, because the discovered knowledge can be given in the form of simple rules that are common in expert systems with knowledge bases. In many practical applications, the problem is in small amounts of training cases due to several reasons. In this case it is hard to find an optimal structure of neural networks because classical statistic rules do not apply. We used a principle of structural minimization with assessment of VC dimension. The principle is based on empirical risk minimization. The true error is assessed by using the combined test error and the assessed generalization error with the help of VC dimension. The testing of the new software has shown its wide applicability: in information technology, medicine, pharmacy – in areas that are successful in Slovenia and export-oriented.

2. Power Engineering

Programme unit head: Assoc. Prof. Dr. Jože Pihler

This programme unit consists of the Power Engineering Laboratory staff.


Researchers of the Power Engineering programme group were involved in one basic project, two applicative projects, three R&D projects, three industrial projects and four international projects. The basic project is a system project, since it encompasses the monitoring and observation of perturbances in the power system caused by large Slovenian electricity consumers. The first of the two applicative projects is a part of the Environmental Protection Programme for the City of
Maribor, while the second is a comparative study on electrical power quality in the EU. The three R&D projects were the following: research work supporting the implementation of the Kyoto Protocol, laboratory for high current tests and energy balance in the Municipality of Maribor. Projects for industrial clients were the development of a new motor starter, low voltage distribution panels for outdoor use, and cable accessories and heat shrinkable tubing. International projects included a virtual electromagnetic laboratory and Web-based distance learning, CO₂ emissions (The Joint Project - National CO2 Emission Baselines and Aditional Project – 5th framework project) and development of protection systems against life-threatening step and touch voltage occurring during an earth fault in the high voltage network of a coal mine, together with a proposal for efficient selective protection. The project DISPOWER – 5th framework programme is still in the evaluation phase.

In addition to the above mentioned large-scale projects the members of the programme group also developed their own software for the planning of overhead lines called “PARAMETRI DALJNOVODOV”, software for protection against lightning called “SCIT”, software for computation of illuminance distribution called “IZOS”, software for computation of glittering called “UGRATING” and software for the calculation of characteristic parameters of wiring systems called “DOTIK”.

The programme group organised, as in previous years, the international experts' meetings “Power Engineering” and “Lighting 2001”, as well as the local conference “Energy for Tomorrow's Maribor – Geothermal Energy”. The members of the programme group also actively participated at international conferences and published their papers in Slovenian and international magazines.

The programme group achieved and even exceeded all the planned objectives in all areas of the programme group's work, i.e. power system analysis, electric power quality, energy supply, lighting and power apparatus. The most important scientific achievements:

1. Development of own computer programmes for all basic areas of the programme group's work;
2. Development of new program modules of the standard network analysis programme tool PSCAD/EMTDC, i.e. module GATECICLE for planning and monitoring of energy systems and DIALUX for computation of illuminance distribution;
3. Research, design and development of new products, testing of prototypes and thus verification of scientific development work;
4. Transfer of new products into regular manufacturing process.

3. Methods in Communications

Programme unit head: Assoc. Prof. Dr. Zdravko Kačič

This programme unit combines the staffs of the Digital and Information Systems Laboratory, Electronic Systems Laboratory, Microcomputer Systems Laboratory, and Digital Signal Processing Laboratory.

Research in the field of robust speech processing encompassed the development of methods for robust automatic fixed and mobile telephone quality speech recognition within the framework of research activities in the field of language technologies. A new noise reduction algorithm was developed that works in time domain (introduction of new weighting function that uses zero-crossing rate and short-time energy) and which enables robust speech detection in noisy signal. In the field of automatic large vocabulary continuous speech (LVCS) recognition an analysis of the influence the OOV rate of a test set on the accuracy of speech recognition for the Slovenian language was performed. In multilingual speech recognition a cross-lingual speech recognition experiment was carried out. Two sets of multilingual HMM models were used which were trained using Spanish, German, and English SpeechDat II databases. In cross-lingual speech recognition, the Norwegian language was used as a test language – Norwegian SpeechDat II database served as a test database. IPA tables were used in defining the lexicon for a Norwegian speech recogniser. The speech recognition results were improved by an adaptation procedure using a small set of Norwegian sentences. A development platform for automatic speech recognition was set up that will enable the evaluation and comparison of newly developed speech pre-processing and recognition methods within the existing reference methods. Comparative analysis of different configurations of recognisers for LVCS recognition was carried out. Word and sub-word models (stem-ending) were used for language models. Evaluation of accuracy was performed using the SNABI speech database. Experiments have shown better recognition results in case of sub-word models. A novel data driven approach of defining stems and endings was proposed for defining the sub-word models. The list of endings was defined in such a way that the smallest number of different units (stems and endings) in the training corpus was achieved. In the framework of data-driven prediction of symbolic prosody for Slovenian language the available speech database was semi-automatically labelled. Two types of symbolic labels were used: labels for the prediction of segmental breaks and labels for the prediction of segmental accents. The automatic prediction of prosody breaks was made using neural networks. The achieved accuracy was greater than 90 %.

The second group in the research programmes goals includes the development of new and the improvement of existing mathematical tools for system specification and verification, the development of new and improvement of existent software tools for formal verification of reactive systems using mathematical tools, as well as the application of mathematical and software tools for ensuring the correctness of practically relevant systems. The following research activities in accordance with the goals were carried out during 2001. We improved our BDD-based computer-aided tool EST for verification of finite-state systems described in the style of CCS. We completed the implementation of searches for counter examples and witnesses during system verification using ACTL model checking. In order to make the writing of ACTL specifications easier for non-specialists, we developed patterns of ACTL formulas for the most often specified properties. CTL patterns were also reconsidered. We upgraded our computer-aided tool for verification of digital synchronous sequential circuits, which, like EST, is based on our home-made software package for the efficient manipulation of binary decision diagrammes. We found that this tool could be employed for the generation of test sequences needed for the detection of stuck-at faults in digital circuits. We implemented the necessary procedures for searching witnesses resp. counterexamples during CTL model checking. We introduced a way of writing structural circuit specifications. We implemented the automatic generation of CTL formulas which express the
existence of single stuck-at faults in the circuit, and the generation of circuit outputs, which are
necessary in order to detect such faults during testing. We also began to investigate how the EST
tool could be employed for the formal verification of digital circuits. As a part of this activity, we
implemented a special parallel composition procedure, which enables communication of the output
of a circuit element with several inputs of other circuit elements. We studied how to use the
temporal logic of actions for verification when mobile processes can communicate as desired in
spite of some physical link disconnections. We proposed a new approach to the specification and
verification of synchronous sequential circuits using the SDL language, the ObjectGEODE toolset,
and the MSC and GOAL languages it supports. Another research goal was an efficient
implementation of protocol stacks for the IP telephony in embedded, real-time systems. The
emphasis was on space and time complexity as well as on concurrent execution.

4. Electromechanical Systems Control

Programme unit head: Prof. Dr. Drago Dolinar

This programme unit consists of the Electromechanical Systems Control Laboratory staff.

Scientific disciplines: Electrical Engineering, Automation, Robotics, Control Engineering,
Electromagnetism, Mathematical and Gen. Theoretical Physics, Classical Mechanics.

This research programme is composed of two topics. The research objective of the first topic is the
development of new dynamic models of electromechanical devices, development of new methods
for parameter determination and design of new systems for the control of electromechanical
devices.

The first subject under investigation was the modelling and control design of high performance
drive with Linear Synchronous Reluctance Machine (RSLM). A nonlinear dynamic model of the
LSRM was developed, verified and validated. The model contains a magnetically nonlinear and
anisotropic model of the LSRM iron core, and the position and current dependent characteristics
of the thrust and friction force. All required characteristics have been determined experimentally.
Furthermore the control of a permanent synchronous machine working in the field weakening
region was designed and a method was proposed for higher harmonics compensation. The
developed solutions were dynamic, therefore the perfect tracking of the reference position
trajectory is assured even in the field weakening region.

In the framework of the applied research programme the experimental system of active magnetic
bearings (AMB) was developed. The design of AMB was achieved in cooperation with the KU
Leuven, ESAT/ELEN, Professor K. Hameyer, whilst the design of the rotor (system) shaft was
achieved in cooperation with the KU Leuven, MECH/PMA, Professor W. Heylen. The development
of the power supply, electronics and the control is based on our knowledge and experiences.
Magnetic bearing force was measured in order to determine the mathematical model by
continuous analytical functions. A control design was implemented based on the derived
mathematical model. An improvement in the static and dynamic system performances was
created. We have created the design as well as manufacturing the AMB experimental system. The
The research objective of the second topic is dynamic power system modelling, control and unit protection. We claim that network modelling can be performed equally based on instantaneous state variables or by using dynamic phasor quantities. Analysis tools for the interaction of power system transients with protection operation have been developed. During the testing phase the new protection algorithms were based on the analytical signal processing methods applied to the power transformers and transmission lines. The transformer turn-to-turn faults are the focus of our current research. This fault type represents a great challenge for existing relays since they are unable to recognize turn-to-turn faults in the early development stage. We hope first to develop an appropriate model describing this fault type with sufficient accuracy based on the great number of measured samples on the laboratory power transformer. The deeper knowledge obtained will be later used to improve the sensitivity of the protection algorithms.

5. Automation

Programme unit head: Assoc. Prof. Dr. Boris Tovornik

This programme unit combines of staffs of the Process Automation Laboratory and Electro-Optical and Sensory Systems Laboratory.


The following research activities were completed according to plan during the course of the year 2001:

1. Fiber optic based interferometer balancing system:
   - The high temperature furnace for heating optical fibers was realised.
   - The electronic circuit for heater controller was developed.
   - The electronic circuit based controller for the linear translator designed for stretching optical fibers was developed.
   - A PC computer based software was made for supervising the balancing system.

2. Miniature fiber-optic medical pressure sensor:
   - A pressure sensor was developed based on the gold foil diaphragm.
   - An electro-optic system was completed for the fiber-optic medical pressure sensor.
   - The system control software was made.

3. Remote control systems:
   - Field network technologies were reviewed and analysed. LONWORKS technology was analysed as a perfect solution for design, realisation, installation and support of the control networks.
- A Three-phase MT330 Energy Power Counter was developed with integrated tariff device, real-time clock, data processing and saving, external power consumer control possibility and LON communication.

- A LON.dll library was added to the CATS control software package for controlling and testing the MT330 power counters in the production phase.

- Fault detection and diagnostic systems.

- Different methods for fault detection and diagnosis were tested and compared to the laboratory heat exchanger application.

4. Fuzzy Welding Control in MIG/MAG Gas Metal Arc Welding:

- Measurement equipment and methods for measuring significant gas metal arc welding process variables were developed and were implemented by measurements done at the Varstroj d.d. company. Repeated welding experiments were assured by an application of a welding robot. The laboratory equipment enables measurements of electrical variables (the welding current, and the welding voltage) and process signal analysis (the signal shape and the frequency, typical time intervals, probability density distributions, etc.) in real time.

- Significant measurement of process variables was done in short-circuit gas metal arc welding. The new VPS 5000 welding device was used.

5. Intelligent buildings:

- Intelligent building system technology is one of the fastest increasing spheres of automotive activities. A model of the intelligence building using the LonWorks Control network was developed for the necessary control networks testing.

- The LON WEB server was built and the local control network was connected to the internet.

- The mathematical model was made of the building energy conditions.

Findings:

1. The accuracy and simplicity of the balancing system beyond every known balancing method. Thus, the balancing system is an indispensable instrument for fiber-optic sensor development.

2. The diameter of our miniature fiber-optic medical pressure sensor is 0.1 mm. It is the thinnest sensor with satisfactory accuracy and it has sufficient dynamic properties.

3. Quite a lot of network technologies are present on the market (CAN, Profibus, FIP, LON, BitBus, Interbus-S, Sercos, ...). No particular one is designed as general standard. The TCP/IP protocol is more and more valued as LAN standard. A LON.dll library was included in the control CATS software package for controlling and testing the MT330 power counters in the production phase. This project enables hardware and software changes during realisation.

4. A lot of fault detection and diagnosis methods are suitable for application on it because of the non-linear character of the heat exchanger. Different tools for process linearisation are
attainable. A linear model is unsuitable for the detection of all possible errors. The non-linear state observer is proposed for better fault detection and diagnosis.

5. New measurement equipment and the welding robot enable measurement and analysis of significant gas metal arc welding process variables in real time. Experimental results have shown that electrical process variables (the welding current, and the welding voltage) are useful information for detecting changes in weld quality. On the basis of the statistical analysis and frequency analysis of significant gas metal arc welding process variables on-line quality monitoring is possible.

6. The Intelligent House model is suitable for testing new technologies, where most important systems needed in up-to-date buildings are integrated: security, fire prevention, heat, ventilation and air-conditioning systems, lighting, power management and other devices. The distance control and the reduction of the energy consumption is made possible by connection to the internet. Calculation of the energy consumption saving is achieved based on simulations.

6. Computer Systems, Methodologies and Cybernetics

Programme unit head: Prof. Dr. Viljem Žumer

This programme unit combines the staffs of Computer Architecture and Languages Laboratory, the Computer Graphics and Artificial Intelligence Laboratory, and the System Software Laboratory.


The National programme groups Computer Systems, Methodologies and Cybernetics combine their research potential in the whole Institute of Computer Science. In the year 2001 our research work was devoted to the following research areas: semantics and implementation of programming languages, a study of natural phenomena, algorithms for surface flattening, development and implementation of algorithms of computational geometry, researching the decomposition of bioelectrical signals, analysing ultrasound images, building virtual computer environments for learning and training, with methods for design of intelligent systems, with heterogeneous processing and web technology.

The automatic generation of language-based tools (compilers/interpreters, editors, debuggers, etc.) has been explored in the field of programming languages. We were able to automatically generate a program visualizer and program animator from formal specifications of LISA compiler generator together with Portuguese partner. Furthermore, we worked on methodologies for the development of domain-specific and aspect-oriented languages. The aspect-oriented language AspectCOOL was developed using a LISA compiler generator which enables separate compilation of aspect and component codes.

In the field of natural phenomena animation, we studied the animation of clouds. We found out that the still image generation of a cloud is simple, while the realistic animation of their movement is a hard problem. Since this problem is as yet unsuccessfully solved, this research was very
interesting. Our research was also dedicated to solving the problem of surface flattening, where we started to develop a new method for the reconstruction and flattening of digitalized surfaces. This method can be used in industrial branches where the objects are composed of plane materials, for example, in the shoe industry.

In the field of computational geometry, we were concerned with the development and implementation of various algorithms of computational geometry (geometric buffers, polygon trapezoidation, a repetitive point-in-polygon test for large sets of points, merging a set of polygons, determination of differences between two sets of polygons), and by the acceleration of these algorithms (sweep-line scanning, two-level uniform space subdivision) applicable in geographical information systems (GIS). A significant part of our research work turned towards the representation, compression, transmission and visualisation of large sets of geometrical data in the internet environment. We also developed a rather simple, but efficient algorithm for spatial visualisation of medical data presented by voxels, obtained from a sequence of 2D images. In the field of geometrical modelling, we have continued to develop and implement our original approach to the constraint-based geometric design in 2D space, as presented a year ago. Our latest research is directed at solving the problems that cannot be constructed by a ruler and a compass only, to giving an ability to a user to define his/her own types of geometrical elements and constraints, and to an incremental design of the algorithm.

We tested the decomposition of bioelectrical signals using least-mean square (LMS) optimisation with third-order cumulants of myoelectric (EMG) signals. We focused on the autocumulants solely and checked how the use of optimisation performs in noisy environments. Using synthetic EMG signals, the approach proved robust and able to lead to a thorough decomposition of multichannel model based only on the autocumulants (we experimented with a two-input three-output model). In collaboration with the Teaching Hospital of Maribor, we developed a computer programme for detection of blood vessels and blood volume surrounding a dominant ovarian follicle. The programme has been implemented and has already introduced important scientific medical results that are going to be published in the highest ranking journals in 2002. In 2001, the development of virtual learning and training environments was still dealing mainly with the virtual delivery room. We improved the baby's vital signs significantly, especially by adding new principles of skin-colour changes and facial mimics. New scenarios were introduced, such as simulating peripheral cyanosis. The most important achievement in this field was the selection of the virtual delivery room project for a Finalist at the Stockholm Challenge Award 2001, the competition of innovative technologies.

We have developed new methods for the design of intelligent systems and expanded the application of intelligent systems to new fields of medicine and education. The new methods are based on evolution algorithms and hybrid methods. We have developed methods for generating decision trees with the use of rough sets-neural networks hybrid, information induction, fuzzy decision trees, parametric independent evolution of decision trees, and AREX rule generator.

A portal which simplifies the creation, integration and management of information contents is developed on the web technologies area. Basic features are document management, search facility, integration of internal services with external information systems, cross referencing of data and services, information categorization, independency of data to different user interfaces and
electronic media, multi language support, authorization of access to data and services, content
and user interface personalization. We have developed our own authentication system, which is
based on a LDAP directory service and a horizontal service based on “Blacksmith” framework for
integration of other horizontal and vertical services. In this year we have upgraded “Blacksmith”
framework with an Experimental XSLT processor for objects (EXPO), which performs mapping
between object model and XML documents based on XSLT style sheets.

7. Cybernetics

Programme unit head: Assoc. Prof. Dr. Vojko Matko

This programme unit comprises the staffs of the Systems and Control Laboratory, Signal
Processing and Remote Control Laboratory, and Measurements Laboratory.

Scientific disciplines: System Information Theory; Automation, Robotics, Control Engineering,
Telecommunication Engineering, Metrology, Physical Instrumentation, Artificial Intelligence.

The Cybernetics Research Programme covers goals, researches and studies of new laws,
methods, algorithms, procedures in measurements, signal processing, communication and
controlling carried out by three laboratories (Laboratory for Control and Systems, Laboratory for
Signal Processing and Remote Control and Measurements Laboratory). This inter-disciplinary
program envisages modern methods of planning intelligent measurement and regulation systems
based on communication, multimedia and modern program systems for signal acquisition and
processing.

The research carried out by the Measurements Laboratory is directed towards developing new
measurement methods, computer-based measurement data acquisition and towards processing
measurement uncertainty with emphasis on resonant methods. Special emphasis is placed on the
use of quartz crystals (for measuring relative dielectricity and very small changes of non-electric
quantities), development of remote measurements via Internet and LAN network, resistance
measurement of materials accumulating electric charge and on comparative measurement of
position, speed, height, accelerations using satellite signals and various databases (Autoroute,
Atlas Slovenije, Jeppesen). To meet the needs of the industry the Measurements Laboratory is
engaged in the development of special measurements of pile load bearing in construction, of large
object vertical displacement laser measurements and in the design of measurements in the
modern home. The laboratory interests also lie in the modelling of measuring uncertainty and
development of an EMI filter designed to reduce disturbances caused by digital switching circuits.

The research work of the Laboratory for Control and Systems specializes in the field of control and
regulation systems in the theoretical and practical research of classical and modern control system
methods and procedures. In particular, this research work is concerned with adaptive, predictive
and robust systems. Since 1996 the Laboratory has been active in the research of predictive
regulation systems based on robust models and robust synthesis method in $H_2$ and $H_{\infty}$. The
Laboratory also works on intelligent systems theory, in particular on the neurone network systems.
In the field of multimedia, the Laboratory is engaged in the research of user-friendly software
applications, man-computer communication and in the development of distance learning, which includes the designing of content and study techniques as well as data transfer technologies. Laboratory for Signal Processing and Remote Control is active in the theoretical scientific fields of signals, information and telecommunications. Recent research work has been directed towards basic research work on intelligent algorithms of 3D image context-based compression and processing, towards ATM network control, planning and development of new algorithms in cable communication and GSM networks, controlling radiator radiation using computer vision, setting image parameters on cathode screens using polynomial methods of edge modelling in pattern recognition and hybrid optimization algorithm, and towards a hybrid regulation algorithm which enables implementation of new control strategies replacing the classic pulse width modulations in controlling power switch controllers.

8. Applied Electromagnetics

*Programme unit head:* Assoc. Prof. Dr. Mladen Trlep

This programme unit consists of the staffs of the Applied Electromagnetics Laboratory, Electrical Machines Laboratory, and Fundamentals and Theory of Electrotechnics Laboratory.

*Scientific disciplines:* Electrical Engineering, Electromagnetism.

Within the framework of the research programme “Applied Electromagnetics”, parallel work is carried out in three fields, with the ultimate aim of incorporating all the knowledge into a complex system which will, as accurately as possible, cover all the demands of a real electromagnetic problem. The three fields are:

- research and development of mathematical models for defining magnetic, electrical, current and temperature field under stationary and dynamic conditions,
- development of measurement methods for defining the real characteristics of material,
- development of models to be used for solving inverse problems in electrotechnics.

The first part focuses on the numerical methods for electromagnetic field calculation, namely the finite element and boundary element methods. The development and application of the above methods are directed to CAD program solutions on concrete objects. In most cases, these objects are electromechanical converters, actuators, switches, insulating and grounding systems, etc.

The development of measurement methods focuses on measurement methods for accurately defining the real characteristics of materials and losses in them, which is necessary for a more realistic mathematical model of the electromagnetic system. This work is carried out using methods for defining magnetization and hysteresis curves, on a determination of pulsating and rotational losses in magnetic materials and on the production of measurement yokes for different shapes (square and circular) of measurement specimen. Software for supporting the measurement methods is developed. The aim of the calculation is to find out the area in the specimen, where the magnetic field is homogeneous enough to measure the material characteristics. The problem is calculated as a three dimensional non-linear transient problem. The influence of the \( z \) component of magnetic density and the influence of the eddy currents on
field homogeneity in the specimen is analysed. The comparison between measured and calculated values of magnetic field confirms the regularity of the calculations.

We decided on a special variation of the boundary element method, the so-called DRM method, for solving the inverse problem, which enables simpler operations in the domain, where we want to determine the inverse problem. Our initial work has been directed to problems of 2D static fields, where we detect any unknown distribution of electromagnetic field sources, or rather, unknown material property. Both problems are very prevalent in bioelectromedicine, for searching defects in material structure, for development of measurement methods, etc.

9. Institute of Robotics

*Programme unit head: Prof. Dr. Karel Jezernik*

This programme unit combines the staffs of the Power Electronics Laboratory, Industrial Robotics Laboratory, and Kinematics and Simulations Laboratory.

*Scientific disciplines: Automation, Robotics, Control Engineering, Motors and Propulsion Systems.*

The research year 2001 was very fruitful for our program unit. The results of our research work were published in international scientific journals of the first category and we have to stress that the results in the area of automation and robotics can only be published if the theoretical work is supported and confirmed through experimental verification. We can report on the published results of the control theory of nonlinear mechanisms using the robust sliding mode control approach. A robust control algorithm based on the PI load estimator that is able to effectively compensate for friction, elasticity and compliance in servo drives was developed and implemented on a 2-axis XY table toll machines by industrial application.

Intensive research work was done on a second order perturbation estimator implemented in DD robot mechanism. The frequency characteristics of a closed loop system was altered by using this estimator, so that the high frequency contents are attenuated too. A fuzzy logic-based perturbation estimator was developed in the framework of the same research. The research results showed that by using this estimator the influence of noise in the measured signals is minimized. Consequently the quality of the perturbation estimation is significantly improved. The results of this work were presented at a few international conferences. The special value at this work concerns the application of the developed fuzzy perturbation estimator in a robot position control.

A sliding-mode based nonlinear control algorithm was also successfully implemented in AC motor drives. In this area an induction motor drive for electric vehicle is the most attractive project. The research work was focused on the control of the induction motor without mechanical sensors and the results were presented in Berlin at the EVS-18 conference and published in the European Journal as the best contribution from the PEMC’00 Conference, Košice, Slovakia. As a main result a new mechanical sensorless observer of electromagnetic force (EMF) and rotor flux was developed and the results were presented at an invited lecture at the IECON’01 in Denver and two invited lectures at the Technical University in Istanbul (Turkey) and at the University in Wisconsin (USA).
The experimental set-up of 130 kW power operating at 500 V voltage for the high pressure hydraulic pump in the mine (Rudnik lignita Velenje) was also built. Several successful tests were performed on the experimental set-up in our lab as well as in the mine. The most critical operating conditions in this explosive high risk environment were considered in the development of the voltage/frequency inverter, microcontroller and implemented software.

The last part of our research programme was dedicated to computer aided design of the real-time control systems in a Matlab/Simulink environment. The gained knowledge allowed us to serve as a consultant to many Slovenian enterprises in the area of fast new products development.

In the postgraduate education of the young researchers the new didactic procedures based on the internet were incorporated into the study. At the conference IMS'01 in Carigrad, Turkey we reported on our gained experiences about the internet based study as experts from the European Community.
## OVERVIEW OF PROJECTS AND STAFF BY RESEARCH UNITS

<table>
<thead>
<tr>
<th>RU</th>
<th>Number of staff members</th>
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</table>

**RU** – research unit  
**RS** – researchers  
**TE** – teaching staff  
**TS** – technical staff  
**JR** – junior researchers  
**AP** – applied projects  
**BP** – basic-research projects  
**RD** – research and development tasks  
**Int.** – international projects  
**Other** – projects of the industry and the Municipality of Maribor
INSTITUTE OF AUTOMATION

Head:
Prof. Dr. Karel Jezernik
Phone: +386 2 220 73 00
E-mail: karel.jezernik@uni-mb.si
URL: http://www.au.feri.uni-mb.si/index.html-l2

The Institute of Automation participates in basic and applied research in the fields of electrical and high precision measurement of electrical and non electrical quantities, measurement automation, signal processing, and remote control, sensor systems, systems theory and control, modelling, identification, computer control of processes, system design in automation, software in automation, expert system in automation, fuzzy control systems, man-machine communication, electro-optics systems, programmable logic control systems, and real time control systems.

The Institute of Automation co-operates with many institutes abroad: Technische Universität Graz - Austria, Technische Universität Wien - Austria, Politehnikais Instituts Latvijas, Riga - Latvia, Fachhochschule München, Technische Universität München - Germany, Deutsche Forschungsanstalt für Luft- und Raumfahrt Oberpfaffenhofen - Germany, Ecole Polytechnique Féminine, Sceaux, Paris - France, Guangxi University of China, Nanning - China, Elektrotehnički fakultet, Zagreb - Croatia, Tehniška univerza, Bratislava - Slovak Republic, University of Sarajevo - Bosnia and Herzegovina, Faculty of Electrical Engineering in Praga and Brno - Czech Republic.

The members of the Institute of Automation belong to five laboratories, which also includes one centre of technology.
**Systems Control Laboratory**

Head: Assoc. Prof. Dr. Rajko Svečko

Employees: Asst. Prof. Dr. Matjaž Debevc; Dr. Martina Leš; Dr. Amor Chowdhury; Boris Ratej, BSc; Josip Vrbanec, MSc; Metka Zorič Venuti, MSc; Andrej Knuplež, Ing.

**Signal Processing and Remote Control Laboratory**

Head: Assoc. Prof. Dr. Žarko Čučej

Employees: Dr. Bojan Gergič; Dr. Peter Planinšič; Jože Mohorko, MSc; Dušan Gleich, BSc; Mihael Kaiser, BSc; Martin Pec, BSc; Tomaž Romih, BSc

**Process Automation Laboratory**

Head: Assoc. Prof. Dr. Boris Tovornik

Employees: Asst. Prof. Dr. Nenad Muškinja; Dr. Marjan Golob; Stojan Peršin, BSc; Alojz Hojnik, Ing.

Part-time employed: Aleksander Polutnik, MSc

**Measurements Laboratory**

Acting Head: Assoc. Prof. Dr. Vojko Matko

Employees: Dr. Gorazd Lipnik; Ladislav Mikola, MSc; Stanislav Lampič, Ing.; Miloš Vute, Ing.

**Electro-Optics and Sensor Systems Laboratory**

Head: Prof. Emeritus Dr. Dali Đonlagić

Employees: Asst. Prof. Dr. Denis Đonlagić; Edvard Cibula, BSc
RESEARCH PROJECTS

Current research projects

**Basic research project**

**Modern Control Theory**

*Leader:* Assoc. Prof. Dr. Rajko Svečko  
*Participants:* Dr. Amor Chowdhury; Josip Vrbanec, MSc; Martin Pec, BSc; Dalibor Igrec, BSc; Aleš Mirnik, BSc  
*Financed by:* Systems and Control Laboratory and Ministry of Science and Technology of the Republic of Slovenia

Controller design problems were originally formulated in the frequency domain. The main tools used during the early phases of research into this class of problems have been operator and approximation theory, spectral factorization, and (Youla) parametrization, leading initially to rather complicated (high-dimensional) optimal or sub-optimal (under the H-infinity norm) controllers.

Riccati equations of the type that arise in linear-quadratic differential games play a key role. These findings have prompted further accelerated research on the topic, for more direct time-domain (state-space) derivation of these results.

Among different time-domain approaches to this class of worst-case design problems, the one that uses the framework of dynamic (differential) game theory seems to be the most natural. This is because the original H_{\infty}-optimal control problem (in its equivalent time-domain formulation) is in fact a minimax optimization problem, and is therefore a zero-sum game, where the controller can be viewed as the minimizing player and disturbance as the maximizing player. Using this framework, our research focuses on a complete theory that encompasses continuous-time as well as discrete-time systems, finite as well as infinite horizons, and several different measurement schemes. We also discuss extensions of linear
theory to nonlinear systems, and derivation of lower-dimensional controllers for systems with regularly and singularly perturbed dynamics.

Currently we are engaged with several problems such as:

- Development of the robust controller synthesis method for systems where the performances demand is asymptotic tracking to the sinus reference signal.
- Order minimization of synthesis weight functions.
- Study of the connection between the pole placement and the $H_\infty$ synthesis.

**Research and development projects**

**Computerized admittance control system**

*Leader:* Assoc. Prof. Dr. Rajko Svečko  
*Participants:* Boris Ratej, MSc; Dr. Amor Chowdhury; Josip Vrbanec, MSc; Andrej Knuplež  
*Financed by:* Systems and Control Laboratory

The computerized admittance control system is globally composed of a monitoring computer, an interface between RS232 and CAN bus, and a CAN bus and microcontroller interface, which manages a contactless card reader and controls an electric key-lock and other light and acoustic signals. The computerized admittance control system also offers absolute control over access into certain areas (rooms) besides keeping track of working time. It enables data acquisition regarding arrival and departure time, view over the circulation of people between various areas, and monitored access into every area included in the system. Using the data, which are saved in the monitoring computer, varied statistical analysis is possible (for example space occupation, utilization of equipment, presence of employees, etc).

The basic operation of admittance control systems is identification. Data are divided according to identifying devices on the PIN code, magnet storage media, finger print, voice, etc. and by procedures themselves divided into the contact and contactless ones. Because the contactless memory medium has many advantages, the contactless smart cards from system LEGIC® are used in our admittance control system.

The user interface, implemented on the monitoring computer, is capable of monitoring and completely controlling of the entire system.

**Control Systems Theory Education Tool**

*Leader:* Assoc. Prof. Dr. Rajko Svečko  
*Participants:* Dr. Amor Chowdhury, Andrej Knuplež
Many concepts involved in control system theory including visualization and symbolic computations could also be done in MATLAB™. It is easy to learn its syntax, but the amount of functions designed for control systems is still increasing and can cause ineffective use. To overcome this problem, examples should be well organized and documented. This was the basic idea of building an additional user interface with links to manuscripts (lectures and computer exercises) in electronic form.

The user interface is prepared in Slovenian language because it is also very important to provide as much information as possible in the native tongue. The Linear Systems Theory Education Tool is designed for the undergraduate electrical engineering students, who initially work with Matlab and will then continue with control systems studies. The interface and the environment are organized in such a way, that it could be extended for other similar subjects in Control Engineering studies.

The Linear Systems Theory Education Tool consists of a main navigation menu and four main graphic units: submenus for navigation through chapters, help, explanations (tutorials) and a graphic presentation window. Additionally, html-help and connections to electronic manuscripts have been prepared. This graphical environment provides show and help in MATLAB™ standard forms and they have been changed only in some details (e.g.: navigation controls and pop-up menus are supplemented in the Slovenian language). It is built in such a way, that its conformation into any other language mostly demands simple translation of comments. The effectiveness is enlarged by the use of Matlab's p-code and multimedia and distance learning capabilities during World-Wide-Web, for future developments.

**Industrial project**

**Central supervision system**

*Leader:* Assoc. Prof. Dr. Rajko Svečko  
*Participants:* Dr. Amor Chowdhury; Josip Vrbanec, MSc; Andrej Knuplež  
*Financed by:* Varnost Priva d.o.o. Maribor, Slovenia

Technical security is build on different technical systems. Each of the systems (fire alarm, burglary alarm) is usually closed, independent and works autonomously. Incompatibility of the technical security appliance and software equipment of the different producers and the autonomous system work concept are the two major problems for the supervision center, where all information about what is happening on the object flows in.

The security service can become complicated and non-transparent because of the huge range of installed hardware and software equipment on the object. The main goal of this
research project is a study of the different technical security systems and development of software equipment for the informational integration of different technical security systems on the supervision computer. The second part of the project is the development of a software user interface intended for the graphical display of security events on the object.

Completed research projects 2001

International project

**UM_JEP-14013-1999** Development of the Department for Technology-Supported Distance Education (Participation in Tempus Phare project)

*Leader:* Asst. Prof. Dr. Matjaž Debevc  
*Participants:* Boris Ratej, MSc; Andrej Knuplč

*Financed by:* European Union  

The main goal of the DETECH project is the development of the Department for Technology-Supported Distance Education within the Centre for Distance Education Development at the University of Maribor. This project will offer co-ordinated adjustment and use of current activities and technological results of individual university faculties and partner universities, operating in distance education areas. This service will also offer logistical, operational, and technological support to other faculties and European universities, which are introducing distance education.

Members of the System Software Laboratory participate in this project by (a) offering expertise in the field of software-supported conceptual learning, (b) setting up of the technological services of the Centre for Distance Education Development and (c) organising project meetings.

In collaboration with the video production team of the Centre we have prepared the first Slovenian video supported web presentation of the PhD defence (http://www.cded.uni-mb.si/predavanja/dr/potocnik).

PUBLICATIONS


Matjaž Debevc, Dean Korošec, “The role of the department for technology supported distance education in Slovenian school environment,” The future of learning - learning for the future, Hagen, 6 pp.


Dean Korošec, Damjan Zazula, Matjaž Debevc, “Tools and toys for learning with the Web - examples from electrical engineering, computer engineering and medicine,” Internet based education, Bratislava, Slovakia, 1 pp.


**PRESENTATIONS BY THE LABORATORY MEMBERS**


SIGNAL PROCESSING AND REMOTE CONTROL LABORATORY

Head:

Assoc. Prof. Dr. Žarko Čučej

Phone: +386 2 220 71 20

E-mail: zarko.cucej@uni-mb.si

RESEARCH PROJECTS

Current research projects

Basic research projects

L2–9072-0796-99 Compression of Two-Dimensional Signals

Leader: Assoc. Prof. Dr. Žarko Čučej

Participants: Asst. Prof. Dr. Peter Planinšič; Dr. Jože Mohorko (until June 2001); Dušan Gleich, MSc; Tomaž Romih; Dr. Bojan Gergič (until October 2001)

Financed by: Ministry of Science and Technology of the Republic of Slovenia (individual research funds, doctoral scholarship)

This research project is an international bilateral research project with the German Aerospace Agency DLR/DFD entitled Compression of Two-Dimensional Signals. This research project started in 1997 and finished successfully in 1999, but further research is still going on. During this year we focused on the image quality of reconstructed images using advanced wavelet coders. We developed new quality measurements based on fuzzy sets and new compression algorithms based on context coding.

We investigated the possibility of replacing the Viterbi algorithm in the trellis quantization using context estimation of surrounding wavelet coefficients. Fuzzy sets were used to predict the subset of the trellis. We developed a probability estimation engine, which also uses fuzzy logic. An arithmetic coder used in the compression scheme is driven using a new probability estimation. We developed a new wavelet-based coder, which uses Space Frequency Quantization and context modeling. It achieves the best results among our developed coders in the rate distortion sense. A primary goal of the investigation focused on the image quality
of the advanced wavelet coders using objective and subjective measurements. The developed algorithms were tested on Synthetic Aperture Radar data, as well on natural optical images. A comparison was made using such well known methods as SPIHT, SFQ and EZW. Test were performed using IDL, Matlab and Visual C++ programs.

**ATM network management and control**

*Leader:* Assoc. Prof. Dr. Žarko Čučej  
*Participant:* Mihael Kaiser  
*Financed by:* Signal Processing and Remote Control Laboratory, Ministry of Science and Technology of the Republic of Slovenia (doctoral scholarship)

Research is focused on “smart” management and traffic flow control in input network switches dealing with massive heterogenic traffic. In control area we investigate possibilities and capabilities of the last generation of network processors and languages for the functional description of traffic management tasks.

**Quality of Services in (narrowband) Radionetworks**

*Leader:* Assoc. Prof. Dr. Žarko Čučej  
*Participants:* Boris Ratej, MSc (Systems and control laboratory, now Ultra Co.); Assoc. Prof. Dr. Rajko Svečko (Systems and Control Laboratory)  
*Financed by:* Systems and Control Laboratory, ULTRA company, Ministry of Science and Technology of the Republic of Slovenia (doctoral scholarship)

The research goal is the management and control of multipurpose terminals in Radionetworks with narrow bands. Terminals generate heterogeneous traffic (data, real-time remotecontrol data, voice). We focus on the Quality of Service management with the “smart” control of queue buffers and voice quality achieved with a variable compression rate.

**Optimal pulse width modulation – phase 2: hierarchical current controller**

*Leader:* Assoc. Prof. Dr. Žarko Čučej  
*Participants:* Assoc. Prof. Dr. Peter Cafuta, Prof. Dr. Bojan Grčar  
*Financed by:* Signal Processing and Remote Control Laboratory

Nowadays hybrid control algorithms enable the introduction of new control strategies, which can replace classical pulse-width modulation in voltage source inverters. The developed hybrid controller has a prescribed switching order, feedforwarded steering of
voltage pattern selection, as well as tabulated logic rules. It has current error of $O(T)$ type, which has lower average value than the current error of $O(T^2)$ type significant for PWM inverter control. Its dynamic is the same as at variable structured control. The theory of such a control has been employed in controller design. We developed and proved the stability conditions for the controller.

**Industrial project**

**Heating radiators quality inspection by computer vision**

*Leader:* Assoc. Prof. Dr. Žarko Čučej  
*Participant:* Dr. Bojan Gergič  
*Financed by:* Aklimat d.o.o. Lenart

We developed and built a system for the final control of heating radiators for the Aclimat Lenart Company. Hardware consist of two TV cameras, frame grabber, personal computer and printer. Software is developed by use of the LabView program suite.

**Completed research projects 2001**

**Basic research project**

**Geometry parameters adjustment of images on CRT**

*Leader:* Assoc. Prof. Dr. Žarko Čučej  
*Participants:* Dr. Jože Mohorko; Tomaž Romih, MSc; Asst. Prof. Dr. Peter Planinšič  
*Financed by:* Signal Processing and Remote Control laboratory  
*Duration:* 2 years

This basic research was conducted on an already finished industrial project for the Elektronika company, Velenje. We focused on three topics in our further investigation:

1. Theoretical background of polinimial methods in pattern-edge modelling for pattern recognition.
2. Mathematical model for the geometrical distortion of image on the CRT screen.
3. Hybrid optimization algorithm. It was developed from the standard secant method. Its convergence in the multidimensional case was improved/extend to nonlinear and discontinuous functions by replacing the Jacobian with the “belonging matrix” and by adding logic condition in the algorithm structure.
**Industrial projects**

**Modem for (narrowband) radio networks**

*Leader:* Assoc. Prof. Dr. Žarko Čučej  
*Participants:* Martin Pec, Borut Barbarič (Ultra d.o.o.), Asst. Prof. Dr. Peter Planinšič, Mihael Kaiser  
*Financed by:* Defence Ministry of the Republic of Slovenia  
*Duration:* 1 year

We developed and made for the Defence Ministry of the Republic of Slovenia in collaboration with the ULTRA company a zero series of data terminal/modems which enable digitalization of voice, transmit data over analog radio networks. The modem is also equipped with GPS for the remote tracking of modem position.

**Development of services for ATM technology**

*Leader:* Assoc. Prof. Dr. Žarko Čučej  
*Participants:* Asst. Prof. Dr. Peter Planinšič, Mihael Kaiser  
*Financed by:* Telekom Slovenia  
*Duration:* 2.5 years

This project investigates the technological possibilities of using the ATM (Asynchronous Transfer Mode) in business, university, and medical environments. Emphasis was placed on a market analysis for the introduction of the ATM into these environments by designing a reference model for distance learning services over an ATM network.

This year we conducted further studies on how to introduce ADSL and ATM technologies into the distance learning process. Further diploma thesis has been done for this purpose.

**PUBLICATIONS**


CONGRESSES, MEETINGS, AND COMMITTEES

Asst. Prof. Dr. Peter Planinšič: Member of organizing committee for conference “Automatization of industry”, Maribor, Slovenia, April 5–6, 2001.

Assoc. Prof. Dr. Žarko Čučej: Member of International program committee of international workshop IWSSIP 2001, Bucharest, Romania, June 7–12, 2001.

Asst. Prof. Dr. Peter Planinšič: Member of local organizing committee for ICEEPUS international summer school, Maribor, Slovenia, June 10–22, 2001.

Assoc. Prof. Dr. Žarko Čučej: Member of International program committee of international conference ViProCom 2001, Zadar, Croatia, June 12–15, 2001.

Assoc. Prof. Dr. Žarko Čučej: Member of International program committee of international conference Elmar 2001, Zadar, Croatia, June 12–15, 2001.

VISITS TO OTHER INSTITUTIONS

Assoc. Prof. Dr. Žarko Ćučej, Mihael Kaiser:
Scientific collaboration in development of cable communication systems at the Faculty of Electrical and Computer Engineering Zagreb, Croatia, May 2001.
RESEARCH PROJECTS

Current research projects

Applied projects

L2-3436-0796  Mehko krmiljenje digitalnih varilnih izvorov za MIG/MAG elektroobločna postopka varjenja (Digital Fuzzy Welding Control in MIG/MAG Gas Metal Arc Welding)

Leader:  Dr. Marjan Golob
Participants:  Assoc. Prof. Dr. Boris Tovornik; Asst. Prof. Dr. Nenad Muškinja; Dr. Marjan Golob; Aleksander Polutnik, MSc; Stojan Peršin; Alojz Hojnik; Miloš Vute

Financed by:  Ministry of Education, Science and Sport of the Republic of Slovenia and Varstroj d.d., Lendava

Welding is an important manufacturing process that can be automated. Its effect on the quality of products is particularly important when new materials are used in the manufacturing process. The permanent demand for higher quality products at lower product prices dictates a permanent development of production quality assurance methods and systems. Super-control of welded products (destructive and non-destructive testing of welds) is time consuming and expensive, so new possibilities are being investigated for fully automated welding processes. One of the feasible possibilities in this domain is to design an intelligent controller for welding sources. This controller offers parameter settings (welding energy, pulse shapes) with respect to the chosen material, weld characteristics and welding program. This is made possible by a decision system based on analysis of feedback information coming from the welding process and the knowledge database decision algorithm, supported by intelligent data analysis, neural network theory and a fuzzy decision system is able to adjust automatically the welding parameters of automated welding cells in order to fulfil the
desired technological requirements. The control and regulation of the welding process is implemented depending on the conditions in the solidified weld which is in direct connection with the quality of the welded joint. This project will combine the results of interdisciplinary research work performed by experts in welding technology, measurements of electrical and physical quantities, intelligent data analysis, soft computing technologies, and microprocessor technologies.

**Inteligentna hiša (Intelligent House)**

*Leader:* Assoc. Prof. Dr. Boris Tovornik  
*Participants:* Stojan Peršin; Asst. Prof. Dr. Nenad Muškinja; Dr. Marjan Golob; Aleksander Polutnik, MSc; Alojz Hojnik  
*Financed by:* personal research funds

Purpose of this project is the development of the Intelligent House, where the most important systems needed in up-to-date buildings are integrated: security, fire prevention, heat, ventilation and air-conditioning systems, lighting, power management and other devices. The LonWorks system was used which is, at the moment one, of the most used technologies in the area of home and building automation. The key part of this technology is a LonWorks control network based on equal nodes. The model of a smart home was made using this technology. It has two rooms and a basement where every room represents a node. The basic components of LonWorks technology: Neuron, transceiver for communication on network, I/O driver with surroundings, and a control network with LonTalk protocol are used in the model.

**International project**

**CEEPUS – CZ 103**  
*Leader:* Assoc. Prof. Dr. Boris Tovornik  
*Financed by:* CEEPUS

Project purpose is student and professor exchanges within the Middle and Eastern Europe region, organisation of international summer schools and co-ordination of proposals for common research projects.

The “International summer school of automation” was held at the Faculty of Electrical Engineering and Computer Science, University of Maribor, June 10–22, 2001. There was collaboration between 25 delegates.

Within the CEEPUS CZ-103 project the Faculty of Electrical Engineering and Computer Science, University of Maribor organised the summer school “International summer school of
automation”, on June 10–22, 2001 in Maribor, Slovenia. The summer school evoked wide interest and was attended by 25 professors and students included members of the TU Prague, TU Bratislava, TU Brno, TU Plovdiv, TU Gabrovo, UNI Zagreb, UNI Split, and from UNI Maribor. Two interesting visits were made during the summer school to the Iskroemeco factory in Kranj and to the brewing industry in Pivovarno Laško. The summer school received wide coverage in the Slovenian mass media and some of its participants were interviewed by local newspapers, radio and television. Split, Croatia is the host city for the next 2002 international summer school.

Completed research projects 2001

**Industrial project**

<table>
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<tr>
<td>55-3512</td>
<td>Trifazni gospodinjski števec MT330 z LON komunikacijo (Three-phase Energy Power Counter MT330 with integrated LON communication)</td>
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</table>

**Leader:** Assoc. Prof. Dr. Boris Tovornik  
**Participants:** Asst. Prof. Dr. Nenad Muškinja; Dr. Marjan Golob; Aleksander Polutnik, MSc; Stojan Peršin; Alojz Hojnik; Primož Žerdin  
**Financed by:** Ministry of Education, Science and Sport of the Republic of Slovenia and Iskra Emeco Kranj  
**Duration:** July 2000 to December 2001

Purpose of this project was the development of a Three-phase Energy Power Counter MT330 with an integrated tariff device, real-time clock, data processing and saving, external power consumer control possibility and LON communication. A LON.dll library was included in the CATS control software package for controlling and testing the MT330 power counters in the production phase. Project enable hardware and software changes during realisation. The modular structure of the MT330 power counter enables one or three phase counters with the possibility of one or two tariffs. The LON.dll library includes: Command, SetData, ReadData ReadSelfDoc, LonInit, LonClose, init (Initialisation of an ActiveX IELON), close (Removing the ActiveX IELON) and ReadNV (Read Network Variables) functions.

**PUBLICATIONS**


Bogdan Pavlič, Aleksander Polutnik, “System for payment data exchange and payment terminal device used therein: PTC Request ... that the present international application be processed according to the Patent Cooperation Treaty,” München, Germany.


Stojan Peršin, Drago Valh, Boris Tovornik, “Fault detection and isolation methods applied in a chemical process,” The Sixteenth Dubrovnik International Course and Conference on the

Boris Tovornik, Drago Valh, “Safety problems in process industry,” Manufacturing systems for the third millenium, Maribor, Slovenia, pp. 177-199.


CONGRESSES, MEETINGS, AND COMMITTEES

Assoc. Prof. Dr. Boris Tovornik, Asst. Prof. Dr. Nenad Muškinja, Dr. Marjan Golob, Stojan Peršin, Alojz Hojnik:


Assoc. Prof. Dr. Boris Tovornik, Asst. Prof. Dr. Nenad Muškinja, Dr. Marjan Golob, Stojan Peršin, Alojz Hojnik:

Organization of the conference “Automation in Industry and Economy”, Maribor, Slovenia, April 5-6, 2001.

Assoc. Prof. Dr. Boris Tovornik:

Member of international program committee at “9th Mediterranean Conference on Control and Automatic”, Dubrovnik, Croatia, June 27–29, 2001.

Stojan Peršin:


VISITS TO OTHER INSTITUTIONS

Assoc. Prof. Dr. Boris Tovornik:

Faculty collaborations, University of Zagreb, Faculty of Electrical Engineering and Computing, Zagreb, Croatia: several visits.

GUESTS AND VISITORS

Prof. Dr. Mikulaš Huba and

Lectures at the “International summer school of
DECORATIONS, AWARDS, AND HONOURS

Tomislav Klančnik, mentor Assoc. Prof. Dr. Boris Tovornik, Prof. Bedjanić Award for the BSc work.
MEASUREMENTS LABORATORY

Acting Head:
Assoc. Prof. Dr. Vojko Matko
Phone: +386 2 220 71 11
E-mail: vojko.matko@uni-mb.si

RESEARCH PROJECTS

Current research projects

Basic research project

Comparison of Measurement of Object Position using GPS Signals and Various Databases

Leader: Assoc. Prof. Dr. Vojko Matko
Financed by: personal research funds

The aim of this project is to compare the measurement of object position using various databases such as “Jeppersen”, “Autoroute”, “Atlas Slovenije” and various GPS signal receivers.

Position measurement using digitally coded satellite signals.
The moving object has no fixed reference point and does not transmit any signals. With the correlation measurement of digitally coded mutually delayed satellite signals it is possible to determine position, velocity and direction of movement, and to predict the position of an object in space coordinates after a certain time. The use of various databases provides a more complex picture of any error occurring in such position measurement. The goal of this research is to determine the GPS system measurement uncertainty for measurements in Slovenia.

**Applied projects**

**Measuring via LAN Network and Internet**

*Leader:* Assoc. Prof. Dr. Vojko Matko  
*Participants:* Bojan Alatič, MSc; Dr. Bojan Gergič  
*Financed by:* programme research funds

This project aims to define the procedures and appropriate software tools for web- and LAN network-based measuring in real time. Under development are the receiving and transmitting measurement data communicator with the option of remote on/off switching of the measurement system and of the individual functions via Internet. The minimal LAN and Internet network occupancy possibilities and the suitability of the measuring systems for such measurement will be studied. The definition of the above procedures would result in a wider application for industry and research.

**Temperature Stabilization of Quartz Oscillator above the Serial Resonant Frequency Range**

*Leader:* Assoc. Prof. Dr. Vojko Matko  
*Financed by:* personal research funds

The goal of this project is to stabilize the oscillation frequency of a quartz oscillator above the serial resonant frequency. In this area the crystal can be used as a very sensible element for measuring non-electric quantities. Added reactance of $-1/jωc$ causes increased temperature instability. It is anticipated that with temperature stabilization the measuring uncertainty could be reduced by multiples of 100, which is also the aim of this project. The solution to the above problem opens completely new measurement areas in measuring techniques.
**Research and development project**

**Computer Network Development for the Laboratory**

*Leader:* Assoc. Prof. Dr. Vojko Matko  
*Participants:* Dr. Bojan Gergič; Ladislav Mikola, MSc; Miloš Vute; Stanko Lampič  
*Financed by:* program research funds

The aim of this project is to develop a computer network for a modern measurements laboratory. The competitiveness of production largely depends on on-time and accurate information during the production process, including measurements and quality control. Given the ever increasing importance of Internet communication, this project aims to develop the communications infrastructure as well as automated measurement procedures and product quality control procedures which will be based on the connection of virtual instruments on the Internet. The knowledge gained shall be passed on to the students, researchers and industry in the framework of laboratory exercises, research projects and diploma theses.

**Industrial project**

**Measuring Resistance of Materials that can Accumulate the Electric Charge**

*Leader:* Ladislav Mikola, MSc  
*Participants:* Miloš Vute, Stanko Lampič  
*Financed by:* Konus Konex d.d.o.

The aim of this projects is to measure the Ohm resistance (high values as a rule), which represents important information on electrostatic material property. The latter is particularly important where the electrostatic discharges represent a significant danger, i.e. particularly the risk of explosion in the environment, e.g. of gases. Such materials can be floorings, textiles, shoe soles, etc. Those measuring procedures are standardized, however, the measuring results have low repeatability, which is mainly due to the order of magnitude of resistance, test material specific properties and temperature. This project measures the resistance of the filter material with in-built conducting fibres. To this end, corresponding measurement tools were developed in line with the standards in the laboratory. The composition and form of the material that shall meet the standards shall be determined in consultation with the client.
Completed research projects 2001

**Basic research project**

3D Distance Measurement of a Moving Object Using Non-Stationary Satellite Signals

*Leader:* Assoc. Prof. Dr. Vojko Matko  
*Financed by:* personal research funds  
*Duration:* 2 years

The moving object has no fixed reference point. When moving along coordinates x, y, z (with optional velocity) its longitudinal and transverse axis and acceleration may change. With satellite signals it is possible to determine distances in all directions, speed of movement, direction and to predict an object's position in 1 minute, 10 minutes or 1 hour. The measuring range from one point to another is up to 500 km.

**Research and development project**

Pile Bearing Capacity

*Leader:* Andrej Štrukelj, MSc  
*Participants:* Dr. Gorazd Lipnik; Boštjan Kovačič, MSc  
*Financed by:* DARS  
*Duration:* 2 years

On soft soil the bridge pier’s foundation has to be additionally reinforced using piles. Depending largely on local conditions, the pile bearing capacity can only be predetermined by field tests on-sight. It is very difficult for designers to predict precisely the pile bearing capacity per coat or at the foundation. As a result, a special measuring procedure for pile load testing was developed and carried out in close cooperation between the Electric Measurements Laboratory and Faculty of Civil Engineering. These type of measurements offer a revolutionary approach to inspecting the quality of construction. Prior to measurements, a special system was designed for inserting the probe into the pile. A special program was also developed for displacement and force monitoring over a longer period of time and simultaneous evaluation of force distribution with the depth. During the progressive increase of load up to 1,200 tons, relative extensions up to the depth of 15 metres were closely controlled at every metre. At the same time the pile displacements and the condition of the supporting construction were observed. The measurements clearly showed the behaviour of the pile up to the maximum load that can be imposed onto the soil supporting the pile foundation.
Industrial project

Load Testing

Leader: Andrej Štrukelj, MSc
Participants: Dr. Gorazd Lipnik; Boštjan Kovačič, MSc
Financed by: DARS, CMC Celje
Duration: 2 years

In close cooperation with the Faculty of Civil Engineering, a laser geodetic measuring system for dynamic controlling of large object vertical displacements was developed in the Measurements Laboratory. A software package for communication and sensor control according to a serial communication port in the Windows environment was developed for the NIKON measuring sensors. Also, a special mobile system for roadway irregularity analysis and a system for dynamic controlling of forces in large objects over long periods with the possibility of regenerating the programs and data in the event of possible power loss.

PUBLICATIONS


### VISITS TO OTHER INSTITUTIONS

<table>
<thead>
<tr>
<th>Name</th>
<th>Institution</th>
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<tr>
<td>Assoc. Prof. Dr. Vojko Matko,</td>
<td>TCL, Velenje, Slovenia.</td>
</tr>
<tr>
<td>Ladislav Mikola, MSc:</td>
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<tr>
<td>Assoc. Prof. Dr. Vojko Matko:</td>
<td>Prevent, Slovenj Gradec, Slovenia.</td>
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<tr>
<td>Assoc. Prof. Dr. Vojko Matko:</td>
<td>Global Vision, Ljubljana, Slovenia.</td>
</tr>
<tr>
<td>Assoc. Prof. Dr. Vojko Matko:</td>
<td>Technological Institute, Ljubljana, Slovenia.</td>
</tr>
<tr>
<td>Assoc. Prof. Dr. Vojko Matko:</td>
<td>Electrotechnical college, Velenje, Slovenia.</td>
</tr>
<tr>
<td>Assoc. Prof. Dr. Vojko Matko:</td>
<td>Acroni, Jesenice, Slovenia.</td>
</tr>
<tr>
<td>Dr. Bojan Gergič:</td>
<td>National instruments Slovenia, Celje, Slovenia.</td>
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</table>

### GUESTS AND VISITORS

<table>
<thead>
<tr>
<th>Name</th>
<th>Activity</th>
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<tr>
<td>Dr. Franc Seme, Emil Jeromel, Bojan Skrt (TCL, Velenje, Slovenia):</td>
<td>Discussion on business.</td>
</tr>
<tr>
<td>Jože Kozmus (Prevent, Slovenj Gradec, Slovenia):</td>
<td>Discussion on business.</td>
</tr>
<tr>
<td>Prof. Dr. Anton Jeglič (Faculty of Electrical Engineering, Ljubljana, Slovenia):</td>
<td>Scientific discussion.</td>
</tr>
<tr>
<td>Prof. Dr. Mladen Boršič (Faculty of Electrical Engineering, Zagreb, Croatia):</td>
<td>Scientific discussion.</td>
</tr>
<tr>
<td>Jožef Tomažič (Slovenian Railways, Ljubljana):</td>
<td>Discussion on business.</td>
</tr>
</tbody>
</table>
LABORATORY FOR ELECTRO-OPTICS AND SENSOR SYSTEMS

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E-mail: donlagic@uni-mb.si

RESEARCH PROJECTS

Current research projects

Basic research project

J2-1262-0796-99  Akustični in optični vlakenski senzorji
(Acoustics and Fibre Optics Sensors)

Leader:  Asst. Prof. Dr. Denis Đonlagić
Participant:  Edvard Cibula

Financed by:  Ministry of Education, Science and Sport of the Republic of Slovenia

The goal of this project is to research the applicability of acoustical and optical physical principles in the metrology area. We are also developing sensor prototypes. Fluid level measurement using the acoustical resonance principle showed sound characteristics in an industrial environment, where dust, foam and sediments are usually present in measurement tanks. Optical fibre sensors experienced fast responses due to their universality and great sensitivity. In this cases we developed temperature and fluid level sensors, industrial and medical pressure sensors, WIM sensor etc.

PUBLICATIONS


**VISITS TO OTHER INSTITUTIONS**

Asst. Prof. Dr. Denis Đonlagić: Postdoctoral work in Corning Inc., USA.
The Institute of Electronics has more than 30 employees including 1 full professor, 4 associate professors, 3 assistant professors, assistants, researchers, and technical staff. The main activities of the Institute of Electronics are teaching graduate and postgraduate courses and research. Research is currently focused on one fundamental research project, which is financed by the Ministry of School, Science and Sport of the Republic of Slovenia, projects with local industry, six international projects and projects with foreign industry partners.

In 2001, the Institute of Electronics staff published 127 papers presenting the findings of its research, organised meetings and conferences, and visited several institutes. The primary areas of study at the Institute of Electronics are speech recognition, language technology, multimedia systems, electronic circuits, digital filters, microcomputer structures, formal verification of distributed systems, and digital signal processing.
Members of the Institute of Electronics are organised into four laboratories and two centres of technology.

**Digital Information Systems Laboratory**
Head: Prof. Dr. Bogomir Horvat

**Electronics Systems Laboratory**
Head: Asst. Prof. Dr. Rudolf Babič

**Microcomputer Systems Laboratory**
Head: Assoc. Prof. Dr. Zmago Brezočnik

**Digital Signal Processing Laboratory**
Head: Assoc. Prof. Dr. Zdravko Kačič

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**Digital and Information Systems Laboratory**
Head: Prof. Dr. Bogomir Horvat

Employees: Assoc. Prof. Dr. Marko Jagodič; Asst. Prof. Dr. Mitja Solar; Janez Stergar, MSc; Rado Slatinek, MSc; Iztok Kramberger, MSc; Andrej Žgank, Univ. Dipl. Ing.; Tomaž Rotovnik, BSc; Damjan Vlaj, BSc; Aleksandra Zögling Markuš, Ing.
Microcomputer Systems Laboratory

Head: Assoc. Prof. Dr. Zmago Brezočnik

Employees: Assoc. Prof. Dr. Tatjana Kapus; Bogdan Dugonik, MSc; Aleš Časar, MSc; Filip Samo Balan, MSc; Andrej Kruščič, BSc; Robert Meolic, MSc; Boštjan Vlaovič, BSc; Peter Vicman, BSc; Aleksander Vreže, BSc

Digital Signal Processing Laboratory

Head: Assoc. Prof. Dr. Zdravko Kačič

Employees: Dr. Mirjam Sepesy Maučec; Matej Rojc, MSc; Marcel Ogner, Ing.; Srečko Grašič, BSc; Vladoimir Hozjan, BSc; Bojan Kotnik, BSc; Robert Veronik, BSc; Daniel Čeh Ambruš, BSc

Centre for Language Technologies

Head: Assoc. Prof. Dr. Zdravko Kačič

Electronic Systems Laboratory

Head: Asst. Prof. Dr. Rudolf Babič

Employees: Asst. Prof. Dr. Tomaž Dogša; Asst. Prof. Dr. Franc Jurkovič; Gerhard Angleitner, MSc; Bojan Jarc, MSc; Matej Šalamon, MSc; Davorin Osebik, MSc; Branko Drevenšek, BSc; Anton Vesenjak, Ing.

Centre for Verification and Validation of Systems

Head: Asst. Prof. Dr. Tomaž Dogša
DIGITAL AND INFORMATION SYSTEMS LABORATORY

Head:
Prof. Dr. Bogomir Horvat
Phone: +386 2 220 72 00
E-mail: bogo.horvat@uni-mb.si

RESEARCH PROJECTS

Current research projects

Applied projects

Telephone Speech database POLIDAT

Leader: Prof. Dr. Bogomir Horvat
Participants: Assoc. Prof. Dr. Zdravko Kačič; Matej Rojc, MSc; Aleksandra Zögling Markuš, Robert Veronik

Financed by: internal research funds

The goal of this project is to create speech databases recorded over fixed and mobile telephone networks that will be used for development and testing of real life automatic telephone speech dialog systems. Databases will have good coverage of applications, languages, speaking styles, and different environments. These databases will contain the voices of 1000 speakers recorded over fixed and mobile phones.

K-981.0 Software for automatic speech recognition

Leader: Prof. Dr. Bogomir Horvat
Participants: Assoc. Prof. Dr. Zdravko Kačič; Matej Rojc, MSc; Janez Stergar, MSc; Damjan Vlaj; Bojan Kotnik

Financed by: Corporate Research Laboratories of SIEMENS

The goal of the project is development of software for automatic speech recognition and speech synthesis. This tasks encompasses speech pre-processing, feature extraction and

**International projects**

**Multilingual text-to-speech synthesiser**

*Leader:* Prof. Dr. Bogomir Horvat

*Participants:* Assoc. Prof. Dr. Zdravko Kačič; Janez Stergar, MSc; Matej Rojc, MSc; Vladimir Hozjan; Bojan Kotnik; Damjan Vlaj

*Partners:* University of Maribor, Siemens

*Financed by:* Ministry of Education, Science and Sport of the Republic of Slovenia

The goal of this project is to gain new knowledge and experiences in the field of multilingual text-to-speech processing. The main area of the proposed research work will be the analyses of language-independent methods used for linguistic and acoustic processing in the framework of text-to-speech systems. Architecture of a language independent text-to-speech system and the use of the most appropriate text coding scheme will be analysed. Criteria for the definition of a database of speech synthesis elements will be defined. Also, required language resources for linguistic-level analysis will be defined (lexica, dictionaries) and methods for handling out-of-vocabulary words will be developed.

![Prosodic analysis of speech.](image-url)
Further research will be carried out on the field of the prosodic analysis of text and text tagging. Within this project framework, an automatic text-to-speech system for the Slovenian and German languages will be developed.

Evaluation of multilingual speech resources and tools

Leader: Prof. Dr. Bogomir Horvat
Participants: Assoc. Prof. Dr. Zdravko Kačič; Dr. Mirjam Sepesy Maučec; Matej Rojc, MSc; Janez Stergar, MSc; Vladimir Hozjan, Andrej Žgank, Tomaž Rotovnik, Bojan Kotnik, Damjan Vlaj
Partners: University of Maribor, UPC
Financed by: Ministry of Education, Science and Sport of the Republic of Slovenia, Ministry of External Affairs of Spain

The goal of the project is to gain new knowledge and experience in the field of multilingual spoken language resources and automatic speech recognition. The focus of the proposed cooperation is the analysis and evaluation of language resources and methods for acoustic–phonetic modelling. This research also includes methods of language modelling based on independent language approach, i.e. statistical language modelling. The experimental work is based on the use of SpeechDat databases for Spanish and Slovenian languages.

Language Technologies in Communication

Leader: Prof. Dr. Bogomir Horvat
Participants: Assoc. Prof. Dr. Zdravko Kačič; Janez Stergar, MSc; Matej Rojc, MSc; Dr. Mirjam Sepesy Maučec
Partners: University of Maribor, University of Zagreb
Financed by: Ministry of Education, Science and Sport of the Republic of Slovenia

This research work encompasses the analysis of psychological and communication factors that influence person to person and person to machine speech communication. We will perform an analysis of the target application domains of speech technology (query services, transaction services, office automation etc.) and will specify the critical factors of each application domain.

PUBLICATIONS


Janez Trontelj, Zmago Brezočnik, Miro Milanovič, Rudolf Babič, Anton Pleteršek, Mitja Solar, Alenka Hren, Franc Mihalič, Filip Samo Balan, Bojan Jarc, Mitja Solar (ed.), Krožni praktikum:


Andrej Kruščič, Rado Slatinek, Tatjana Kapus, Bogomir Horvat, “A multimedia presentation for the support of teaching telecommunications protocols,” *3rd International symposium on Video*


Gorazd Kandus, “Primerjava nacionalnih načrtov oštevilčenja v članicah EU in predstavitev nujnih sprememb načrta oštevilčenja v Republiki Sloveniji,” 1. mednarodni simpozij o pravnih
vidikih informacijske družbe na temo Izvajanje nove pravne ureditve na področju telekomunikacij, Portorož, Slovenia, Nov. 2001, 4 pp.

CONGRESSES, MEETINGS, AND COMMITTEES

Prof. Dr. Bogomir Horvat: 7th International Science Workshop Advances in speech technology, Faculty of Electrical Engineering and Computer Science, University of Maribor, Slovenia, July 5–6, 2001.

VISITS TO OTHER INSTITUTIONS

Prof. Dr. Bogomir Horvat, Damjan Vlaj: Visit to Corporate Research Laboratories of SIEMENS, Munich, Germany, Jan. 12, 2001.


GUESTS AND VISITORS


DECORATIONS, AWARDS, AND HONOURS

Prof. Dr. Bogomir Horvat and Digital and Information Systems Laboratory, *Award for Achievements in Cooperation in International Research Projects*, Faculty of Electrical Engineering and Computer Science, Maribor, Slovenia, Nov. 2001.
ELECTRONIC SYSTEMS LABORATORY

Head:
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RESEARCH PROJECTS

Completed research projects 2001

Applied projects

Digital Filters Realization with Field Programmable Gate Arrays

Leader: Asst. Prof. Dr. Rudolf Babič
Participants: Bojan Jarc, MSc; Davorin Osebik MSc, Asst. Prof. Dr. Mitja Solar;
Matej Šalamon, MSc; Anton Vesenjak

Financed by: personal research funds
Duration: two years

The main aim of this permanent project is the realization of higher-order, nonrecursive digital filters with field-programmable gate arrays, FPGA circuits. We have found that distributed arithmetic is well suited for this research. The scope of our research is the investigation of distributed arithmetic structures with ROM-accumulator architecture and distributed arithmetic structures with online calculation of partial sums of coefficients.

They have ROM capabilities as low as possible and also offer the realization of higher-order, nonrecursive digital filters with high-speed of operation. Using XILINX 4000 FPGA circuits for realization of digital filter, a sampling frequency of 400 kHz was obtained.

We are searching for an appropriate design for structures that would allow implementation of online calculation of partial sums of coefficients with programmable gate arrays working at highest possible speeds.

Simultaneously with the development of FIR digital filter structures we’re working on the implementation of adaptive algorithms using FPGA circuits. Due to limited ability for execution of arithmetic operations with FPGA circuits, we have developed structures allowing implementation of required numerical calculations with FPGAs. We would like to emphasize
the implementation of a sequence of 16 multipliers linked to a group of 16 sequential adders.

We have used the above described structures to design an adaptive filter with online calculation of the partial sums of coefficients together with an LMS algorithm, which is simple enough for realization in FPGA distributed arithmetic. This filter is used for extraction of signal from background noise. We have achieved 100 kHz input sampling frequency with this adaptive FIR filter featuring 16 coefficients, 16 bit input-output word and 16 bit internal arithmetic, implemented with XILINX series 4000 FPGA. This filter improved signal to noise ratio for 15 dB.

We are also working on FPGA prototype circuits design for student laboratory practice. Our goal is to attract more students to research work in the field of digital filters.

**Problem tracking system**

*Leader:* Asst. Prof. Dr. Tomaž Dogša  
*Participants:* Branko Drevenšek; Matej Šalamon, MSc  
*Financed by:* personal research funds  
*Duration:* two years

The purpose of this project was to develop software testing tools that would be suitable for verification of electronic circuit simulators. During this year we focused mainly on DC operating points. Our testing tool generates many electrical circuits with random topology and elements and automates test execution and failure detection. We tested different versions of SPICE simulators. With these tools it is possible to compare more objectively the quality of simulators.

**PUBLICATIONS**


RESEARCH PROJECTS

Current research projects

Research and development projects

2001-MGCP-FERI  Razpoznavalnik in konstruktor protokola MGCP (Decoder and Encoder of MGCP)

Leader: Boštjan Vlaovič
Participants: Aleksander Vreže, Peter Vicman, Simon Nedok, Assoc. Prof. Dr. Zmago Brezočnik
Partner: Iskratel Ltd.
Financed by: Iskratel Ltd.

The development of Decoder and Encoder of Media Gateway Control Protocol (MGCP) includes an analysis of the protocol, functional and design specification of the software, and its realisation using special programming tools, which produce the C code. The decoder and encoder are parts of the MGCP protocol stack developed jointly with Iskratel Ltd. The aim of the project is to enable Iskratel's switch node SI2000 V5 to actively participate in the development of the Next Generation Telecommunication Networks.

2001-SIPTEL-FERI  Razpoznavalnik, konstruktor in krmilni protokol protokolov SIP in SDP za IP telefon (Decoder, Encoder, and Protocol Control for SIP and SDP protocols for IP telephone)

Leader: Boštjan Vlaovič
Participants: Peter Vicman, Simon Nedok, Aleksander Vreže, Assoc. Prof. Dr. Zmago Brezočnik
Partner: Iskratel Ltd.
Financed by: Iskratel Ltd.

Decoder, Encoder, and Protocol Control of SIP and SDP protocols for the IP telephone is part of a joint project with the company Iskratel Ltd. The main objective is to develop a modern IP telephone with the use of SIP (Session Initiation Protocol) signalling. Parts of the program code from project 2000-JG-BV-FERI will be adapted to new requirements and ported to Real Time Operating System VxWorks.

International projects

VISIOCOM Video-supported online communities

Co-ordinator: Asst. Prof. Dr. Matjaž Debevc
Participant: Bogdan Dugonik, MSc
Project partners: Center for Distance Education Development, University of Maribor; Society for Project and Research Work on Internet MIRK; Rehabilitation Technology Centre of Tallinn Technical University (RTC TTU), Estonia; Hapinet Distance Learning Center, Hungary

Financed by: European Union (programme Phare-ACCESS)

The basic aim of this project is to enhance the applicability of and access to video-supported technologies for people with special needs as well as in the environments in which the use of the technologies is still rare. As part of the project, new technological solutions, such as web-supported video lecturing, streaming video on demand, innovative videoconferencing solutions, and video-supported collaboration solutions will be presented, which allow the people with special needs an easier access to learning materials.

BITHEMA Bilingual Teaching Material for the Deaf by Means of ICT

Co-ordinator: Niels Nielsen, Denmark
Participant: Bogdan Dugonik, MSc
Project partners: institutions from Denmark, France and Slovenia

Financed by: European Union (programme Socrates-GRUNDTVIG)

In the framework of this project, educational methods for deaf adults who cannot apply for a better job because of a lower level of knowledge or bad qualifications will be enhanced. Appropriate technical, software and didactical tools will be proposed and developed to help improve the knowledge level of the adults. Special software will be developed, which will enable tutors to prepare learning material on the web by themselves. The tool will allow them to prepare the material containing multimedia elements, such as video, 3D-animation, videochat, web-chat, and others.
Completed research projects 2001

**Research and development project**

**2000-JG-BV-FERI** Specifikacija in realizacija prehoda SIP-V5.2 (Specification and realisation of SIP-V5.2 Gateway)

*Leader:* Boštjan Vlaovič  
*Participants:* Peter Vicman, Simon Nedok, Aleksander Vreže, Assoc. Prof. Dr. Zmago Brezočnik  
*Partner:* Iskratel Ltd.  
*Financed by:* Iskratel Ltd.  
*Duration:* January to October 2001

Specification and realisation of SIP-V5.2 Gateway included a study of Session Initiation Protocol (SIP) and Session Description Protocol (SDP). The objective was to develop SIP-V5.2 interface for the Iskratel's Switch Node SI2000 V5 which would enable SIP telephones to connect to the switch and to use available services. The project was realised with the use of programming language C and SDL (Specification and Description Language).

**International project**

**DETECH** Development of the Department for Technology Supported Distance Education

*Co-ordinator:* Asst. Prof. Dr. Matjaž Debevc  
*Participant:* Bogdan Dugonik, MSc  
*Project partners:* University of Maribor, Slovenia; Technical University of Vienna, Austria; University of Oulu, Finland; Gjøvik College – Higher Education Institution, Norway; Fernuniversität Hagen, Germany; Open University, England  
*Financed by:* European Union  
*Duration:* November 1999 to November 2001

The main goal of the project was to establish a department for technology-supported distance education as a part of the Center for Distance Education Development at the University of Maribor. An organisational, didactical, technological, administrational and financial model of the distance education had to be prepared. On the local level, the establishment of the department, i.e. the implementation of the five models, should make it possible to introduce distance learning as an additional form of education at the faculties of the University of Maribor. On the global level, it should have helped the university to participate in the
programme SOCRATES – Open and Distance Learning Action (ODL).

PUBLICATIONS


PRESENTATIONS BY THE LABORATORY MEMBERS


Bogdan Dugonik, A demonstration of recent technology, production and video transfer options using the Internet, at the co-ordination meeting of the BITEMA project partners, Centre for Deaf People, Castberggaard, Danmark, Oct. 26–28, 2001.

CONGRESSES, MEETINGS, AND COMMITTEES


Assoc. Prof. Dr. Zmago Brezočnik, Assoc. Prof. Dr. Tatjana Kapus: Co-ordinated organisation of the IEEE Slovenia Section Paper Contest during the ERK 2001 conference, Portorož, Slovenia, Sept. 25, 2001.


Boštjan Vlaovič, Aleš Časar, MSc, Robert Meolic, MSc, Filip Samo Balan, MSc: Editors of the Proceedings of the symposium “Extra Skills for Young Engineers”, Maribor, Slovenia, 2001.


Assoc. Prof. Dr. Zmago Brezočnik: IEEE Slovenia Section Vice-Chairman and University of Maribor IEEE Student Branch Counsellor.

VISITS TO OTHER INSTITUTIONS


Assoc. Prof. Dr. Zmago Brezočnik: Member of the commission for the PhD defence of Gordan Ježić, MSc, Department of Telecommunications, Faculty of Electrical Engineering and Computing, University of Zagreb, April 26, 2001.

Bogdan Dugonik, MSc: Participation in the meeting of the project VISIOCOM partner institution representatives, Hapinet Distance Learning Center, Budapest, Hungary, Nov. 22–24, 2001.

GUESTS AND VISITORS


Kimmo Salmenjoki (University of Vaasa, Vaasa, Finland): Discussion about study programmes at the Faculty of Electrical Engineering and Computer Science, University of Maribor, Slovenia, May 31, 2001.

Foreign guests of the European House during the Energy and Environment Meeting: Visit of some laboratories at the Faculty of Electrical Engineering and Computer Science, University of Maribor, Slovenia, Oct. 6, 2001.
DECORATIONS, AWARDS, AND HONOURS

Assoc. Prof. Dr. Zmago Brezočnik and Microcomputer Systems Laboratory, an honour for successful and innovative collaboration with the Iskratel Ltd. company, Kranj, Slovenia, received from the Faculty of Electrical Engineering and Computer Science, University of Maribor, on the Faculty Day, Nov. 27, 2001.
DIGITAL SIGNAL PROCESSING LABORATORY

Head:
Assoc. Prof. Dr. Zdravko Kačič
Phone: +386 2 220 72 20
E-mail: kacic@uni-mb.si

RESEARCH PROJECTS

Current research projects

Applied project

Software for automatic speech recognition

Leader: Prof. Dr. Bogomir Horvat
Participants: Assoc. Prof. Dr. Zdravko Kačič; Matej Rojc, MSc; Damjan Vlaj; Bojan Kotnik; Janez Stergar, MSc

Financed by: Corporate Research Laboratories of SIEMENS A.G.

The goal of this project is the development of software for automatic speech recognition and speech synthesis. The tasks encompass speech pre-processing, feature extraction and acoustic modelling for automatic speech recognition and development of a multilingual text-to-speech synthesis system. Application domains: telecommunication systems, office automation.

International projects

INTERFACE - Multimodal Analysis/Synthesis System for Human Interaction to Virtual and Augmented Environments
Project IST – 1999 – 10036 (fifth framework)

Leader: Assoc. Prof. Dr. Zdravko Kačič
Participants: 14 partners from 8 European countries and Australia
This project will define new models and will implement advanced tools for audio-video analysis, synthesis and representation in order to provide essential technologies for the implementation of large-scale virtual and augmented environments. The metaphor, which will inspire the project approach, is oriented to make person-machine interaction as natural as possible, based on everyday human communication means like speech, facial expressions and body gestures from both sides. A case study application on Internet will be developed and demonstrated.

The figure presents JAVA applet, which is a part of network version of common software platform (N-CSP). N-CSP is product of the Interface project. Applet analyses speech signal and recognises emotion and gender of speaker.

**Evaluation of multilingual speech resources and tools**

**Leader:** Prof. Dr. Bogomir Horvat  
**Participants:** Assoc. Prof. Dr. Zdravko Kačič; Matej Rojc, MSc; Janez Stergar, MSc; Vladimir Hozjan; Andrej Žgank; Dr. Mirjam Sepesy Maučec  
**Financed by:** Ministry of Education, Science and Sport of the Republic of Slovenia, Ministry of External Affairs of Spain
Goal of this project is to gain new knowledge and experiences in the field of multilingually spoken language resources and automatic speech recognition. The focus of the proposed cooperation is the analysis and evaluation of language resources and methods of language modelling based on language independent approach - statistical language modelling. The experimental work is based on the use of SpeechDat databases for Spanish and Slovenian language.

**COST Action 278**

**Spoken Language Interaction in Telecommunication**

*Leader:* Assoc. Prof. Dr. Zdravko Kačič

*Participants:* 19 countries of the West, East, and Central Europe

*Financed by:* EU, co-financed by the Ministry of Education, Science and Sport of the Republic of Slovenia

The main objective of this project is to create knowledge in several problem areas of spoken language interaction in telecommunications in order to achieve communicative interfaces that provide a natural human-computer interaction through more cognitive, intuitive and robust interfaces, whether monolingual, multilingual or multimodal. The work encompasses research on speech and dialogue processing in multimodal communication interfaces, issues related to robustness and multilinguality, human-computer dialogue theories, and models and systems as well as associated tools for the establishment of interactive systems. It also involves the evaluation of telecommunication applications in which spoken language is the only or one of many types of input or output modalities.

**Completed research projects 2001**

**International project**

**INCO COPERNICUS**

**– Project 977126**

**A Multimedia Multilingual Teaching and Training System for Speech Handicapped Children**

*Leader:* Assoc. Prof. Dr. Zdravko Kačič

*Participants:* Technical University of Budapest (Hungary), Robot Control Software Ltd. (Hungary), University of Reading (Great Britain), University of Maribor (Slovenia)

*Financed by:* EU

*Duration:* 1998 – 2001

The aim of this project was to develop a new audio-visual pronunciation teaching and training method and a software system for hearing and speech-handicapped persons to help them...
control speech production. A teaching method has been drawn up for progression from individual sound preparation to the practice of sounds in sentences. The software system is planned to be built in different modules. The basis is a general language-independent measuring system and a database editor. The database editor makes it possible to construct modules for all participant languages and for different speech disabilities. Two modules are planned for construction in all languages: one is for teaching and training vowels to hearing-impaired children and the other is for correcting misarticulated fricative sounds. These are the most common forms of articulation disorders. The system helps patients to discover how to control their speech organs by simultaneously comparing the visual patterns (speech pictures) of a normal acoustic speech signal with a defective one. While watching and viewing the system, the patient can simultaneously see and hear a speech pattern.

Exercise of uttered letter “z”.

PUBLICATIONS


**CONGRESSES, MEETINGS, AND COMMITTEES**

Assoc. Prof. Dr. Zdravko Kačič: 7th International Science Workshop Advances in speech technology, Faculty of Electrical Engineering and Computer Science, University of Maribor, Slovenia, July 5–6, 2001.

**VISITS TO OTHER INSTITUTIONS**

Assoc. Prof. Dr. Zdravko Kačič, Bojan Kotnik: Visit to Corporate Research Laboratories of SIEMENS, Munich, Germany, Jan. 12, 2001.


Assoc. Prof. Dr. Zdravko Kačič, Vladimir Hozjan: Board meeting of the INTERFACE project, Mykonos, Greece, May 29 to June 4, 2001.


GUESTS AND VISITORS

Udo Hain (Corporate Research Laboratories of SIEMENS, Munich, Germany):

Dr. Harald Höge, Cristian Geissler, Erdem Caglayan, Bernt Andrassy, Josef Bauer (Corporate Research Laboratories of SIEMENS, Munich, Germany):

DECORATIONS, AWARDS, AND HONOURS

Assoc. Prof. Dr. Zdravko Kačič, Silver Medal of University of Maribor.

Assoc. Prof. Dr. Zdravko Kačič and Digital Signal Processing Laboratory, Award for Achievements in Cooperation in International Research Projects, Faculty of Electrical Engineering and Computer Science, Maribor, Slovenia, Nov. 2001.
INSTITUTE OF POWER ENGINEERING

Head:
Prof. Dr. Ivan Zagradišnik
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The research work of the Institute of Power Engineering is divided into three main areas: electromagnetic devices; production, transmission and distribution of electrical energy; and power system control. The research on electromagnetic devices is focused on numerical methods. The research on electrical energy deals mainly with optimisation processes, reliability, and the quality of electric energy. Modernising control of power systems is the subject of the third topic.

The Institute of Power Engineering co-operates with many universities and institutes abroad: Elektrotehnički fakultet Zagreb, Croatia, Technische Universität Graz - IGTE, Austria, Technical University of Budapest - Institute for electric machines, Hungary, Universität Stuttgart - Institute für elektrische Maschinen und Antriebsysteme and Institut für Theorie der Elektrotechnik, Germany, University of Wisconsin - Wisconsin Power Electronics Research Center Madison, USA, ETH Zürich - Institute for electric machines, Swiss, National Technical University of Athens, Institute for electrical engineering, Greece, Katholieke Universiteit Leuven - Institute for electric machines and drives, Belgium, University of Johannes Kepler Lienz - for control and drives – Austria, University of Lodz, Institute of Electrotechnical Machines and Transformers – Poland, University Sts. Cyril & Methodius, Faculty of Electrical Engineering Skopje – Macedonia.
Institute of Power Engineering
Head:
Prof. Dr. Ivan Zagradišnik

Electrical Machines Laboratory
Head:
Prof. Dr. Ivan Zagradišnik

Power Engineering Laboratory
Head:
Assoc. Prof. Dr. Jože Voršič

Electromechanical Systems Control Laboratory
Head:
Prof. Dr. Drago Dolinar

Fundamentals and Theory of Electrotechnics Laboratory
Head:
Assoc. Prof. Dr. Igor Tičar

Applied Electromagnetics Laboratory
Head:
Assoc. Prof. Dr. Mladen Trlep
Electrical Machines Laboratory

Head: Prof. Dr. Ivan Zagradišnik
Employees: Bojan Slemnik, MSc; Matej Gajzer, MSc; Florijan Leskovar, Miralem Hadžiselimović

Power Engineering Laboratory

Head: Assoc. Prof. Dr. Jože Voršič
Employees: Asst. Prof. Dr. Jože Pihler; Andrej Orgulan, MSc; Miran Horvat, MSc; Andrej Hanžič; Darko Koritnik; Marjan Stegne; Jurček Voh

Electromechanical System Control Laboratory

Head: Prof. Dr. Drago Dolinar
Employees: Prof. Dr. Bojan Grčar, Asst. Prof. Dr. Gorazd Štumberger, Asst. Prof. Dr. Jožef Ritonja, Dr. Oto Težak, Boštjan Polajžer, Aleksander Krašovec, Zlatko Strelec

Fundamentals and Theory of Electrotechnics Laboratory

Head: Assoc. Prof. Dr. Igor Tičar
Employee: Mitja Žnidarič, MSc

Applied Electromagnetics Laboratory

Head: Assoc. Prof. Dr. Mladen Trlep
Employees: Assoc. Prof. Dr. Anton Hamler, Dr. Marko Jesenik, Dr. Bojan Štumberger, Viktor Goričan, Jernej Ribič
ELECTRICAL MACHINES LABORATORY

Head:
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RESEARCH PROJECTS

Current research projects

Applied project

Special motors for modern servo drives

Leader: Asst. Prof. Dr. Riko Šafarič
Participants: Bojan Slemnik, MSc; Matej Gajzer; Miralem Hadžiselimović
Financed by: Ministry of Education, Science and Sport of the Republic of Slovenia, Indramat elektromotorji, Proizvodnja električnih motorjev, d.o.o.

The object of this project is special synchronous motors with permanent magnets supplied by frequency converters build into modern servo drives for the main spindle drive of CNC machines, especially at high rotation.

The practical requests and demands of a motor’s pulsating torque result from regulations in connection with the quality of work materials in modern servo drives it is possible to fulfil the practical requests by choosing a suitable frequency converter but this must then be harmonized the electric motor with the chosen converter.

We want to achieve a compromise between the price of the motor which has to be competitive, and the quality of the motor, using special treatments for electric motors.

In the first stage of project we analyzed qualitatively the motor parameters as they are shapes of magnetic lamination, material and the geometrical properties of permanent magnets and windings sorts that have a decisive influence on the motor torque. The CAD solution of the program language Mathematica was developed.

At the same time the program module for 2-D parametric modelling of the synchronous motor
using software Ansys/EMAG was developed, making possible numerical estimation of the motor characteristics.

We developed parallel to this a software module to perform and analyze measurements of the synchronous motor with software LabView making possible automation of measurement procedure and so to do a comparison between numerical and measurement results.

**Completed research projects 2001**

**Applied project**

**55-3567** Big hermetic motors

*Leader:* Prof. Dr. Ivan Zagradišnik  
*Participants:* Bojan Slemnik, MSc; Matej Gajzer; Miralem Hadžiselimović; Mirko Petrovčič  
*Financed by:* Ministrstvo of Economics and Rotomatika, d.o.o.  
*Duration:* 2000 – 2001

In the year 2001 we finished the work on project No 55-3567. At the end of the project in Rotomatika we build with regard to the results of previous research, an optimal lamination with outer diameter 160 and 223 mm. Using these laminations the prototypes of three-phase motors 0.5 HP, 0.75 HP, 1 HP and 1.8 Hp were built and also single phase motors of 1.5 HP for build in compressors Bitzer. On the lamination 223 mm we built the samples 11 kW for
built in compressors ABS and 25 HP motors for built in compressors Bitzer. The research and correction of the slot bridges of the laminations which have an essential influence on the required characteristics of the motors were very important. All mentioned samples were measured and tested in compressors especially the influence of the cooling media (oil) on the insulation winding materials of the motors and on their life time.

Particular measurements of the motor samples, from which we found out the additional loses in the motors, were executed by practical use of electrical machines at FERI Maribor. The measurements were very pretentious and lasting in particular the influence of the stator winding displacement on the characteristics in the case of the 25 HP motor with the connection of a part section of winding during the start of the motor.

Measurement results generally have shown an influence on the chosen technology and materials and on the characteristics and good agreement proceeding theoretical research with the measurement data of the characteristics at the end of the project.

**PUBLICATIONS**


GUESTS AND VISITORS

Dr. Bernd Schnurr
(Rexroth, Gruppe Bosch, Germany):

Scientific co-operation.

Prof. Dr. Stjepan Štefanko
(University of Osijek, Croatia):

Scientific co-operation.
POWER ENGINEERING LABORATORY

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RESEARCH PROJECTS

Current research projects

Applied project

Local agenda – Environmental Protection Programme for Maribor

Leader: Assoc. Prof. Dr. Jože Voršič
Participants: Dr. D. Rebolj; M. Bartol, MSc; A. Hanžič; A. Orgulan, MSc; M. Horvat, MSc; B. Bizjak, MSc; D. Koritnik; I. Recer; R. Gostinčar; G. Vizovišek

Financed by: Municipality of Maribor, Institute of Environmental Engineering of Maribor, Tourist Association of Maribor, Slovenia

The project links activities of working groups, responsible for co-ordination of individual areas of environmental protection. The main objectives of our activities are the definition of preferential tasks and strategic guidelines for solving environmental protection problems for local areas. The working groups have full authority to propose new or additional research and analyses when it they are unable to make conclusions.

The working groups cover the following areas: water, waste, atmosphere, noise, emissions, municipal green areas, agriculture, industry, tourism, energy policy, IT, environment and health, economy and organisation. Our working group covers energy planning. In the framework of the Programme FERI organises seminars people, responsible for decision making in this field.
Research and development projects

**CRP-KS 985-05/01 (V1-0480-01)**

Research supporting the implementation of Kyoto Protocol – Target oriented research programme “Competitiveness of Slovenia 2001-2006”

**Leader:** Prof. Dr. Miha Tomšič

**Participants:** Assoc. Prof. Dr. Jože Voršič, Andrej Hanžič

**Project Partners:** FERI Maribor, ISPO d.o.o Slovenija, Javno podjetje elektrogospodarstvo Slovenije, Umweltbundesamt Austria, KWI Architects Engineers Consultants, Austria

**Financed by:** Ministry of Environment and Physical Planning, Ministry of Education, Science and Sport of the Republic of Slovenia

The Slovenian Government adopted in November 2000 the Strategy and Short-Term Action Plan for Greenhouse Gases Emission Reduction. The Strategy defines targets, basic principles of emission reduction and a set of possible measures. The next steps and milestones of policy for prevention of climate changes (in accordance with the National Programme of Environmental Protection, Official Gazette of RS, no. 8/99) will be elaboration of the National Programme for Greenhouse Gases Emission Reduction, implementation of measurement and monitoring of their effects, and elaboration of national reports by the year 2002. The National Programme for Greenhouse Gases Emission Reduction will quantitatively define targets for each sector and provide detailed specification of measurements. Financial evaluation of the entire programme will also be included in the National Programme.

The core activity of the research work in the framework of this project is preparation of a methodology proposal for distribution of the emission reduction burden among the sectors. A tool for quantitative evaluation and analysis of potential national Kyoto strategies for Slovenia, and evaluation of individual sector strategies and instruments, will be developed on the basis of the upgrading and integration of existing computer models. An analysis of the worldwide development of new flexible Kyoto mechanisms and tools for the quantitative evaluation of the effects of their implementation will be the basis for the elaboration methodology proposal for implementation of these mechanisms in Slovenia.

The expected project results will be an important Professional support for operative preparation of the National Programme for Greenhouse Gases Emission Reduction.

The project team will prepare a survey of various sector approaches and implemented mechanisms for the distribution of emission reduction burdens among sectors for selected EU countries. An analysis of the anticipated development of common EU policy in this field will also be made. This will serve as a basis for the proposal of methodology and mechanisms for distribution of greenhouse emission burdens among the sectors in Slovenia.
Laboratory for high current tests

Leader: Andrej Pirih, MSc (Iskra Zaščite)
Participants: Assoc. Prof. Dr. Jože Voršič; Dr. J. Pihler; Dr. V. Kumperščak; Dr. F. Brešar; A. Orgulan, MSc; B. Bizjak, MSc; M. Horvat, MSc; M. Žnidarič, MSc; L. Mikola, MSc; D. Koritnik; A. Hanžič; M. Stegne; J. Voh; Research Group Protection and Systems; Research Group Iskra TECHNO

Financed by: Ministry of Economy of the Republic of Slovenia, Iskra Zaščite

Iskra Zaščite Ljubljana and FERI Maribor have started planning a new project, i.e. building a new laboratory for certification and accreditation. The laboratory will have two measurement locations that will satisfy all the needs of Slovenian industry and research institutes for high current tests and measurements. In Ljubljana a laboratory for tests using a surge current generator is under construction, while the ICEM laboratory in Maribor is equipped for tests with high DC and sinusoidal AC currents. Both laboratories are very specific electrical power consumers, and are potential sources of disturbances in the electrical power system and in their neighbourhoods.

The research & development phase of the project includes: impact of measurements and tests on neighbouring facilities, simulation of disturbances and impacts on electrical power systems, designing the earthing system, research of practical solutions regarding the laboratory set-up and possible tests, design of measurements for preparation of propagation of disturbances into the neighbourhood, impact of laboratories on the environment, planning and preparation of project of measurement procedures automation, and development of adequate software.

Energy Balance in the Municipality of Maribor for 2001 and computation of emissions

Leader: Assoc. Prof. Dr. Jože Voršič
Participants: A. Hanžič; A. Orgulan, MSc; M. Horvat, MSc; M. Dornik (IE); G. Černe, MSc (ZRMK)

Financed by: Municipality of Maribor, Slovenia

“Energy Balance in the Municipality of Maribor” is the basic document on the final energy consumption by individual kinds of energy, and quantities of primary energy, necessary for satisfying the energy requirements of the Municipality. The final energy consumption will serve as a basis for estimating the emissions of harmful substances. In addition to the energy balance for 2001, an estimation of greenhouse gas emissions from sectors of industry, traffic, energy consumption and energy transformation was also made for the same year.

The Energy Balance has been made in accordance with the EUROSTAT methodology, which is, starting from this year, also the official methodology for the Energy Balance of the
Republic of Slovenia. Thus the comparability of the Energy Balance in the Municipality of Maribor with the Energy Balance of the Republic of Slovenia is ensured.

Urban Renovation of the Historic City Centre

Leader: Igor Recer (IGRE d.o.o.)
Participants: Assoc. Prof. Dr. Jože Voršič, A. Hanžič
Project Partners: IGRE d.o.o. Maribor, IEI d.o.o. Maribor, FERI Maribor, OEGA Consult d.o.o. Ljubljana, SI Consult d.o.o. Maribor, UM Inštitut za gospodarsko pravo Maribor, Agencija za tržno komuniciranje Maribor

Financed by: Municipality of Maribor, Slovenia

Twenty years ago a ten-year Programme of Renovation for Maribor's Historic City Centre was adopted. The Programme was financed from the system source at the then Self-Management Housing Community. The implementation of this Programme was considered successful and was also presented to the Professional public in Slovenia and abroad. In recent years some new problems have emerged, which impede successful renovation of the city centre. The ownership structure has changed and it is impossible to restore the source of financing. It will be necessary to set new objectives for renovation and find financial sources, which will be the primary task of this project. The basic target of the project is to revitalise the historic city centre commercially and culturally. The Project Consortium has an intention to provide the city of Maribor, through Professionally executed renovation, a higher degree of tourist recognisability and enable marketing of the historic city centre as a trademark.

Industrial project

New Motor Starter

Leader: Assoc. Prof. Dr. Jože Pihler
Participants: Assoc. Prof. Dr. Jože Voršič, Dr. I. Tičar, D. Koritnik, A. Hanžič, M. Stegne, A. Lovrenčič (ELA), J. Jeraj (Orkom), J. Varga (Vitalner).

Financed by: ELA Slovenske Konjice, Vitalner d.o.o., Slovenia

In the year 2001 the method of mechanical fixing for the starter was modified according to the requirements of European customers. The electromagnetic drive was modified according to the requirements of the American market, i.e., 110 V and 230 V, 60 Hz. The imperfections detected during the prototype tests were eliminated and new testing of the first manufactured series of products has been performed in compliance with IEC 60947-41 subclause 9.3.1:

Test sequence 1:
Temperature rise test - IEC 60947-4-1 subclause 9.3.3.3
Operation and operational limits test - IEC 60947-4-1 subclause 9.3.3.1 in 9.3.3.2
Dielectric test - IEC 60947-4-1 subclause 9.3.3.4

Test sequence 2:
Rated Making & Breaking capacity test- IEC 60947-4-1 subclause 9.3.3.5
Conventional operation test - IEC 60947-4-1 subclause 9.3.3.6

Test sequence 3:
Short circuit operation test - IEC 60947-4-1 subclause 9.3.4

Test sequence 4:
Ability of conducting overload current test - IEC 60947-4-1 subclause 9.3.5

Test sequence 5:
Mechanical properties of connections test – IEC 60947-1 subclause 8.2.4

Patent applications were submitted in some foreign countries (European Union, USA, Russia, Japan, India, etc.), and the technical documentation was re-arranged accordingly.

International projects

NNE5-2001-0075  DISPOWER – Distributed Generation with High Penetration of Renewable Energy Sources (5 framework programme; project in the approval procedure – final evaluation)

Leader: Assoc. Prof. Dr. Jože Voršič
Participants: A. Hanžič; A. Orgulan, MSc; M. Horvat, MSc
Project Partners: Institut für Solare Energieversorgungstechnik Wien, Austria
Financed by: European Union

The process for deregulation of the European energy market will inevitably lead to the appearance of new electricity generators with their production based upon distributed generation units.

Improvements in the field of power system control and development of electronic components and telecommunication systems, especially for the purpose of remote control, will make it possible to improve the generation and transmission of electricity on the liberalised market.

The following activities are envisaged in the project:

- Elaboration of strategy and concept of stability of distribution network and control systems (distributed generation);
• Preparation of security standards and standards for power quality in networks with decentralised energy sources, improvement possibilities, and requirements of decentralised voltage transformers and decentralised generation units;

• Development of adequate design models and development of efficient penetration of distributed generation into regional and local networks;

• Design of internet based information systems to support improvement in communication procedures, power system control and electricity trading;

• Building of test system for testing and further development of distributed generation systems;

• Load flow modelling.

Slo-A19/2002 Virtual Electromagnetic Laboratory and Web-based Distance Learning

Leader: Assoc. Prof. Dr. Igor Tičar
Participants: Dr. J. Pihler; Dr. A. Hamler; A. Orgulan, MSc; M. Žnidarič, MSc; Prof. Dr. Kurt Preis (IGTE)

Project Partners: Institut für Grundlagen und Theorie der Elektrotechnik (IGTE), TU Graz, Austria

Financed by: Ministry of Education, Science and Sport of the Republic of Slovenia

The project will intensify the successful co-operation between Laboratory of Applicative Electrical Engineering of FERI and Institut für Grundlagen und Theorie der Elektrotechnik (IGTE) of TU Graz. Both institutions have successfully co-operated for many years in the field of numerical solving electromagnetic field problems, which is evident from several commonly published papers. This co-operation has been in the last couple of years especially intensive and successful in the field of computer supported educational programmes for the subjects Principles of Electrical Engineering and Theoretical Electrical Engineering. The solving of applicative problems for industry using previously developed program tools has also been very successful. Further upgrading of existing, and the design of new program tools will include development of new pre-processors for planar and rotationally symmetrical electromagnetic problems, pre-processors for planar problems in polar co-ordinates for electric machines, two and three dimensional program packages EleFAnT2D and EleFAnT3D. In addition to this, some examples of a virtual electromagnetic laboratory will be developed to improve practical exercises for the subject Principles of Electrical Engineering. Procedures of computer animation of electromagnetic phenomena will also be developed.

The institutes at TU Budapest and TU Stuttgart are also included in this co-operation. The Austrian partner also co-operates with the University of Bath (UK) and University of Genoa (I) in the EU project Teleteaching and distance education and in INCO COPERNICUS project P.nr. 15CT960703.
Completed research projects 2001

Basic research project

J2-0130-0796-00 Impact of Voltage Fluctuation on Generator Life Time

Leader: Assoc. Prof. Dr. Jože Voršič
Participants: Dr. J. Pihler; Dr. V. Kumperščak; Dr. M. Logar; A. Orgulan, MSc; M. Žnidarič, MSc; M. Horvat, MSc; B. Bizjak, MSc; D. Koritnik

Financed by: Ministry of Education, Science and Sport of the Republic of Slovenia
Duration: 3 years

The impacts of big electric arc furnaces are represented as disturbances – voltage fluctuations – in the electric power system. A synchronous generator operating in the vicinity of the source of disturbances to a large extent eliminates such voltage fluctuations. Unfortunately, such a mode of operation can have a negative impact on the generator’s lifetime.

The impacts of voltage fluctuations on synchronous generator operation can be divided into two types of problems. The first are problems of stator thermodynamics and rotor winding, while the second are problems related to the impact on the mechanical parts of machines (bearings). In dynamic operations, the time constants of heating and cooling are important for the determination of thermodynamic conditions. These two time constants are not constant for the entire machine. Excessive heating of certain parts of the machine can lead to gradual destruction of insulation and consequently to the reduction of machine lifetime.

Applied project

0203/1-01/2001-3.6 Elaboration of Comparative Study on Electrical Power Quality in the European Union

Leader: Andrej Orgulan, MSc
Participants: Assoc. Prof. Dr. Jože Voršič; B. Bizjak, MSc; Dr. J. Pihler; D. Koritnik; Dr. M. Logar; A. Hanžič; M. Stegne; M. Horvat, MSc; M. Žnidarič, MSc

Financed by: Energy Agency of the Republic of Slovenia
Duration: 1 year

Electrical power has become, according to the definitions of the Slovenian Energy Act, a tradable commodity, the quality of which should be monitored. The criteria for voltage quality is defined in the SIST EN 50160 standard, while the quality of electrical power sometimes
also requires the monitoring of electrical current parameters.

The objective of the project is to perform measurements and to elaborate a report on the quality of electrical power in transmission and distribution networks. For the purpose of this project we had to analyse the conditions in the Slovenian transmission network and some previously elaborated studies dealing with similar issues. The minimum set of measurement points has been defined. In the next step the measurement points were selected, individually for each Slovenian region. In the first part of the project the measurements of electrical power quality have been performed at the voltage levels 110 kV, 20(10) kV and 400 V. The presentation and the analysis of results are very demanding tasks due to the extent of the measurements – measurements with the duration of one week have to be performed on various locations around the country – and consequently due to the large amount of measurement results, which have to be clear and should not be misleading.

The project results will serve as a basis for determination of the measurement points of the future power quality monitoring system in the Slovenian transmission and distribution systems, which calls for well argumented evaluation and presentation of the obtained results.

**Industrial projects**

**Low Voltage Distribution Panels for Outdoor Use**

*Leader:* Assoc. Prof. Dr. Jože Pihler  
*Participants:* Assoc. Prof. Dr. Jože Voršič, D. Koritnik, A. Hanžič, M. Stegne  
*Financed by:* Elektro Celje, Elum Zvone Aleš s. p., Slovenia  
*Duration:* 1 year

Adaptation of low voltage distribution panels type NN-400 and low voltage protection panels for concrete pole mounted transformers for outdoor use, has been made to comply with the requirements of IEC 60439-1 standard. The complete type testing comprising the following tests has been made:

- Temperature rise test (*IEC 60439-1* subclause 8.2.1);
- Dielectric properties test (*IEC 60439-1* subclause 8.2.2.4);
- Protective earth circuit test (*IEC 60439-1* subclause 8.2.4.1);
- Creepage and clearance test (*IEC 60439-1* subclause 8.2.5);
- Degree of mechanical protection test (*IEC 60529* subclause 7.4 in 8.3.1);
- Mechanical operation test (*IEC 60439-1* subclause 8.2.6).
Cable Accessories and Heat Shrinkable Tubing

**Leader:** Darko Koritnik  
**Participants:** Dr. J. Pihler, M. Stegne  
**Financed by:** PE. TE. ZE. d.o.o. Ljubljana, Slovenia  
**Duration:** 1 year

Heat shrinkable tubing CFM CFW, manufactured by CANUSA EMI is a relatively new product, used in electrical power facilities. The manufacturer has performed several tests in accordance with Canadian and German standards. On the basis of these measurements and studying of the above mentioned standards the compliance with Slovenian and international IEC standards had to be verified in order to confirm the adequacy of these product for their entry into the Slovenian market.

International projects

The JOINT project - National CO₂ Emission Baselines and Additional Projects – A Pilot case Study of the Slovenian Energy System by Means of SESAM

**Leader:** M. Seliškar (ISPO d.o.o.)  
**Participants:** A. Hanžič, Assoc. Prof. Dr. Jože Voršič  
**Project Partners:** Eco Consult Denmark, ISPO d.o.o. Consulting for Business Ljubljana, EGS Elektrogospodarstvo Slovenije and FERI Maribor, ZRMK d.d. Ljubljana, Slovenia  
**Financed by:** Ministry of Environment and Physical Planning, Slovenia  
**Duration:** 2 years

On the basis of methods and procedures for the SESAM model, a study of modelling the emissions of greenhouse gases from industrial, general energy consumption and electricity generation sectors has been elaborated. The emissions for the entire Slovenian territory, divided by the above mentioned sectors into three climate zones, have been modelled. The purpose of the project was to investigate the possibilities of Slovenia making its contribution to the global reduction of greenhouse gases emissions through the application of mechanisms for clean development and emission trading with participation in the Joint Implementation (JI) Projects.

Systems of Protection Against Life-Threatening Touch and Step Voltage During Earth Faults in High Voltage Networks of Ore and Coal Mines, and a Proposal of Efficient Selective Protection

**Leader:** Assoc. Prof. Dr. Jože Voršič
The project is a part of an intergovernmental programme of scientific co-operation between the Republic of Slovenia and Bosnia and Herzegovina. The subject of the project is a method of dynamic modelling of electrical power systems during earth faults. The dynamic model has been developed as an upgrade of the EMTDC program tool. The practical simulation has been made on the basis of the 6 kV network of the surface mine “Gračanica” in Gatsko, Bosnia and Herzegovina. Simulations of various possible earth fault cases have been used as a background for selecting the protection system against life threatening touch and step voltage that appear during earth faults. Practical measurements for verification of simulations have also been performed.

**PUBLICATIONS**


Samo Ulaga, Jože Flašker, “Model izobrazbe održavatelja na Sveučilištu u Mariboru,” Zbornik radova, Zagreb, Croatia, pp. 159-165.


PRESENTATIONS BY THE LABORATORY MEMBERS

Jože Voršič, Boris Bizjak, “Uticaj potrošača na oblik napona: mjerenja, analiza i otklanjanje smetnji,” lecture at the University of Tuzla, Faculty of Electrical Engineering, Tuzla, Bosnia and Herzegovina, Jan. 15, 2001.


CONGRESSES, MEETINGS, AND COMMITTEES


Assoc. Prof. dr. Jože Voršič: Member of editorial board of electrotechnical magazine ER.


Andrej Orgulan, MSc: Editor of the proceedings of Slovenian Lighting Association, Maribor, Slovenia, 2001.

VISITS TO OTHER INSTITUTIONS


Andrej Orgulan, MSc: Visit to the Lighting Technology Laboratory in SITEC, Trunrent: presentation of the laboratory, lighting technology centre and manufacturing of lamps; talks about the co-operation in the fields of research and education, Turnrent, March 22–23, 2001.

Darko Koritnik: Visit to the 4th VDE/ABB Blitzschutztagung workshop: the main topic was protection against lightning and consequences of overvoltage –
changes in European standardisation and legislation; discussion on technical solutions of overvoltage protection at the Kum radio and television transmitter, Neue-Ulm, Germany, Nov. 8–9, 2001.

GUESTS AND VISITORS

Assoc. Prof. Dr. Enver Delamič (University of Tuzla, Faculty of Electrical Engineering, Bosnia and Herzegovina):

Lecture on dynamic conditions in high voltage networks of mines.

Prof. Dr. Ruslan Borisov (Technical University of Moscow, Russia):

Visit of director of the "RPC ELECTRICAL ENGINEERING: RESEARCH & PRACTICE" institute: lecture on protection against lightning and co-operation in software development.
ELECTROMECHANICAL SYSTEMS CONTROL LABORATORY

Head:
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Phone: +386 2 220 70 70
E-mail: dolinar@uni-mb.si

RESEARCH PROJECTS

Current research projects

Research and development projects

RR-61-2596  System for control, protection and local automation in power systems

Leader:  Prof. Dr. Bojan Grčar
Participants:  Prof. Dr. Drago Dolinar, Asst. Prof. Dr. Gorazd Štumberger, Asst. Prof. Dr. Jožef Ritonja, Dr. Oto Težak, Boštjan Polajžer

Financed by:  Ministry of Education, Science and Sport of the Republic of Slovenia, Iskra SYSEN

This project considers the practical implementation of different protection and control algorithms. Besides some new concepts in transformer protection, turn-to-turn faults are the focus of our current research. This fault type represents a great challenge for existing relays since they are unable to recognize turn-to-turn faults in the early development stage. Based on a great number of measured samples on the laboratory power transformer we hope to first develop an appropriate model describing this fault type with sufficient accuracy. Obtained deeper knowledge will be later used to improve the sensitivity of protection algorithms.

Modelling, analysis and control of Linear Synchronous Reluctance Motor (LSRM)

Leader:  Prof. Dr. Drago Dolinar
Participants:  Asst. Prof. Dr. Gorazd Štumberger, Prof. Dr. Bojan Grčar, Prof. Dr. Kay Hameyer, Dr. Bojan Štumberger
The subject under investigation was the modelling and control design of high performance drive using Linear Synchronous Reluctance Machine (RSLM). A nonlinear dynamic model of the LSRM has been developed, verified and validated. The model contains a magnetically nonlinear and anisotropic model of the LSRM iron core and the position and current dependent characteristics of the thrust and friction force. All required characteristics have been determined experimentally.

Experimental system: Linear synchronous reluctance servodrive.

Completed research projects 2001

Basic research projects

**J2-7611-0796-99** Electromagnetic Devices - Basic Computational Methods

*Leader:* Prof. Dr. Božidar Hribernik

*Participants:* Prof. Dr. Drago Dolinar, Assoc. Prof. Dr. Mladen Trlep, Assoc. Prof. Dr. Anton Hamler, Asst. Prof. Dr. Gorazd Štumberger, Dr. Marko Jesenik, Dr. Bojan Štumberger

*Financed by:* Ministry of Education, Science and Sport of the Republic of Slovenia

*Duration:* 3 years
Our research dealt with the modelling and control of electrical machines. Determination of some new, improved dynamic models of electrical machines and methods for determining machine parameters was the main task of the modelling. The modified models of linear induction and reluctance machines have been used successfully in designing some new high-performance machine operation control.

**J2-0800-796-00  Local automation and unit protection in power systems**

*Leader:* Prof. Dr. Bojan Grčar  
*Participants:* Prof. Dr. Drago Dolinar, Asst. Prof. Dr. Gorazd Štumberger, Asst. Prof. Dr. Jožef Ritonja, Dr. Oto Težak, Boštjan Polajžer  
*Financed by:* Ministry of Education, Science and Sport of the Republic of Slovenia  
*Duration:* 3 years

In this basic research project dynamic power system modelling, control and unit protection were discussed. We claim that network modelling can be performed equally based on instantaneous state variables or by using dynamic phasor quantities. Analysis tools for the interaction of power system transients with protection operation have been developed. In testing phase there are new protection algorithms based on the analytical signal processing methods applied to the power transformers and transmission lines.

**Applied project**

**L2-0796-0796-99  Active Magnetic Bearings**

*Leader:* Prof. Dr. Drago Dolinar  
*Participants:* Prof. Dr. Bojan Grčar, Assoc. Prof. Dr. Peter Cafuta, Asst. Prof. Dr. Gorazd Štumberger, Asst. Prof. Dr. Jožef Ritonja, Dr. Oto Težak, Boštjan Polajžer, Prof. Dr. Kay Hameyeer  
*Financed by:* Ministry of Education, Science and Sport of the Republic of Slovenia  
*Duration:* 3 years

Resulting from this research project an experimental system of active magnetic bearings was developed. The design of magnetic bearings was achieved in cooperation with the KU Leuven, ESAT/ELEN, Professor K. Hameyer, while the design of the rotor (system) shaft was achieved in cooperation with the KU Leuven, MECH/PMA, Professor W. Heylen. The development of the power supply, electronics and the control is based on our knowledge and experiences. Magnetic bearing force was measured in order to determine the mathematical model by analytical continuous functions. Based on the derived mathematical model, a control design was implemented. The improvement of the static and dynamic system
performances was established. We have realized the design as well as manufacturing of the experimental system of active magnetic bearings. The modular type of the realization and the user friendly control desk make it possible to use the system in applied and theoretical research as well as for educational purposes.

Prototype of the active magnetic bearings.

Industrial project

Protection of Power Transformers Tertiary Windings

Leader: Prof. Dr. Bojan Grčar
Participants: Prof. Dr. Drago Dolinar, Asst. Prof. Dr. Gorazd Štumberger, Asst. Prof. Dr. Jožef Ritonja, Dr. Oto Težak, Boštjan Polajžer

Financed by: Eles, Slovenia
Duration: 2 years

This study discusses the problem of power transformers (400/110/31.5 kV in 220/110/10.5 kV) tertiary winding protection in special cases where tertiary winding is also used for station power supply. Such configuration makes the protection system design and settings difficult under some operating conditions and even the transformer itself can be threatened. Based on dynamic model short circuit and turn-to-turn analyses, relay systems and effective over-voltage protection are described in the project.

PUBLICATIONS


PRESENTATIONS BY THE LABORATORY MEMBERS


CONGRESSES, MEETINGS, AND COMMITTEES

Prof. Dr. Drago Dolinar: Scientific Committee of VANEM 2001 Conference, Lodz, Poland.

VISITS TO OTHER INSTITUTIONS

Prof. Dr. Drago Dolinar: Modelling and Control of Electrical Machines, lecture at University d’ Artois, Bethune, France, April 2001.

Prof. Dr. Drago Dolinar: Visit to the Central Queensland University, Rockhampton, Australia (Prof. P. Wolfs), May 2001.
Asst. Prof. Dr. Gorazd Štumberger: Work in the project entitled “Sizing design of a permanent magnet linear motor for aircraft launch” (project leader: Thomas A. Lipo, University of Wisconsin-Madison; co-workers: Gorazd Štumberger, Mehmet Aydemir; sponsor: Office of Naval Research), University of Wisconsin–Madison, Aug. 8 to Nov. 30, 2001.

Prof. Dr. Bojan Grčar: Research work in the project entitled “Non-Linear Control of Induction Motors”, Northeastern University Boston, Nov. 1–30, 2001.

Prof. Dr. Drago Dolinar: KU Leuven, Belgium, research co-operation.

Asst. Prof. Dr. Jožef Ritonja: Czech Technical University of Prague, CEEPUS fellowship holder.

GUESTS AND VISITORS

Prof. Dr. Kay Hameyer (KU Leuven, Belgium): Visiting the laboratory, work with doctoral candidate, work in the research project, Sept. 2001.


DECORATIONS, AWARDS, AND HONOURS

Prof. Dr. Bojan Grčar, Silver Award of the University of Maribor.

Prof. Dr. Bojan Grčar, Award for Successful and Innovatory Co-operation with Industry, Faculty of Electrical Engineering and Computer Science of Maribor, Slovenia, Nov. 2001.
RESEARCH PROJECTS

Industrial project

New Motor Starter

Leader: Assoc. Prof. Dr. Jože Pihler
Participants: Dr. J. Voršič, Dr. I. Tičar, D. Koritnik, A. Hanžič, M. Stegne A. Lovrenčič (ELA), J. Jeraj (Orkom), J. Varga (Vitalner)

Financed by: ELA Slovenske Konjice, Vitalner d.o.o., Slovenia

In the year 2001 the method for the mechanical fixing of a starter was modified according to the requirements of European customers. The electromagnetic drive was modified according to the requirements of the American market, i.e. 110 V and 230 V, 60 Hz. The imperfections detected during the prototype tests were eliminated and new testing of the first manufactured series of products has been performed in compliance with IEC 60947-41 subclause 9.3.1:

Test sequence 1:
Temperature rise test - IEC 60947-4-1 subclause 9.3.3.3
Operation and operational limits test - IEC 60947-4-1 subclause 9.3.3.1 in 9.3.3.2
Dielectric test - IEC 60947-4-1 subclause 9.3.3.4

Test sequence 2:
Rated Making & Breaking capacity test- IEC 60947-4-1 subclause 9.3.3.5
Conventional operation test - IEC 60947-4-1 subclause 9.3.3.6

Test sequence 3:
Short circuit operation test - IEC 60947-4-1 subclause 9.3.4
Test sequence 4:
Ability of conducting overload current test - IEC 60947-4-1 subclause 9.3.5

Test sequence 5:
Mechanical properties of connections test – IEC 60947-1 subclause 8.2.4

Patent applications were submitted to some foreign countries (European Union, USA, Russia, Japan, India, etc.), and the technical documentation was re-arranged accordingly.

International project

Slo-A19/2002 Virtual Electromagnetic Laboratory and Web-based Distance Learning

Leader: Assoc. Prof. Dr. Igor Tičar
Participants: Dr. J. Pihler; Dr. A. Hamler; A. Orgulan, MSc; M. Žnidarič, MSc; Prof. Dr. Kurt Preis (IGTE)
Project Partners: Institut für Grundlagen und Theorie der Elektrotechnik (IGTE), TU Graz, Austria
Financed by: Ministry of Education, Science and Sport of the Republic of Slovenia

This project will intensify the successful co-operation between Laboratory of Applicative Electrical Engineering of FERI and Institut für Grundlagen und Theorie der Elektrotechnik (IGTE) of TU Graz. Both institutions have successfully co-operated for many years in the field of numerically solving electromagnetic field problems, which is evident from several commonly published papers. During the last couple of years this co-operation has been especially intense and successful in the field of computer supported educational programmes for the subjects entitled Principles of Electrical Engineering and Theoretical Electrical Engineering. The solving of applicative problems for industry using previously developed program tools has also been very successful. Further upgrading of existing and design of new program tools will include the development of new pre-processors for planar and rotationally symmetrical electromagnetic problems, pre-processors for planar problems in polar co-ordinates for electrical machines, two and three dimensional program packages EleFAnT2D and EleFAnT3D. In addition to these, some examples of virtual electromagnetic laboratory will be developed to improve practical exercises for the subject Principles of Electrical Engineering. Procedures will also be developed for the computer animation of electromagnetic phenomena.

The institutes at TU Budapest and TU Stuttgart are also included in this co-operation. The Austrian partner also co-operates with the University of Bath (UK) and University of Genoa (I) in the EU project Teleteaching and distance education and in INCO COPERNICUS project P.nr. 15CT960703.
PUBLICATIONS


**CONGRESSES, MEETINGS, AND COMMITTEES**

Andrej Orgulan, MSc: Editor of Slovenian Lighting Association magazine “Svetlobna tehnika”, Maribor, Slovenia, 2001.

Andrej Orgulan, MSc: Editor of the proceedings of Slovenian Lighting Association, Maribor, Slovenia, 2001.

**VISITS TO OTHER INSTITUTIONS**

Andrej Orgulan, MSc: Visit to the Lighting Technology Laboratory in SITEC, Trunrent: presentation of the laboratory, lighting technology centre and manufacturing of lamps; talks about co-operation in the fields of research and education, Turnrent, March 22–23, 2001.
Assoc. Prof. Dr. Igor Tičar: TU Graz, IGTE – Virtual Electromagnetic Lab.

Assoc. Prof. Dr. Igor Tičar: TU Budapest – Theoretical Electrotechics Institute – Fluxet sensor.

GUESTS AND VISITORS

Prof. Dr. Kurt Preis, Prof. Dr. Oszkar Biro (Technical University of Graz, Austria):

Visit from the Faculty of Electrical Engineering – Virtual Electromagnetic Laboratory of Graz.
Applied Electromagnetics Laboratory

Head:
Assoc. Prof. Dr. Mladen Trlep
Phone: +386 2 220 70 41
E-mail: mladen.trlep@uni-mb.si

RESEARCH PROJECTS

Current research projects

Industrial projects

Optimisation of the poles of a 1 phase synchronous motor with permanent magnets

Leader: Assoc. Prof. Dr. Anton Hamler
Participants: M. Trlep, M. Jesenik, B. Štumberger, V. Goričan
Financed by: Iskra MEHANIZMI, d.d., Lipnica 8, KROPA, Slovenia

The aim of this project is to assure the reliable operation of the synchronous motor with permanent magnets in the as big as possible voltage range with an in advance defined rotation direction, which is unreliably defined by that motor. Both demands can be satisfied by the shaping of the stator poles. Automatic optimisation algorithms cannot be used for the shaping of the poles, because the connection between pole shape, rotational torque and operation reliability at different voltages is covered. This is the reason why intuitive shaping procedures were used, which were based on the finite element method magnetic field analysis and on the direct method of torque calculation from magnetic field distribution. The prototype is made and it is in the testing stage. In the range of this project investigations were made and the first prototype of the rotor for synchronous motors with 24 poles made of Ne Fe B magnets was made. To achieve good quality magnetizations of these materials, a large amount of energy is required. A large amount of energy causes big problems at the more pole magnetizations of small dimension magnets.

Development of permanent magnets direct current motor

Leader: Assoc. Prof. Dr. Anton Hamler
Participants: M. Trlep, M. Jesenik, B. Štumberger, V. Goričan
The aim of this project is the development of a direct-current motor with permanent magnets, with parameters such as power, rotational torque, operation duration, heating, blocking moment, free run rotations, quantity and the kinds of used material suited to strict tolerance demands. Dimensions of this motor are highly limited, because of the reasons for using this motor. All these facts required research into the permanent magnets demagnetization process in the case of the short contact, and in the case of the rotor, coil heating. Extra attention is focused on the motor supply, which is made using a rectifier. In this way the performance of the motor is changed and motor the characteristics are influenced. This motor is momentarily at the stage of prototype testing.

**Wide applicable linear motor**

*Leader:* Assoc. Prof. Dr. Anton Hamler  
*Participants:* M. Trlep, M. Jesenik, B. Štumberger, V. Goričan  
*Financed by:* Applied Electromagnetics Laboratory, Ideal sistemi, Grajska vas, Gomilsko, Slovenia

The aim of the cooperation for this project is the production of widely applicable and robust reluctance motors. The shapes of the active motor parts were constructed and an analysis was made of the magnetic and mechanical conditions. More variants of the secondary part of the motor were expected dependant on driving requirements. Prototype is in the stage of testing. The potential areas of usage will be various transport and production systems.

**Production of prototype and preparing pilot production of the switch MS 32**

*Leader:* Assoc. Prof. Dr. Anton Hamler  
*Participants:* M. Trlep, M. Bizjak, M. Jesenik, B. Štumberger, V. Goričan, G. Hrovat  
*Financed by:* Ministry of Economy, Iskra Stikala d.d. Savska loka 4, Kranj, Slovenia

Project was related to the development of a technical pretentious motor protection switch, the production of which will be cheaper than the production of existing less pretentious switches. Analysis of the magnetic, electrical and heating conditions, already done from the basic idea of switch construction, was our job in that project. Because the construction of the type of switch defines is 70% of costs, it bears the main burden of the switch price. The construction has likewise a basic influence on switch efficiency, which can be changed during the development and switch construction only, as earlier mentioned analysis. Pilot switch production is in the stage of testing.
International project

Numerical modelling of electromagnetic structures

**Leader:** Assoc. Prof. Dr. Mladen Trlep, Prof. Dr. Andrzej Krawczyk

**Participants:** B. Hribnik, A. Hamler, M. Jesenik, G. Štumberger, V. Goričan, J. Sikora, J. Starzynski, R. Sikora, S. Wiak

**Financed by:** Ministry of Education, Science and Sport of the Republic of Slovenia and Ministry of Economy, Polish academy of Sciences

Applications of numerical methods for electromagnetic field analysis in biological tissues together with the development of an inverse approach with the DRM method for use in medical diagnostics was the work covered by this project. New software, which will provide some specific solutions and will be adapted to the existing program solutions, is being developed. The first Slovenian – Polish seminar on the subject of application electromagnetism was conducted during this project.

Completed research projects 2001

**Basic research project**

J2-7611-0796-99  Electromagnetne naprave - temeljne računske metode  
(Electromagnetic Devices – Basic Computational Methods)

**Leader:** Prof. Dr. Božidar Hribnik

**Participants:** M. Trlep, A. Hamler, D. Dolinar, M. Jesenik, B. Štumberger, G. Štumberger, B. Slemnik

**Financed by:** Ministry of Science and Technology of the Republic of Slovenia

**Duration:** 1996 – 2001

The main aim of this project was the development of computer methods for calculating how electromagnetic fields activity effects static and dynamic conditions by taking real properties of the used material into account. The pretentiousness of the provided project was the reason, that if was divided into three thematic parts (1. Basic numerical method – leader M. Trlep, 2. Consideration of the real material characteristics – leader A. Hamler, 3. dynamic models – leader D. Dolinar). The basis of everything was development of the basic numerical methods. The emphasis was on the finite element method – FEM, which was completed using the boundary element method and both methods were the basis for the development of a hybrid method. Calculation can be made by the consideration of the linear or non-linear conditions and in the two dimensional or three dimensional spaces. Time problems were expanded from the first harmonic problems into the transient problems. During the last period
Inverse problems were calculated too. More mathematical models of the hysteresis (Jiles-Lagevin, Stoner-Wohlfart, Preisach and others) were studied by investigations of the real materials characteristics. In the range of the project the Preisach hysteresis model was chosen. The scalar model was expanded into the vector model. By realisation of the project, necessary measuring methods were developed and appropriate measuring and computer equipment was obtained or chosen. Appropriate sensors were investigated and developed and computer simulations of the measurements with help of numerical methods were developed. Although the developed methods make possible the calculations of many problems, the development of these methods is unfinished, because new bigger and bigger challenges demand continuous progress.

Applied projects

L2-7718-0796-99 Strukture električnih pogonov (Structure of Electric Drives)
Leader: Prof. Dr. Božidar Hribernik
Participants: Karel Jezernik, Anton Hamler, Ivan Zagradišnik, Alenka Hren, Miran Rodič, Dušan Drevenšek, Milan Curkovič, Jože Korelič, Mladen Trlep, Bojan Štumberger, Marko Jesenik, Bogdan Kreča, Matjaž Plejić, Viktor Goričan, Bojan Slemnik, Matej Gajzer
Financed by: Ministry of Education, Science and Sport of the Republic of Slovenia and the INDRAMAT Železniki Company, Slovenia

Duration: 1999 – 2001

Finding the optimal realization of electric drives with regard to possible structures was the main idea of the project. Research of the control was focused on the carrying out of a control scheme for alternating current motors without the use of mechanical sensors, that increases the priority of such a drive in regard to price, smaller external dimensions and easier support. Parallel research was done in two areas. The first area was direct control of the moment and the second area was usage of the direct vector scheme for motor control. The actions of both control schemes were checked and confirmed with simulations and experiments under real conditions. Analysis of the properties of different magnetic structures of electric engine can be made for some types and application by determination of inductivity and torques or engine forces. Iron losses have to be known for more accurate calculations. CAD packages for calculating the position dependant inductivities and torques or forces based on the finite element method were developed. Procedure for calculation of losses in the iron cores of the alternating and rotational (elliptic) sinusoidal and non-sinusoidal fields were developed. The accuracy of the five mathematical-physics models for the losses calculations was investigated. Results were verified and validity was confirmed on a synchronous engine with sunken permanent magnets and on the reluctance linear synchronous motor. Results of the work on the project were published at conferences, in the technical and scientific magazines and were directly transferred into the economy. Our main partners are DOMEL, or INDRAMAT Železniki, BSH Nazarje, ROTOMATIKA Sp. Idrija and ISKRA MEHANIZMI Kranj.

PUBLICATIONS


**CONGRESSES, MEETINGS, AND COMMITTEES**

Assoc. Prof. Dr. Mladen Trlep: The aim of Slovenian-Polish conference was a review of the Slovene and Polish scientific work in the field of numerical calculations of electromagnetic fields and a review of the applications from this field; next conference will be in 2003 in Poland; Faculty of Electrical Engineering and Computer Science of Maribor, Slovenia, Sept. 10–12, 2001.
Assoc. Prof. Dr. Mladen Trlep, Assoc. Prof. Dr. Anton Hamler, Dr. B. Štumberger, Dr. M. Jesenik: Reviewers for JOURNAL OF TECHNICAL PHYSICS, Warsow, Poland.

VISITS TO OTHER INSTITUTIONS

Assoc. Prof. Dr. Mladen Trlep: Institute of Electrical Engineering, Warsaw, Poland.

Assoc. Prof. Dr. Mladen Trlep: Technical University of Czestochowa, Czestochowa, Poland.

Dr. B. Štumberger, V. Goričan, J. Ribič: Instituto Elettrotecnico Nazionale, Torino, Italy.

GUESTS AND VISITORS

Prof. Dr. Andrzej Krawczyk (Institute of Electrical Engineering, Warsaw, Poland), Prof. dr. Slawomir Wiak (Technical University of Lodz, Institute of Electrotechnical machines and Transformers, Lodz, Poland): Co-operation within the joint Slovene-Polish project.

Y. Ishihara (Doshisha University, Kyoto, Japan): Scientific co-operation.

Prof. Dr. Zijad Haznadar, Prof. Dr. Željko Štih, Prof. Dr. Sead Berberović (Faculty of Electrical Engineering and Computing, Zagreb, Croatia): Scientific co-operation.

Marija Čundeva (University “Sts Cyril & Methodius”, Faculty of Electrical Engineering, Skopje, Macedonia): Scientific co-operation.
Olaf Henze
(University of Stuttgart, Institute for Theory of Electrical, Engineering, Stuttgart, Germany):

Scientific co-operation.
The Institute of Robotics performs basic and applied research for the development and building of robotics systems, production automatization, sensor systems, control theory, modeling, identifications, computer process control, industrial robotics, servo-systems, robot controllers, and real-time control systems. We develop advanced-control algorithms for the control of position, speed, and torque with the use of various kinds of executive modules and constructions of robotic mechanisms.

In the Kinematics and Simulation Laboratory, we conduct robot and robotization kinematics control and process simulation. We use both real and simulated controllers and mechanisms. Simulations deal with virtual and real systems and processes. We also investigate nonlinear and robust control for this reason.

In the Power Electronics Laboratory, we study electronic power devices. We research resonance converters and basic structures of DC/DC converters through modulation procedures.

The Institute of Robotics co-operates with many universities abroad. In the Socrates-Erasmus project we co-operate with Universidade do Minho - Portugal, Technische Universität Braunschweig - Germany, Technische Universität Wien - Austria, Universitat Politechnica de...
Catalunya - Spain, Universitat Rovira i Virgili - Spain, Loughborough University - United Kingdom. In CEEPUS program we co-operate with Technical University of Timisoara - Romania, Budapest University of Technology and Economics - Hungary, Cracow University of Technology - Poland, Vienna University of Technology - Austria in Technical University of Košice - Slovak republic.

The institute members are listed below by the laboratory with which they are affiliated.
**Power Electronics Laboratory**

Head: Assoc. Prof. Dr. Miro Milanović

Employees: Dr. Franc Mihalič, Dr. Alenka Hren, Anton Otič

**Industrial Robotics Laboratory**

Head: Prof. Dr. Karel Jezernik

Employees: Assoc. Prof. Dr. Riko Šafarič; Asst. Prof. Dr. Martin Terbuc; Dr. Miran Rodič; Dr. Suzana Uran; Dr. Dušan Drevenšek; Dr. Aleš Hace; Dr. Andreja Rojko; Janez Pogorelec, MSc; Milan Čurkovič, BSc; Gregor Edelbaher, BSc; Jože Harnik, BSc; Jože Korelič, BSc; Evgen Urlep, BSc

**Technological Centre for Mechatronics and Automation (TCMA)**

Head: Prof. Dr. Karel Jezernik

**Kinematics and Simulation Laboratory**

Head: Assoc. Prof. Dr. Peter Cafuta

Employees: Asst. Prof. Dr. Boris Curk, Marijan Španer
POWER ELECTRONICS LABORATORY

Head:
Assoc. Prof. Dr. Miro Milanović
Phone: +386 2 220 73 30
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RESEARCH PROJECTS

Completed research projects 2001

Applied project

L2-1346-796 High-frequency Unipolar Resonant Link Converter
Leader: Assoc. Prof. Dr. Miro Milanović
Participants: Prof. Dr. K. Jezernik, F. Mihalič, A. Hren, R. Kovačič, A. Otič
Financed by: Ministry of Education, Science and Sport of the Republic of Slovenia
Duration: 2 years

Direct AC to AC matrix converters are devices interposed between sources of electrical energy and loads that usually convert energy from an AC voltage source to some other AC voltage with variable magnitude and frequency. In principle, for a given set of input three phase voltages, any desired set of output voltages can be synthesised by suitably toggling matrix switches. The well known theory states that an AC to AC matrix converter can operate with a unity power factor. Symmetric and antisymmetric switching strategies enable this mode of operation. The hard switching mode operation has been traditionally used in ordinary matrix converters. In the proposed research project we would like to introduce a soft switching mode of operation. The resonant link capacitor will be distributed at the matrix switching transistor. In addition the unity displacement factor operation will be achieved by using combined symmetric and antisymmetric modulation strategy. This combined algorithm enables a unity displacement factor operation without current sensing and current control.
PUBLICATIONS


CONGRESSES, MEETINGS, AND COMMITTEES

Assoc. Prof. Dr. Miro Milanovič: Member of the technical program committee, IEEE International Symposium on Circuits and Systems, Sydney, Australia, May 2001.
Assoc. Prof. Dr. Miro Milanović: Member of the organising committee, Annual Electrical and Computer Science Conference, Portorož, Slovenia, Sept. 2001.

Assoc. Prof. Dr. Miro Milanović: Organizer of special session "Non-linear Control and PWM", 9th Mediterranean Conference on Control and Automation.
INDUSTRIAL ROBOTICS LABORATORY

Head:
Prof. Dr. Karel Jezernik
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RESEARCH PROJECTS

Current research projects

**Industrial project**

**R55-3355**  
**Stroj za razrez z vodnim curkom (Waterjet cutting machine)**

*Leader:*  
Asst. Prof. Dr. Martin Terbuc

*Participants:*  
Dr. Miran Rodič, Dr. Aleš Hace, Marijan Španer

*Financed by:*  
Ministry of Education, Science and Sport, Alpina d.d., Žiri, Slovenia

The goal of this project is a waterjet cutting machine. This machine will introduce a higher level of flexibility in the shoe production process. It will even allow the production of a single particular pair of shoes. The waterjet machine will be included in the shoe production process in the first working phase, which follows after defining the shoes geometry using the CAD system.

**International project**

**UNISTRUCT**  
**Novel methods of adaptive control based on simplified uniform structures and learning**

*Leader:*  
Prof. Dr. Karel Jezernik, Prof. Dr. Jozsef K. Tar

*Participants:*  
Dr. Martin Terbuc, Dr. Riko Šafarič, Dr. Aleš Hace, Dr. Andreja Rojko, Prof. Dr. Imre Rudas, Dr. Janos F. Bito, Dr. Laslo Horvat

*Financed by:*  
Ministry of Education, Science and Sport of the Republic of Slovenia

Slovenian-Hungarian intergovernmental S&T cooperation programme. It is hoped that a novel
special branch of soft computing can be developed. Also, clarifying the necessary conditions for convergence is expected. The results will be illustrated via simulation results. It is expected that the new approach will be efficient in various practical fields of control applications.

Completed research projects 2001

Basic research project

**J2-7527-796**  
*Napredne strukture mehanskega gibanja*  
(*Advanced motion control*)

*Leader:* Prof. Dr. Karel Jezernik  
*Financed by:* Ministry of Education, Science and Sport of the Republic of Slovenia  
*Duration:* 1996 – 2001

The dynamic input-output behavior of mechanical motion is characterised by structural uncertainties. The key parameters of control plant change during operation depending on load and friction. The aim of this project is to derive robust sliding mode and adaptive neural and fuzzy control algorithms and implement them in special micro-controllers and/or transputer multiprocessor networks. We derived, and experimentaly tested, robust control algorithms with variable structures for AC servo motors with asynchronous and synchronous permanent magnet motors. We verified theoretically derived control results through experimentation with nonlinear loads on multi-axis manipulators for direct drive servo motors. We also studied position/force control algorithms for manipulators in joint and space coordinates.

Applied projects

**2811-01-00052**  
*Novi didaktični pristopi študija na daljavo*  
(*A new educational approach for a distance learning*)

*Leader:* Assoc. Prof. Dr. Riko Šafarič  
*Participants:* Dr. Boris Curk, Aleš Polič  
*Financed by:* Ministry of Information Society of the Republic of Slovenia  
*Duration:* 3 month

The server system for a faculty computer network was built. The old long distance server educational software was transferred to the new built server system. A software driver for a video system and a distance control camera was made. An actuation software driver for 1
DOF robot mechanism to be controlled via the internet was made.

L2-1506-796 Strukture električnih pogonov (Structure of Electric Drives)

Leader: Prof. Dr. Božidar Hribernik
Participants: A combined project; participants from the Institute of robotics: Prof. Dr. Karel Jezernik, Dr. Alenka Hren, Milan Čurkovič, Jože Korelič
Financed by: Ministry of Education, Science and Sport, Domel d.d., Železnik, Slovenia
Duration: 1998 – 2001

During last year, our research was focused in the field of measurement and identification methods of induction motor (IM) parameters. Any mismatch between the actual motor parameters and those parameters used in a vector control scheme leads to deterioration of motor performance in terms of steady-state error and transient oscillations of rotor flux and motor torque. Based on the theory of electromagnetic fields, we derived a dynamic model of the linear induction motor (LIM) and we developed an input-output linearising control scheme. We verified all theoretical issues with the experimental set up of Škoda pick-up and Škoda ß elcar electric vehicles.

PUBLICATIONS


CONGRESSES, MEETINGS, AND COMMITTEES


Prof. Dr. Karel Jezernik: Member of the IFAC Technical Committee on Robotics – MIR.

Prof. Dr. Karel Jezernik: President of Automatic Control Society of Slovenia.

Prof. Dr. Karel Jezernik: Technical Program Co-Chairman, reviewer and chairman of the IEEE Industrial Electronics Society Annual Conference IECON ’01, Denver, USA.

Prof. Dr. Karel Jezernik: Member of the International Steering Committee and reviewer of the IEEE symposium SDEMPED ’01, Gorizia, Italy.

Prof. Dr. Karel Jezernik: Member of the International Scientific Committee and chairman of the workshop RAAD 2001, Vienna, Austria.

Prof. Dr. Karel Jezernik: Member of the Program Committee of the symposium Mechatronika 2001, Trencianske teplice, Slovakia.

Prof. Dr. Karel Jezernik: Member of the International Program Committee and reviewer of the IFAC DECOM - TT 2001, Ohrid, Republic of Macedonia.

Prof. Dr. Karel Jezernik: Member of the International Program Committee of the ITM 2001, Istanbul, Turkey.

Prof. Dr. Karel Jezernik: Member of the Advisory Board of the ERK 2001, Portorož, Slovenia.

Prof. Dr. Karel Jezernik: Member of the International Program committee and reviewer of the IFAC workshop IAD 2001, Gramado, Brazil.

Prof. Dr. Karel Jezernik: Reviewer for the journal IEEE Transactions on Industrial Electronics.
Prof. Dr. Karel Jezernik: Reviewer for the journal IEEE/ASME Transactions on Mechatronics.

Prof. Dr. Karel Jezernik: Reviewer for the journal IEEE Transactions on Control Systems Technology.

Prof. Dr. Karel Jezernik: Reviewer for the conference EPE-PEMC 2002, Dubrovnik, Croatia.

Prof. Dr. Karel Jezernik: Reviewer for the IFAC World Congress 2002, Barcelona, Spain.

Prof. Dr. Karel Jezernik: Reviewer for the conference MED '01, Dubrovnik, Croatia.

Prof. Dr. Karel Jezernik: Reviewer for the IEEE symposium ISIE 2002, L'aquilla, Italy.

Assoc. Prof. Dr. Riko Šafarič: Member of the International Program Committee of the IFAC workshop AFNC'01, Valencia, Spain.

VISITS TO OTHER INSTITUTIONS


GUESTS AND VISITORS

Prof. Dr. Imre Rudas, Prof. Dr. Jozsef K. Tar (Budapest Polytechnic, Hungary): Exchange of researchers: bilateral intergovernmental S&T cooperation, April 30 to May 12, 2001.
Tomasc Goik,  
Adam Slota  
(Cracow University of Technology,  
Poland):  
Exchange of students in CEEPUS RO-104, July 2–  

Prof. Dr. Ferenc Alpek  
(Untiversity of Technology and  
Economics Budapest, Hungary):  
Exchange of researches: bilateral interuniversity  

Dr. K. David Young  
(Hong Kong University of Science & Technology, Hong Kong):  

Prof. Dr. Dusan Borojevic  
(Virginia Tech, USA):  
Working visit; lectures entitled “Education and research in power electronics at Virginia Tech” and  

Prof. Dr. Bo Hyung Cho  
(Seoul National University, Korea):  

Prof. Dr. Thomas A. Lipo  
(University of Wisconsin, USA):  

Tomasz Kraszewski  
(Silesian University of Technology,  
Poland):  
Exchange of students in CEEPUS PL-0119, Oct. 2–  

Marek Sukob,  
Peter Čörnej  
(University of Technology Kosice,  
Slovakia):  
Exchange of students in CEEPUS SK-0119, Nov.  
KINEMATICS AND SIMULATION LABORATORY

Head:
Assoc. Prof. Dr. Peter Cafuta
Phone: +386 2 220 73 40
E-mail: cafuta@uni-mb.si

RESEARCH PROJECTS

Completed research projects 2001

Basic research project

**J2-0823-0796-98/25** Nonlinear Control Methods for Electromechanical Systems

*Leader:* Assoc. Prof. Dr. Peter Cafuta

*Participants:* Assoc. Prof. Dr. Bojan Grčar, Prof. Dr. Drago Dolinar, Asst. Prof. Dr. Gorazd Štumberger, Asst. Prof. Dr. Boris Curk, Marjan Španer

*Financed by:* Ministry of Education, Science and Sport of the Republic of Slovenia

*Duration:* 1998 – 2001

This project includes research into interactive systems, analytical design of nonlinear control, and the experimental testing and evaluation of the results obtained. Geometric, and kinematic conditions, and dynamic characteristics (contacts) are included in the interactive system models. Holonomic conditions in particular were investigated, yet the research hypothesis is also extended to the non-holonomic examples.

PUBLICATIONS


### VISITS TO OTHER INSTITUTIONS

Assoc. Prof. Dr. Peter Cafuta: Visits to Inst. for RT, University of Graz, Austria.
Head:

Prof. Dr. France Brešar until Oct. 31, 2001     Prof. Dr. Vitodrag Kumperščak from Nov. 1, 2001
Phone: +386 2 220 73 80                       Phone: +386 2 220 73 90
E-mail: bresar@uni-mb.si                      E-mail: vito.kumpsca@uni-mb.si

URL: http://www.mp.feri.uni-mb.si

Members of the Institute of Mathematics and Physics are participating in research activities at the Faculty for Electrical Engineering and Computer Sciences and at the Institute for Mathematics, Physics, and Mechanics at the University in Ljubljana. Because our research work is not unilaterally organised, we are reporting on individual contributions.
Members of the Institute of Mathematics and Physics are organised into one laboratory.

**Institute of Mathematics and Physics**

Head:
Prof. Dr. France Brešar until Oct. 31, 2001
Prof. Dr. Vitodrag Kumperščak from Nov. 1, 2001

**Applied Mathematics Laboratory**

Head:
Prof. Dr. France Brešar until Oct. 31, 2001
Prof. Dr. Vitodrag Kumperščak from Nov. 1, 2001

**Applied Mathematics Laboratory**

Head: Prof. Dr. France Brešar (until Oct. 31, 2001),
Prof. Dr. Vitodrag Kumperščak (from Nov. 1, 2001)

Employees: Assoc. Prof. Dr. Gorazd Lešnjak; Dr. Andrej Duh; Milan Kutnjak, MSc; Dr. Marjan Logar; Asst. Prof. Dr Tatjana Petek; Iztok Peterin, MSc; Jasna Petric, BSc; Aleksandra Tepeh, BSc
Applied Mathematics Laboratory

APPLIED MATHEMATICS LABORATORY

Head:
Prof. Dr. France Brešar until Oct. 31, 2001, Prof. Dr. Vitodrag Kumperščak from Nov. 1, 2001

Phone: +386 2 220 73 80, +386 2 220 73 90
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RESEARCH PROJECTS

Current research projects

Basic research projects

P0-0510-0101 (B)  Operator theory
Leader: Dr. Peter Šemrl
Participants: Dr. Tatjana Petek et al.
Financed by: Ministry of Education, Science and Sport of the Republic of Slovenia

This project is devoted to the study of Jordan homomorphisms, spectral properties (invertibility, spectral radius, quasinilpotents) preservers and comutativity preserving maps. We shall research the related problem of characterizing Lie homomorphisms.

P0-0508-0101 (B)  Algebraic methods in operator theory
Leader: Dr. Matjaž Omladič
Participants: Dr. Gorazd Lešnjak et al.
Financed by: Ministry of Education, Science and Sport of the Republic of Slovenia

In this project we plan to study operators defined on real or complex Banach and Hilbert spaces and on Banach lattices as well as linear operators on finite dimensional vector spaces (matrices) over general fields.

Z1-3073-0101-01  Structural and algebraic properties of graph classes
Leader: Dr. Boštjan Brešar
Graph classes defined either by metric properties, by certain elimination procedures, or as subgraphs of product graphs are studied. The main focus is given to the research of structure of these graphs, as well as to the existence of subgraphs that are invariant under automorphisms or related maps.

**Completed research projects 2001**

**Basic research projects**

**J1-7483 (C)**  
New measuring techniques and methods of magnetic resonance  
*Leader:* Dr. Janez Stepišnik  
*Participants:* Dr. Andrej Duh et al.  
*Financed by:* Ministry of Education, Science and Sport of the Republic of Slovenia  
*Duration:* Jan. 1, 1996 to June 30, 2001

Research and development of NMR spectroscopy and image system in Earth's weak magnetic field.

**J1-0498 (B)**  
Graph products and the metric theory of graphs  
*Leader:* Sandi Klavžar  
*Participants:* Bošjan Brešar, Uroš Milutinović  
*Financed by:* Ministry of Education, Science and Sport of the Republic of Slovenia  
*Duration:* July 1, 1998 to June 30, 2001

Study of graph products, their invariants and related problems.

**PUBLICATIONS**


Andrej Duh, Vitodrag Kumperščak, Mirko Pšunder, “Deformations in moderately thick laminated plate loaded on both sides,” *Advances in computational engineering & sciences ICES ’01*, Puerto Vallarta, Mexico, 6 pp.


**PRESENTATIONS BY THE LABORATORY MEMBERS**


Aleš Mohorič, Janez Stepišnik, Andrej Duh, Gorazd Planinšič, Miha Kos, “An earth's magnetic field magnetic resonance imaging apparatus,” a poster at the 16th Waterloo NMR Summer School, University of Waterloo, 2001.

CONGRESSES, MEETINGS, AND COMMITTEES

Asst. Prof. Dr. Tatjana Petek: Referee for Linear Algebra and Applications.

Assoc. Prof. Dr. Gorazd Lešnjak: Referee for Linear and Multilinear Algebra.

VISITS TO OTHER INSTITUTIONS

Assoc. Prof. Dr. Gorazd Lešnjak: Research visit at Department of Mathematics at KLTE, University of Debrecen, Hungary, Nov. 2001.

GUESTS AND VISITORS

Lajos Mólnar: Research visit of Professor from Department of Mathematics at KLTE, University of Debrecen, Hungary, Feb. 2001.
INSTITUTE OF COMPUTER SCIENCE

Head:
Prof. Dr. Viljem Žumer
Phone: ++386 2 220 74 50
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URL: http://www.cs.feri.uni-mb.si/rac/

The Institute of Computer Science has 42 employees, including 3 full professors, 2 associate professors, 4 assistant professors, assistants, researchers, and technical staff. The main activities of the Institute of Computer Science are teaching graduate and postgraduate courses and research work. Research work currently being performed includes the national program group Computer Systems, Methodologies and Cybernetic projects financed by the Ministry of Education, Science and Sport Republic of Slovenia, 4 fundamental research projects, 24 international projects, 3 research and development projects, 12 applied research projects, and 4 industrial projects.

During the past year, the institute has published more than 100 papers, presented a great deal of research work, and in addition, organised meetings, conferences, and visits to other institutions. The main research areas of the institute are: computer graphics, artificial intelligence, computer animation, multimedia, programming languages, computer architecture, medical informatics, software engineering, signal and image processing, and system software.
Members of the institute are divided into six laboratories and seven centres of technology.

### Institute of Computer Science

**Head:** Prof. Dr. Viljem Žumer

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**Computer Graphics and Artificial Intelligence Laboratory**

- **Head:** Prof. Dr. Nikola Guid

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**Computer Architecture and Languages Laboratory**

- **Head:** Prof. Dr. Viljem Žumer

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**System Design Laboratory**

- **Head:** Assoc. Prof. Dr. Peter Kokol

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**System Software Laboratory**

- **Head:** Prof. Dr. Damjan Zazula

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**Heterogeneous Computer Systems Laboratory**

- **Head:** Asst. Prof. Dr. Milan Ojsteršek

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**Geometric Modelling and Multimedia Algorithms Laboratory**

- **Head:** Assoc. Prof. Dr. Borut Žalik
Computer Graphics and Artificial Intelligence Laboratory

Head: Prof. Dr. Nikola Guid

Employees: Simon Kolmanič, MSc; Damjan Strnad, MSc; Bogdan Lipuš; Korno Bozi

Centre for Computer Animation and Multimedia

Head: Prof. Dr. Niko Guid

Computer Architecture and Languages Laboratory

Head: Prof. Dr. Viljem Žumer

Employees: Asst. Prof. Dr. Marjan Mernik; Asst. Prof. Dr. Janez Brest; Mitja Lenič, MSc; Enis Avdičaušević, MSc; Robert Krušec; Damijan Rebernak; Borko Boškovič

Centre for Programming Languages

Head: Prof. Dr. Viljem Žumer

System Design Laboratory

Head: Assoc. Prof. Dr. Peter Kokol

Employees: Dr. Špela Hleb - Babič; Dr. Vili Podgorelec; Dr. Milan Zorman; Matej Šprogar; Mitja Lenič, MSc

Centre for Medical Informatics

Head: Assoc. Prof. Dr. Peter Kokol

System Software Laboratory

Head: Prof. Dr. Damjan Zazula

Employees: Asst. Prof. Dr. Danilo Korže; Dr. Andrej Šoštarič; Dr. Dean Korošec; Dr. Božidar Potočnik; Boris Cigale, MSc; Aleš Holobar; Matjaž Divjak; Jurij Munda

Centre for Interactive Network Applications

Head: Prof. Dr. Damjan Zazula
Centre for Biomedical Signal and Image Processing
Head: Prof. Dr. Damjan Zazula

Heterogeneous Computer Systems Laboratory
Head: Asst. Prof. Dr. Milan Ojsteršek
Employees: Aleksander Kvas, MSc; Uroš Novak, MSc; Zlatko Čajič; Borut Gorenjak; Ervin Schaffranietz; Branko Horvat; Bojan Letnik

Centre for Heterogeneous Processing
Head: Asst. Prof. Dr. Milan Ojsteršek

Laboratory for Geometric Modelling and Multimedia Algorithms
Head: Assoc. Prof. Dr. Borut Žalik
Employees: David Podgorelec, MSc; Matej Gomboši; Sebastian Krivograd; Gregor Klanjšek; Mirko Zadravec

Centre for Geometric Modelling
Head: Assoc. Prof. Dr. Borut Žalik
RESEARCH PROJECTS

Current research projects

**Industrial project**

**SO3DA**

**Seminar on fundamentals of 3D animation**

*Leader:* Prof. Dr. Nikola Guid

*Participants:* Simon Kolmanič, MSc; Korno Bozi

*Financed by:* Institute for support of civil society initiative and multicultural collaboration – Pekarna magdalenske mreže, Maribor, Slovenia

Computer animation has developed into an efficient communication tool, especially useful in the presentation of new products or services. Because of this fact, the Institute for Support of Civil Society initiative and Multicultural Collaboration contacted us to organize a seminar, where their co-workers and others interested in computer animation could hear something about the fundamentals of 3D animation. In addition the aim of the seminar was to prepare the promotional animation of this institute, which will be officially presented in public at the beginning of 2002.

PUBLICATIONS


PRESENTATIONS BY THE LABORATORY MEMBERS


VISITS TO OTHER INSTITUTIONS

RESEARCH PROJECTS

Current research projects

Applied project

L2-3302-0796  Informacijski sistem za projektno vodenje proizvodnje v strojegradnji (Information system for the project oriented production of machinery and working tools)

**Leader:**  Asst. Prof. Dr. Janez Brest  
**Participants:**  Enis Avdičaušević MSc; Robert Krušec  
**Financed by:**  Ministry of Education, Sciece and Sport of the Republic of Slovenia, and Lestro Engineering d.o.o., Maribor, Slovenia

This project oriented production model in the field of woodworking machines is used for rapid production adaptation to market demands. To minimize the development time of the product, it takes the efforts of all participants, who have to be able to contribute to the product's development. Furthermore, the participants are required to manage all the modifications and adaptations. The main goal of this research is the design and implementation of an information system for the development, planning and control of the production process for machinery and working tools.
**Industrial project**

Informacijski sistem za projektno vodenje proizvodnje v strojegradnji (Information system for the project oriented production of machinery and working tools)

*Leader:* Prof. Dr. Viljem Žumer  
*Participants:* Asst. Prof. Dr. Janez Brest, Damijan Rebernak, Borko Boškovič  
*Financed by:* Lestro Ledinek Engineering d.o.o., Maribor, Slovenia

The main objective of this project is the implementation and upgrading of the information system which is currently used in woodwork manufacturing. The project has several phases in which the analyse of currently used information system is studied, after which the organization of database is made, and the information system is implemented. One of the project's aim is studying of the complexity of the production process and its implementation.

**International projects**

Generični, adaptivni in aspektno usmerjeni opis jezika (Generic, Adaptive and Aspect-Oriented Language Definitions)

*Leader:* Prof. Dr. Viljem Žumer, Prof. Dr. Guenter Riedewald  
*Participants:* Asst. Prof. Dr. Marjan Mernik; Mitja Lenič, MSc; Enis Avdičaušević, MSc; Robert Krušec; Dr. Ralf Laemmel; Elke Tetzner; Wolfgang Lohmann  
*Financed by:* Partly the Ministry of Education, Science and Sport of the Republic of Slovenia and German partner

The main objective of this project is to integrate generic, adaptive and aspect-oriented programming with attribute grammars in order to support the practical applicability of attribute grammars in the design and implementation of domain-specific languages (DSL) and other important application areas.

Avtomatsko generiranje programskih orodij iz formalnih specifikacij jezika (Automatic Generation of Language-Based Tools)

*Leader:* Prof. Dr. Viljem Žumer, Assoc. Prof. Dr. Pedro Henriques  
*Participants:* Asst. Prof. Dr. Marjan Mernik; Mitja Lenič, MSc; Enis Avdičaušević, MSc; Robert Krušec; Matej Ćrepinšek; Dr. João Saraiva; Dr. José Ramalho; Maria João Pereira  
*Financed by:* Partly the Ministry of Education, Science and Sport of the Republic of Slovenia and Portugal partner
The main aim of the project is to extend language definitions in such a manner that many other language-based tools can be generated and to automatically generate some of them. One of the language-based tools, which we would like to be automatically generated is an algorithm animator and program visualizer. Currently, algorithm animators and program visualizers are strongly language and algorithm oriented. In this project we would like to show that algorithm animators and program visualizers could also be language independent and automatically generated from extended language definitions.

Completed research projects 2001

International project

Generično in modularno programiranje: FNC2/LISA (Generic and Modular Programming: FNC2/LISA)

Leader: Prof. Dr. Viljem Žumer, Dr. Didier Parigot
Participants: Asst. Prof. Dr. Marjan Mernik; Mitja Lenič, MSc; Enis Avdičauševič, MSc; Robert Krušec; Dr. Gilles Roussel; Remi Forax; Carine Courbis; Pascal Degenne; Alexandre Fau

Financed by: Proteus
Duration: 1999 – 2001

The language design process should be supported by modularity and abstraction in a manner that allows incremental changes as easily as possible. This is one of the strategic directions of further research on programming languages. Since attribute grammars have proved useful in specifying the semantics of programming languages, modularity, reusability, and extensibility should be incorporated into attribute grammars. Object-oriented languages aim at high reusability and extensibility by introducing polymorphism and inheritance concepts. The goal of the project was to incorporate ideas of various programming paradigms into attribute grammars to achieve better reusability, modularity, and extensibility.

PUBLICATIONS


**PRESENTATIONS BY THE LABORATORY MEMBERS**

Marjan Mernik, “DSL and AOP: is there any relation?” invited lecture within the project entitled *Automatic generation of language-based tools*, at the University of Minho, Braga, Portugal, Nov. 29, 2001.

**CONGRESSES, MEETINGS, AND COMMITTEES**

**Asst. Prof. Dr. Marjan Mernik, Prof. Dr. Viljem Žumer:** Organization and mini-track chair and reviewers of “Domain-Specific Languages for Software Engineering”, HICSS-34 Hawaii International Conference on System Sciences, Maui, Hawaii, Jan. 3–6, 2001.

**Asst. Prof. Dr. Marjan Mernik:** ACM SIG APP Annual Business Meeting, Las Vegas, USA, March 12, 2001.

**Asst. Prof. Dr. Marjan Mernik:** Member of LDTA '01Organizing Committee, Programme Committee and reviewer for the 1st Workshop on Language Descriptions, Tools and Applications, Genoa, Italy, April 7, 2001.

**Asst. Prof. Dr. Janez Brest:** Reviewer for ITI '2001, 23rd International Conference Information Technology Interfaces, Pula, Croatia, June 19–22, 2001.
Asst. Prof. Dr. Marjan Mernik: Member of SCI/ISAS 2001 Organizing Committee and reviewer for the 5th world multiconference on systemics, cybernetics and informatics, Orlando, USA, July 22–25, 2001.


Asst. Prof. Dr. Marjan Mernik: Reviewer for Science of Computer Programming.

Asst. Prof. Dr. Marjan Mernik: Guest Editor of Journal of Computing and Information Technology, special issue on “Domain-Specific Languages”.

Asst. Prof. Dr. Marjan Mernik: Reviewer for Journal of Computing and Information Technology.

VISITS TO OTHER INSTITUTIONS


Enis Avdićaušević, MSc: University of Rostock, Germany, Aug. 13–22, 2001.


GUESTS AND VISITORS

Assoc. Prof. Dr. Pedro Henriques, Maria João Pereira (University of Minho, Portugal): Joint research work, Sept. 10–13, 2001.

Prof. Dr. Guenter Riedewald, Wolfgang Lohmann (University of Rostock, Germany): Joint research work, Oct. 15–29, 2001.
SYSTEM DESIGN LABORATORY

Head:
Assoc. Prof. Dr. Peter Kokol
Phone: +386 2 220 74 57
E-mail: kokol@uni-mb.si

RESEARCH PROJECTS

Current research projects

Applied project

ORDIS Statistics and Basics of Research Work

Leader: Assoc. Prof. Dr. Peter Kokol
Participants: Dr. Vili Podgerelec, Dr. Milan Zorman, Br. Špela Hleb Babič, Matej Šprogar

Financed by: Ministry of Education, Science and Sport of the Republic of Slovenia

The Laboratory for System Design organized an educational course for the Ministry for Education, Science and Sport.

Industrial project

SOM Statistical Analysis of Medical Data

Leader: Assoc. Prof. Dr. Peter Kokol
Participants: Dr. Vili Podgerelec, Dr. Milan Zorman, Dr. Špela Hleb Babič, Matej Šprogar

Financed by: General Hospital of Maribor, Health Center Adolf Drolc, Maribor, Slovenia

During various medical research huge medical data bases are created which are difficult to analyse using common statistical methods. Therefore the Laboratory for System Design provides comprehensive complex statistical analysis of such data to medical institutions.
International projects

5th FP EUNITE, ref. No.: IST-2000-29207
European Network on Intelligent Technologies for Smart Adaptive Systems

Local Coordinator: Assoc. Prof. Dr. Peter Kokol
Participants: Dr. Milan Zorman; Mitja Lenič, MSc

The aim of the project is to encourage research in the field of adaptive systems in different areas. Our institution is involved in the design of adaptive intelligent systems in the field of medicine.

5th FP PLANET, ref. No.: IST-2000-29656
Network of Excellence in AI Planning

Local Coordinator: Assoc. Prof. Dr. Peter Kokol
Participants: Dr. Milan Zorman; Mitja Lenič, MSc

The aim of the project is to encourage research in the field of artificial intelligence and planning in different areas. Our institution is involved in the design of hybrid intelligent systems in the field of planning.

5th FP AgentLink II, ref. No.: IST-1999-29003
Continuation of a Network of Excellence for Agent-Based Computing

Local Coordinator: Assoc. Prof. Dr. Peter Kokol
Participants: Dr. Milan Zorman; Mitja Lenič, MSc

The aim of the project is to encourage research in the field of agent technologies. Our institution is involved in the design of intelligent agent systems in the field of medicine.

HEMIS-J
Heterogeneous Medical Intelligent Systems

Leader: Assoc. Prof. Dr. Peter Kokol, Prof. Dr. Ryouchi Yamamoto
Participants: Dr. Špela Hleb Babič, Dr. Vili Pod gorelec, Dr. Milan Zorman, Matej Šprogar
The number and size of medical databases (electronic or manual) is increasing enormously. While providing great help for successful health care process they also contain much “hidden knowledge” not evident without careful and elaborate analysis. This statistical analysis and various computerised tools can be of great help, but often this is insufficient and more unconventional methods like intelligent systems should be performed. To be able to design successful medical intelligent systems (MIS) we must design them with appropriate design paradigms, one of them is MetaMet - a two levelled system design approach. Single methods like neural networks, evolutionary algorithms, decision trees and similar are quite successful in intelligence, they also have many weaknesses that can be solved by a combination of their uses – hybrid approach and the employment of the theory of chaos and complexity. Medical databases are normally distributed over several computers, institutions or even countries normally using different operating systems or protocols. In this way a heterogeneous approach has to be used. The additional advantage of heterogeneous computing is enlarged computational power that can be used to effectively execute the resource-consuming algorithms presented above.

**ISCooMAA**

**Intelligent Systems Construction by Multiple Autonomous Agents**

**Co-ordinators:** Assoc. Prof. Dr. Peter Kokol, Prof. Dr. Lenka Lhotska

**Participants:** Dr. Milan Zorman; Dr. Vili Podgorelec; Mitja Lenič, MSc; Matej Šprogar

**Project partners:** Czech Technical University of Prague

**Financed by:** Ministry of Education, Science and Sport of the Republic of Slovenia

In order to design successful intelligent systems to be used in medical applications, we must design them with an appropriate design methodology. Therein lies another weakness—very few, if any, such methods exist in the world. Therefore the goals of our research are:

- to develop successful design methods
- to use these methods in designing real-world agent based intelligent medical systems.

**SQUAB-M**

**Physical Based Software Complexity Metrics**

**Leaders:** Assoc. Prof. Dr. Peter Kokol, Prof. Dr. Miklos Biro

**Participants:** Dr. Vili Podgorelec; Dr. Milan Zorman; Mitja Lenič, MSc; Matej Šprogar

**Project partners:** Computer and Automation Institute Hungarian Academy of Sciences, Budapest, Hungary
Reliability is one of the key issues in assuring the quality of software in complex systems. It is very important to economically and consistently assure the appropriate level of software reliability, because more and more activities and systems rely on software. One of the ways to assure software reliability is to use software complexity metrics. The development of software is a complex and complicated process, where we unintentionally make errors in the code. It has been proven that the pattern of making unintentional errors in code is related to measurable quantities of the code, especially those measured with software complexity metrics. For instance, large systems are made of different modules, where each module can be described by its attribute values. It could be very appropriate to predict the number of errors in the code, using these attribute values.

Both of our projects deal with researching the use of fractal software complexity metrics in predicting and evaluating the characteristics of software.

Within the project we will study the simulation of hospital management. The basis of the simulation will be a data base containing data of administration, sources, schedules, employees, etc. Second part of the project represents a system for diagnosing Alzheimer disease based on the analysis of EEG signals. This analysis will be performed with the use of the symbolic description of EEG signal, soft automata, statistical analysis, and neural networks.
Intelligent Vaccination Support Systems

Co-ordinators: Assoc. Prof. Dr. Peter Kokol, Prof. Dr. Yves le Normand
Participants: Dr. Milan Zorman; Dr. Vili Podgorelec Mitja Lenič, MSc; Matej Šprogar
Project partners: University of Nantes, France
Financed by: Ministry of Education, Science and Sport of the Republic of Slovenia, PROTEUS

The aim of this project is the design of intelligent systems for the support of vaccination prior to travelling to high-risk countries.

Completed research projects 2001

Basic research project

INCOMPETENT Intelligent Computer Support for MetaMet
J2-0514-0796-98
Leader: Assoc. Prof. Dr. Peter Kokol
Participants: Dr. Vili Podgorelec, Dr. Milan Zorman, Dr. Špela Hleb Babič
Financed by: Ministry of Education, Science and Sport of the Republic of Slovenia
Duration: 1999 – 2001

Method Engineering is a recent development in software design that appears promising. Method Engineering is based on the emerging view that software design processes need to be engineered to fulfil the requirements of a design situation. The aim of the proposed project was to combine Method Engineering with MetaMet and to develop intelligent computerised support for their successful use. The tools developed were based on evolutionary programming, automated learning, and decision trees.

Applied projects

INSIST Intelligent Systems in Medicine: The Case of Breast Feeding
J2-1640-0796-99
Leader: Assoc. Prof. Dr. Peter Kokol
Participants: Dr. Špela Hleb Babič, Dr. Milan Zorman, Dr. Vili Podgorelec
Project partners: Healthcare Centre Adolf Drolc Maribor, UNICEF, INFONET Kranj, Slovenia
The aim of this project was to research the development and applications of hybrid intelligent systems in medicine. Our main focus was on decision trees, neural networks, and evolutionary programming. All approaches were tested using the subject of breastfeeding, as one of the main goals of the project was to heighten awareness about extending the length of time mothers breastfeed their children. To collect data for the project, we published a Breast feeding booklet.

**KALIMO**

**Leader:** Assoc. Prof. Dr. Peter Kokol  
**Participants:** Dr. Vili Podgorelec, Dr. Milan Zorman, Dr. Špela Hleb Babič, Matej Šprogar

**Financed by:** Ministry for Education, Science and Sport of the Republic of Slovenia  
**Duration:** 2001

Conceptual networks are frequently and successfully used in educational processes. In the framework of this project we developed a software package that supports the creation and use of conceptual networks.

**INSIST-Z**

**Leader:** Assoc. Prof. Dr. Peter Kokol, Boris Topolovec  
**Participants:** Dr. Vili Podgorelec, Dr. Milan Zorman, Dr. Špela Hleb Babič, Matej Šprogar

**Project partner:** Top Foto

**Financed by:** Ministry of Health of the Republic of Slovenia  
**Duration:** 2001

The project advertised natural breast-feeding through a breast-feeding booklet and web site.

**International projects**

**Tempus Phare ODIN**  
**AC_JEP-14045-1999**

**Co-ordinator:** Assoc. Prof. Dr. Peter Kokol  
**Participants:** Dr. Milan Zorman, Dr. Vili Podgorelec, Dr. Špela Hleb Babič, Matej Šprogar

**On-Demand Intranet For Nursing Education**
The goal of this project was to enable improved health care for all at a cost lower than current EU standards. Our research resulted in more effective and efficient health care processes, which in turn was a consequence of better-educated nurses. Better education of nurses can be achieved through regular and continuing education supported by a computerised knowledge network (i.e. ODIN Intranet) respecting EU regulations and directives, "health enterprises" and governmental needs, and state-of-the-art nursing care.

**INMES**  
**Intelligent Medical Systems**

*Co-ordinators:* Assoc. Prof. Dr. Peter Kokol, Prof. Dr. Lenka Lhotska  
*Participants:* Assoc. Prof. Dr. Tatjana Welzer Družovec, Dr. Milan Zorman, Dr. Vili Podgorelec, Dr. Špela Hleb Babič, Matej Šprogar  
*Project partners:* Czech Technical University of Prague  
*Financed by:* Ministry of Education, Science and Sport of the Republic of Slovenia  
*Duration:* 1999 – 2001

In order to design successful intelligent systems for use in medical applications, we must design them with an appropriate design methodology. Therein lies another weakness—very few, if any, such methods exist in the world. Therefore the goals of our research were:

- to develop successful design methods
- to use these methods in designing real-world intelligent medical systems that are also based on hybrid approaches
- to use these systems in a manner that "invents" new medical knowledge in selected medical fields.

**HEMIS-N**  
**Heterogeneous Medical Intelligent Systems on the Internet**

*Leader:* Assoc. Prof. Dr. Peter Kokol, Prof. Dr. Christian Ohmann  
*Participants:* Dr. Milan Zorman, Dr. Vili Podgorelec, Dr. Špela Hleb Babič  
*Project partners:* Heinrich Heine University Duesseldorf, Department of General Trauma and Trauma Surgery, Germany  
*Financed by:* Ministry of Education, Science and Sport of the Republic of Slovenia  
*Duration:* 1999 – 2001
One of the problems of medical data analysis is that the data is distributed in different
departments, institutions, or even countries on different computers with different operating
systems. This was the reason why we used heterogeneous computing through the WWW. An
additional advantage of the heterogeneous approach is in an increase in computational
power, which can be very helpful in cases of complicated analyses.

SQUAB-I  
New Software Complexity Metrics for Real World Applications

Leaders:  
Assoc. Prof. Dr. Peter Kokol, Dr. Maurizio Pighin

Participants:  
Dr. Vili Podgorelec, Dr. Milan Zorman, Dr. Špela Hleb Babič, Matej Šprogar

Project partners:  
Matematica e Informatica, Universita di Udine, Italy

Financed by:  
Ministry of Education, Science and Sport of the Republic of Slovenia

Duration:  
1998 – 2001

SQUAB-A  
Physical Based Software Complexity Metrics

Leader:  
Assoc. Prof. Dr. Peter Kokol, Rich DeLoch

Participants:  
Dr. Vili Podgorelec, Dr. Milan Zorman, Dr. Špela Hleb Babič

Project partners:  
General Electric, Erie, USA

Financed by:  
Ministry of Education, Science and Sport of the Republic of Slovenia

Duration:  
1999 – 2001

Reliability is one of the key issues in assuring the quality of software in complex systems. It is
very important to economically and consistently assure the appropriate level of software
reliability, because more and more activities and systems rely on software. One of the ways to
assure software reliability is to use software complexity metrics. The development of software
is a complex and complicated process, where we unintentionally make errors in the code. It
has been proven that the pattern of making unintentional errors in code is related to
measurable quantities of the code, especially those measured with software complexity
metrics. For instance, large systems are made of different modules, where each module can
be described by its attribute values. It could be very appropriate to predict the number of
errors in the code, using these attribute values.

Both of our projects dealt with researching the use of fractal software complexity metrics in
predicting and evaluating the characteristics of software.

EVOBADEN  
Evolutionary Based Construction Of Decision Network

Leader:  
Assoc. Prof. Dr. Peter Kokol, Prof. Ole Hejlesen

Participants:  
Dr. Vili Podgorelec, Dr. Milan Zorman, Dr. Špela Hleb Babič, Matej Šprogar
The aim of this project was to enhance knowledge extraction from medical databases and thus firstly support more effective decision-making of medical personnel and secondly gain new medical knowledge. A new knowledge extraction/data-mining paradigm has been designed and tried out on real world medical examples (data warehouses). A software environment has been built to try out various learning and evolution approaches, automatic programming techniques and different fitness functions.

**PUBLICATIONS**


Vili Podgorelec, Peter Kokol, “Evolutionary decision forests - decision making with multiple evolutionary constructed decision trees,” *Problems in applied mathematics and computational intelligence (Mathematics and computers in science and engineering)*, pp. 97-103.


**PRESENTATIONS BY THE LABORATORY MEMBERS**


Milan Zorman, Alojz Tapajner, ”Miselni vzorci,” a talk at *Festival vzgoje in izobraževanja*, Celje, Slovenia, April 12, 2001.
Milan Zorman, "Umetne nevronske mreže in njihova uporaba na primeru afazije," a talk at the Medical Centre of Ljubljana, Slovenia, May 9, 2001.

Milan Zorman, "Umetne nevronske mreže," a talk at the Faculty of Humanities, Ljubljana, Slovenia, May 11, 2001.


Matej Šprogar, "Vector Based Medical Intelligent Systems," lecture at the Heinrich Heine University Duesseldorf, Department of General and Trauma Surgery, Duesseldorf, Germany, June 22, 2001.

Peter Kokol, Milan Zorman, "Inteligentni medicinski sistemi," a talk at the seminar entitled Informatika v zdravstvu, within INFOS '01, Ljubljana, Slovenia, Oct. 25, 2001.


Milan Zorman, "Hybrud Intelligent Systems," a talk at the occasion of the visit to Japan supported by the JSPS grant, Kyushu University, Fukuoka, Japan, Dec. 19, 2001.

CONGRESSES, MEETINGS, AND COMMITTEES


Assoc. Prof. Dr. Peter Kokol, Dr. Vili Podgorelec: Organization of invited session on conference ISC 2001, Orlando, USA, July 2001.

Assoc. Prof. Dr. Peter Kokol, Dr. Milan Zorman: Organisation of the ODIN project meeting, Maribor, Slovenia, Sept. 2001.


Editor-in-chief, Informatica Medica Slovenica.

Editor, IEEE Computational Medicine Newsletter.

President of consulting committee IEEE Working Group on Computational Medicine.

Member of steering committee of the Slovene society for medical informatics (SDMI).

Program committee of magazine Organizacija.

Member of working group IMIA-WG on Nursing Informatics.

Member of working group EFMI-WG on Nursing Informatics.

Reviewer for IEEE Software.

Reviewer for IEEE Computer.
Assoc. Prof. Dr. Peter Kokol: Editorial board of Virtual Medical World Magazine.

Assoc. Prof. Dr. Peter Kokol, Dr. Špela Hleb Babič: Editor of the special issue of International Journal of Medical Informatics.

Assoc. Prof. Dr. Peter Kokol, Dr. Vili Podgorelec: Editor of the special issue of Journal of Medical Systems.

VISITS TO OTHER INSTITUTIONS


Assoc. Prof. Dr. Peter Kokol, Matej Šprogar: EU Meeting on Telecommunications, Prague, Czech Republic, March 19–20, 2001.

Assoc. Prof. Dr. Peter Kokol, Dr. Vili Podgorelec: Visit in the framework of bilateral project, Udine, Italy, March 5–9, 2001.

Assoc. Prof. Dr. Peter Kokol, Dr. Vili Podgorelec: Project co-operation with General Electric, Chicago, USA, April 5–11, 2001.

Assoc. Prof. Dr. Peter Kokol: Visit in the framework of Soctares/Erasmus programme, University of La Laguna, Spain, May 12–15, 2001.

Assoc. Prof. Dr. Peter Kokol, Dr. Vili Podgorelec: Visit in the framework of bilateral project, Czech Technical University of Prague, Czech Republic, June 2–5, 2001.

Matej Šprogar: Project HEMIS-N with the University of Duesseldorf, Germany, June 21–26, 2001.

Assoc. Prof. Dr. Peter Kokol: Projekt HEMIS-N with the University of Duesseldorf, Germany, June 23–25, 2001.

Assoc. Prof. Dr. Peter Kokol: Project collaboration with General Electric, San Francisco, USA, June 28 to July 2, 2001.

Assoc. Prof. Dr. Peter Kokol: Visit in the framework of bilateral project, University of Madeira, Portugal, July 10–19, 2001.

Assoc. Prof. Dr. Peter Kokol: Visit in the framework of the Soctares/Erasmus programme, University of Madeira, Portugal, Nov. 12–16, 2001.


Mitja Lenič, MSc, Matej Šprogar: Project HEMIS-J at the Osaka Medical College, Japan, Dec. 8–14, 2001.

Assoc. Prof. Dr. Peter Kokol: Project HEMIS-J at the Osaka Medical College, Japan, Dec. 8–16, 2001.

Dr. Milan Zorman: The JSPS grant at the Osaka Medical College, Osaka, Japan, Nov. 8–18 and Dec. 21, 2001.

Dr. Milan Zorman: The JSPS grant and visit to the Kyushu University, Fukuoka, Japan, Dec. 19–20, 2001.

GUESTS AND VISITORS


Umberto Giani (University of Naples, Italy), Paula Procter, Linda Nicklin (University of Sheffield, Great Britain): TEMPUS ODIN project members meeting, Sept. 2001.

SYSTEM SOFTWARE LABORATORY

Head:
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RESEARCH PROJECTS

Current research projects

Basic research project

**J3-2085-0334-01** Characteristic of the Dominant Follicle in Unstimulated Cycles

*Leader:* Prof. Dr. Veljko Vlaisavljević (Teaching Hospital of Maribor)

*Participants:* Prof. Dr. Damjan Zazula, Dr. Dean Korošec, Dr. Božidar Potočnik, Jurij Munda, Nicolas Sergent (Ecole Centrale de Nantes, France)

*Financed by:* Ministry of Education, Science and Sport of the Republic of Slovenia

This project was accepted in 2000 for a duration of two and half years. Our contribution to the project consists in developing and implementing a computer program for the interpretation of ovarian B-ultrasound and Doppler images. The problem is very complex, owing to the high demands for automated object recognition in extra noisy environments.

In the first project year, we built a prototype for the automated follicle recognition computer-assisted estimation of blood quantity around a dominant follicle. In 2001, this application was further improved, we increased its robustness and flexibility under various calibration conditions encountered in the ultrasound recordings. More than 100 ultrasound examinations were analysed. Several patients were examined during a few consecutive days of their ovulation cycles. The outcomes are medically significant, especially because they mean a step further in selecting the right dominant follicle to ovulate.
International projects

CoLoS Conceptual Learning of Science
(American-European project)

Leader: Prof. Dr. Damjan Zazula
Participants: Asst. Prof. Dr. Danilo Korže, Dr. Dean Korošec, Dr. Božidar Potočnik, Matjaž Divjak, Aleš Holobar, Jurij Munda

Financed by: This project does not have permanent financial support

This is a permanent project, aiming to develop and construct software tools that would enhance comprehension of basic scientific fields (for example physics, chemistry, or computer science). Special emphasis has been placed on an intuitive approach and computer-assisted learning. In 2001, the System Software Laboratory staff focused on an upgrading of the teaching applets which were written by the students in previous years. However, the students additionally implemented a simple teaching simulator of communications in the computer networks. We have also improved several details of the virtual delivery room training tools and the virtual baby. Our previous year achievements were presented at the regular CoLoS meeting held at Alcazares near Murcia, Spain, in September 2001.

AREVIDERO Assessment and Revision of Virtual Delivery Room

Leader: Prof. Dr. Damjan Zazula
Participants: Dr. Dean Korošec, Matjaž Divjak, Aleš Holobar

Financed by: Ministry of Education, Science and Sport of the Republic of Slovenia

AREVIDERO project extends the work of VIDER (Virtual Delivery Room) project whose main goal was to create a virtual environment in which a group of medical students or even doctors could perform virtual neonatal resuscitation. The AREVIDERO project concentrates on validation and verification of the VIDER’s program code, improvement and extension of a newborn’s life signs, and practical evaluation of the virtual training environment in educational processes of neonatal medicine.

During last year we designed graphical simulation of the newborn’s peripheral cyanosis, implemented the newborn’s facial mimics, and graphically represented different student actions, such as applying blow-by-oxygen and chest compression. We accelerated the program module for motion tracking and improved robustness of navigation in the virtual world. In collaboration with the Hermes Softlab software company we extended Virtual Delivery Room with the speech recognition and synthesis which enables interactive voice control of the newborn’s life signs. The user is now able to navigate freely through the virtual room while verbally communicating with the life signs control system, i.e. applying some
action or retrieving the life sign values. Furthermore, we developed a model for control of the newborn’s life signs by a single variable and implemented a program tool for its validation. In physiological terms, this single control variable can be approximately related to the oxygen level in the blood. We also implemented a stand-alone program for tuning and validation of this model – VIDERO Simulator and Animator. Introduction of this approach seems necessary for the purpose of supervised training. The mechanism is now under evaluation and has not yet been built into the current version of VIDERO. All other improvements were successfully installed at Stanford University, School of Medicine in Palo Alto, USA, where their medical students will test them.

**NEW**  
Neuromuscular Assessment in the Elderly Worker

*Leader:* Prof. Dr. Damjan Zazula  
*Participants:* Dr. Dean Korošec, Aleš Holobar  
*Financed by:* The 5th Framework Programme of EU

As people age their neuromuscular system deteriorates causing pain, slowing of responses, reduced working ability. There is a need to monitor this phenomenon in order to prevent it and reduce its consequences by providing greater protection to the most vulnerable individuals. The NEW project focuses on the non-invasive assessment of muscle properties through the information extracted from the electrical (surface EMG) and mechanical (MMG) signals generated by muscle contractions.

Our laboratory is responsible for extraction of information from the raw signals detected on the muscles, specifically for the decomposition of surface EMG signals. In last year we developed the decomposition techniques that are based on the optimisation of non-linear system of equations using higher-order statistics. A lot of attention was paid to the properties of the excitation pulse trains in the theoretical surface EMG model. We also developed and tested the procedures for blind source separation and deconvolution of pulsed sources by utilizing the known approach of joint diagonalization of spatial time-frequency distribution matrices of the observed signals.

**Completed research projects 2001**

**International project**

**DETECH**  
Development of the Department for Technology-Supported Distance Education  
(Participation in Tempus Phare project)

*Leader:* Asst. Prof. Dr. Matjaž Debevc  
*Participant:* Dr. Dean Korošec
The main goal of the DETECH project has been the development of the Department for Technology-Supported Distance Education within the Centre for Distance Education Development at the University of Maribor. Its offers operational and technological service as well as consultation in the field of open and distance learning. The department has now grown to become a part of the Institute for New Media and Distance Education Technologies at the University of Maribor.

Members of the System Software Laboratory participated in this project by (a) offering expertise in the field of software supported conceptual learning, (b) setting up of the technological services of the Centre for Distance Education Development and (c) organising project meetings.

PUBLICATIONS


Matjaž Debevc, Dean Korošec, “The role of the department for technology supported distance education in Slovenian school environment,” The future of learning - learning for the future: shaping the transition, Hagen, 6 pp.


Dean Korošec, Damjan Zazula, Matjaž Debevc, “Tools and toys for learning with the Web - examples from electrical engineering, computer engineering and medicine,” Internet based education, Bratislava, Slovakia, 1 pp.


PRESENTATIONS BY THE LABORATORY MEMBERS


Damjan Zazula, “Presentation of the system software laboratory team, University of Maribor, Slovenia,” presentation at the 1st NEW meeting, Torino, Italy, March 31 till April 1, 2001.

Božidar Potočnik, “Avtomatska analiza zaporedij ultrazvočnih slik jajčnikov: razpoznavanje objektov iz zaporedja slik s postopki predikacije,” lecture at the SDRV seminar, Faculty of Electrical Engineering, Ljubljana, Slovenia, April 11, 2001.


Dean Korošec, “Streaming technology - introduction and concept,” invited lecture at the University of Oulu, Faculty of Education, Finland, Sept. 2001.


CONGRESSES, MEETINGS, AND COMMITTEES

Dr. Dean Korošec: Projekt TEMPUS DETECH: TELAB, Institute of Computer Technology, Faculty of Electrical Engineering, University of Technology, Vienna, Austria, Feb. 7–10, 2001.
Dr. Dean Korošec: Meeting organisation and leading of the Tempus DETECH group, Maribor, Slovenia, Feb. 22–24, 2001.

Dr. Dean Korošec: Centre for Distance Education Development, Fernuniversität Hagen, Germany, March 26 to Apr. 4, 2001.


Prof. Dr. Damjan Zazula, Dr. Dean Korošec: Arrangement and presentation of the Virtual Delivery Room prototype at the Stockholm Challenge Award exhibition; Stockholm, Sweden, Sept. 22–27, 2001.

Dr. Dean Korošec: Research Unit for Educational Technology, Faculty of Education, Oulu, Finland, Sept. 27–29, 2001.

Boris Cigale, MSc, Jurij Munda, Dr. Božidar Potočnik, Asst. Prof. Dr. Danilo Korže, Dr. Dean Korošec: Arrangement and putting-up of the exhibition area for the Faculty of EE and CS (FERI) of Maribor at the INFOS 2001 exhibition. The Virtual Delivery Room prototype was exhibited too, while its speech-controlled version was developed and presented together with Hermes Softlab; Ljubljana, Slovenia, Oct. 21–25, 2001.

Prof. Dr. Damjan Zazula: Reviewer for Elsevier Signal Processing.

Prof. Dr. Damjan Zazula: Reviewer for IEEE Transactions on Biomedical Engineering.

VISITS TO OTHER INSTITUTIONS

Aleš Holobar: A visit to the LiSIN lab in the framework of the NEW
Prof. Dr. Damjan Zazula, Dr. Dean Korošec: Visit to the Stockholm Children Hospital, getting acquainted with their approach to the training of medical students in neonatal resuscitation and exchange of information with the Swedish training co-ordinator Prof. Dr. Anders Dahlström about the importance of virtual computer environments for the medical training; Stockholm, Sweden, Sept. 26, 2001.


Prof. Dr. Damjan Zazula: A visit to the Institut de Recherche en Communication et Cybernetique de Nantes (IRCCyN); collaboration in the framework of the NEW project, Nantes, France, Oct. 14–19, 2001.

GUESTS AND VISITORS


Prof. Dr. Zvonko Fazarinc (HP Labs, Palo Alto, USA): Research work in conjunction with the AREVIDERO project, Dec. 2001.

DECORATIONS, AWARDS, AND HONOURS


System Software Laboratory, The Faculty Award for participation in the EU Fifth Framework Programme. Honoured at the celebration of the Day of the Faculty of Electrical Engineering and Computer Science, Maribor, Slovenia, Nov. 27, 2001.

Matjaž Divjak, Aleš Holobar, Iztok Prelog, The Faculty Award for research achievements. Honoured at the celebration of the Day of the Faculty of Electrical Engineering and Computer Science, Maribor, Slovenia, Nov. 27, 2001.
HETEROGENEOUS COMPUTER SYSTEMS LABORATORY

Head:
Asst. Prof. Dr. Milan Ojsteršek
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RESEARCH PROJECTS

Current research projects

Basic research project

Ogrodje za avtomatsko persistenco objektov v relacijski podatkovni bazi (Framework for Automatic Object Persistence in Relational Database)

Leader: Asst. Prof. Dr. Milan Ojsteršek
Participants: Zlatko Čajič, Borut Gorenjak, Bojan Letnik, Ervin Schaffranietz, Branko Horvat

Financed by: internal funding

Most modern distributed enterprise systems have been developed using an object oriented programming language and a relational database to store data. This kind of set-up causes considerable development problems because of impedance mismatch between objects and relational calculus. For this reason some sort of object to relational mapping is needed. The solution is a special framework for automatic object persistence in the relational database. In order to achieve automatic mapping, a framework-mapping scheme has to be defined in such a way that takes into account ease of use and performance issues. The framework-mapping scheme defines how an object is represented and stored in the relational database, and it should facilitate full object oriented properties like inheritance, polymorphism, objects’ aggregations and associations. The model describes mappings between objects and relational database based on the framework-mapping scheme. The model is composed in a modelling tool, which provides several other key functions that add the possibility of round-trip engineering design evolution. We have developed an Experimental XSLT processor for objects (EXPO), which perform mapping between object models and XML documents based on XSLT stylesheets.
Applied projects

Maribor – town of knowledge

Leader: Asst. Prof. Dr. Milan Ojsteršek
Participants: B. Gorenjak, U. Novak
Financed by: Municipality of Maribor, Slovenia

Software, realized within the project, makes it possible to present educational opportunities in the Maribor and Drava region on the Internet. This offer includes the possibilities for education, offered to members of the community by different companies, outside regular education. Data on educational opportunities is entered by interested organizations themselves by means of special software. Web application enables printout of data on educational activities (sorted by types of programme, by performers, by months, when educational activities are performed), search on educational activities (criteria is title, place, type of programme, date, performer, location) and search on performer (criteria is title and place). Data on educational activities, offered by others, can be downloaded to the computer of any person who is entering the data.

Izdelava strateškega plana informatizacije mestne uprave Mestne občine Maribor

Leader: Asst. Prof. Dr. Milan Ojsteršek
Participants: Branko Horvat
Financed by: Municipality of Maribor

Our goal is to create a strategic information technology plan for the Municipality of Maribor. This plan will use current state of the municipality’s IT development to further activities by introducing electronic commerce and to devise a plan of software development in the future.

Research and development projects

Informacijski sistem za predstavitev mest na elektronskih medijih (Information Systems for City Representations on Electronic Media)

Leader: Asst. Prof. Dr. Milan Ojsteršek
Participants: A. Kvas, Z. Čajić, B. Letnik, B. Gorenjak, B. Šorgo, E. Schaffranietz
Financed by: Municipality of Maribor, Municipality of Koper, Municipality of Sežana, Municipality of Radovljica, Municipality of Oplotnica, Municipality of Kungota, Slovenia
We have created the framework for building Web-based information systems. This framework is based on a set of rules that define a general data storage model independent of the underlying database management system. A set of high-level data types, customised and optimised for use in the World Wide Web (WWW) environment, has been defined for the general data storage model. The benefits of using this framework are independent design and content management, multilingual support, independence from the database management system, and automatic support for multimedia information. Current implementation of the framework is based on RDB. This framework has been used to develop city information systems for the cities of Maribor and Ljubljana. The information is collected from organisations, companies, users of the information system, and other Internet and database servers. The information is currently used for presentation on the Internet, on infoterminals, on cable TV, and on teletext. In year 2001 we have built portals of municipalities of Koper, Sežana, Radovljica, Oplotnica and Kungota.

Portal “Sraka.com”

**Leader:** Asst. Prof. Dr. Milan Ojišček

**Participants:** A. Kvas, Z. Čajič, B. Letnik, B. Gorenjak, B. Šorgo, E. Schaffranietz, B. Horvat

**Financed by:** University of Maribor, Nova Kreditna banka Maribor, Ministry of Information Technology of the Republic of Slovenia

Information portal simplifies the creation, integration and management of information contents and by that increases the usability and efficiency of the stored data so that users spend less time on searches and more on information use and analysis. Also this simplifies
administration and user management.

Basic features are:

- Document management
- Search facility
- Integration of our internal services with external information systems
- Cross referencing of data and services
- Information categorization
- Independency of data to different user interfaces and electronic media
- Multi language support
- Authorization of access to data and services
- Content and user interface personalization.

We have developed our own authentication system and integrated it with the portal this year. The authentication service is based on a LDAP directory service to store user information, access control lists and permissions. The system has been used as a portal at University of Maribor, at Faculty of Electrical Engineering and Computer Science, at ELISA ( Electronic Information Service of the Rector’s Conference of Alps-Adriatic Universities ), at Nova KBM bank as an internal portal.

Completed research projects 2001

Applied projects

Prenova akademskega podsistema informacijskega sistema Univerze v Mariboru (Modernisation of the Academic Information System at the University of Maribor)

Leader: Asst. Prof. Dr. Milan Ojsteršek
Participants: E. Schaffranietz, B, Horvat
Financed by: University of Maribor, Slovenia
Duration: 1999 – 2001

The University of Maribor began modernising its information systems in 1999. Our staff have been responsible for the requirements analysis of the academic system. The most important function of the system is to secure the continuous operation of the educational process, where the main emphasis is on accurate and up-to-date storage of students’ registration and examinations. The academic system must offer efficient service to university administration staff, students, faculty, Ministry of Education, National Statistics Bureau and others who need information from the students’ registration database (Student Housing Services, Employment Bureau). In addition, the system must support easy integration with international student
exchange schemes, tracking of educational process quality and the presentation of the university’s programs and classes on various electronic media.

Računalniška podpora kontroli ekološkega kmetovanja (Computer-Aided Controlling of Ecological Farming.)

Leader: Asst. Prof. Dr. Milan Ojsteršek
Participants: E. Schaffranietz, A. Bregant, U. Novak, Z. Čajič

Financed by: Kmetijski zavod Maribor and PHARE
Duration: 2000 – 2001

Farmers, who want to trade their crops, products or meat as ecological products, have to breed, grow or produce them in a way that meets strict ecological criteria. On a farm inspection a qualified controller can determine whether the inspected farm meets all required criteria. Without a good computer-aided support all needed data is uncontrollable and non-transparent. At this current stage we produced a distributed application that supports printing, statistical reports and data manipulation of data needed at ecological farming, like the data of potential clients, farmers and their farms, their animals, cultures and products; contacts with farmers, employees, controllers and their knowledge on different areas of farm inspection and ecological farming.

PUBLICATIONS


VISITS TO OTHER INSTITUTIONS

Asst. Prof. Dr. Milan Ojsteršek: Technical University of Munich (Germany).
**GEOMETRIC MODELLING AND MULTIMEDIA ALGORITHMS LABORATORY**

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**RESEARCH PROJECTS**

**Current research projects**

**International project**

**Valvazor/ALIS**

**ALIS 63**

Application of Computational Geometry in Visualisation of Medical Data

**Co-ordinators:** Assoc. Prof. Dr. Borut Žalik, Prof. Dr. Gordon Clapworthy

**Participants:** David Podgorelec, MSc; Matej Gomboši

**Project partner:** De Montfort University, Kents Hill, United Kingdom

**Financed by:** Ministry of Science and Technology of the Republic of Slovenia, British Council Slovenia

Visualisation of medical data deals with a huge amount of data obtained from different medical devices. This data has normally been presented to radiologists as two-dimensional “slices”. Nowadays, the data contained in the slices are frequently synthesised with the aid of computer graphics, so that the anatomical structures can be displayed in three-dimensional form. This use of computer graphics enables the three-dimensional relationships between various organs and their pathologies to be displayed, providing much greater awareness of the spatial features of the organs displayed. Developed in computational geometry is also needed besides the algorithms from computer graphic techniques. For example, Voronoi diagrams can be used to locate rapidly the nearest healthy cells when regarding those cells infected by some illness. It is anticipated that the expertise of the Slovene group in geometric modelling will enable even more economical algorithms to be developed to enhance the current work of the UK group. In return, the Slovene group will gain expertise in medical visualisation and will instigate work in this area, which currently, is not widely undertaken in Slovenia. This project will be concluded in 2002.
Completed research projects 2001

**Basic research project**

**2811-01-00042** Visualisation of huge 3D data sets via internet

*Leader:* Assoc. Prof. Dr. Borut Žalik  
*Participants:* David Podgorelec, MSc; Matej Gomboši; Sebastian Krivograd  
*Financed by:* Ministry of Information Society of the Republic of Slovenia  
*Duration:* Sept. 14, 2001 to Dec. 31, 2001

The goal of the project was to develop a solution for a system able to transmit over the internet and visualise a huge amount of geometric data for making flying over in real time. Today’s communication canals do not allow transmission of a large data set in a real time, and besides this, visualisation of such amount of data can cause additional problems. The proposed solution consists of three steps: data preparation (presenting data with a triangular mesh, mesh decimation, data division into several resolution models, compression of these models), data transmission from a server to a client, and receiving the data on the client’s side and their visualisation. It was proved right that relatively low throughput of the communication canal in the presented solution already enables transmission and visualisation of huge geometric data sets in real time.

**Research and development project**

**2511-01-310004** A model for offering data for Surveying Authority of Republic Slovenia and a plan for its implementation

*Leader:* Assoc. Prof. Dr. Borut Žalik  
*Participants:* David Podgorelec, MSc; Matej Gomboši; Sebastian Krivograd  
*Project partners:* IGEA d.o.o., Aster d.o.o., Slovenia  
*Financed by:* Surveying and Mapping Authority of the Republic of Slovenia  
*Duration:* October 2001 to December 2001

In the project, parameters affecting electronic offering of data of Surveying and Mapping Authority of the Republic of Slovenia are analysed in detail first. Analysis considers spatial data and their use. After this, the model of system is proposed. In co-operation with other government institutions, this system will enable complete offering of the spatial data of Surveying and Mapping Authority of the Republic of Slovenia. We also propose organisation and team structure necessary to realise the system. At the end, we analyse particular steps of the system realisation. These steps are evaluated according to priority, time and price.
**Industrial project**

**Difference termination between two sets of topologically congruent polygons**

**Leader:** Assoc. Prof. Dr. Borut Žalik  
**Participants:** Matej Gomboši  
**Financed by:** IGEA d.o.o., Slovenia  
**Duration:** November 2000 to May 2001

The goal of this project was the automation of control and evidence changes in a digital land register. The data in land registers need to be frequently updated because some parcels of land could be sold or divided up between several inheritors, or simply because of a previous wrong input. Parcels are represented by a set of polygons. Changes are analysed inside a selected area. It can be small consisting of some ten parcels, or the whole city containing thousands of parcels. Newly measured parcels should be compared by an existing version in a land register. We have developed a new comparison algorithm, which successfully detects and analyses various changes. This program enables evidence of the changes besides updating the land register. In this way, a change can be tracked through a selected time period. The application is implemented in MS Visual C++ in Windows environment. The data are stored in Dbase3 files.

Example of the input set of polygons: the town of Piran.
International project

Alg Vis Algorithms for Computer Graphics, Computational Geometry and Visualisation in Parallel and Distributed Processing

Co-ordinators: Assoc. Prof. Dr. Borut Žalik, Prof. Dr. Václav Skala
Participants: Prof. Dr. Nikola Guid; Simon Kolmanič, MSc; David Podgorelec, MSc; Damjan Štrnad, MSc; Matej Gomboši; Sebastian Krivograd

Project partner: University of West Bohemia, Plzen, Czech Republic

Financed by: Ministry of Science and Technology of the Republic of Slovenia, Government of Czech Republic

Duration: April 1999 to March 2001

The main goals of the joint work were: to set up international bilateral co-operation in the field of computational geometry, computer graphics and data visualisation algorithms, especially in the Internet environment, to present results of the common research at international conferences, workshops and in recognised scientific journals, to develop new algorithms in the fields referred by the project, and to prepare common international project proposals.

PUBLICATIONS


**PRESENTATIONS BY THE LABORATORY MEMBERS**


Borut Žalik, “Contributions to geometric modelling at Faculty of EE&CS of University of Maribor,” invited lecture at the *Konversatorium* course, University of Technology, Graz, Austria, Nov. 2001.

**VISITS TO OTHER INSTITUTIONS**

Matej Gomboši, Sebastian Krivograd: Research work in the Alg Vis project, University of West Bohemia, Plzen, Czech Republic, May 13–19, 2001.

Assoc. Prof. Dr. Borut Žalik: Invited lecture *Contributions to geometric modelling at Faculty of EE&CS of University of Maribor* and restoring the co-operation, Graz University of Technology, Graz, Austria, Nov. 2001.

**GUESTS AND VISITORS**

Martin Franc, Michal Rousal (University of West Bohemia, Plzen, Czech Republic): Research work in the Alg Vis project, May 20–27, 2001.

Asst. Prof. Dr. Ivana Kolingerova (University of West Bohemia, Plzen, Czech Republic): Research work in the Alg Vis project, June 3–10, 2001.
INSTITUTE OF INFORMATICS

Head:
Prof. Dr. Ivan Rozman
Phone: +386 2 235 51 00
E-mail: i.rozman@uni-mb.si
URL: http://www.in.feri.uni-mb.si/

Students of the informatics sciences programs acquire a knowledge of information systems' development, algorithm analysis and design, data structures, database design, software engineering, object technology and component based development, intelligent systems design, and software quality management. Graduates then pursue careers in the fields of software engineering, design and maintenance of information systems, intelligent systems, and databases.

Members of the Institute conduct research in the fields of software engineering with special focus on object-oriented methods and tools, information systems design, intelligent systems supporting system engineering activities, expert systems design, database design, and design and implementation of software quality management methodologies.
The educational and research activities of the Institute are divided into four laboratories.

Information Systems Laboratory
Head: Prof. Dr. Ivan Rozman

Database Technologies Laboratory
Head: Assoc. Prof. Dr. Tatjana Welzer Družovec

Computer Mediated Communication Laboratory
Head: Assoc. Prof. Dr. József Györkös

Real-Time Systems Laboratory
Head: Assoc. Prof. Dr. Matjaž Colnarič

Information Systems Laboratory
Head: Prof. Dr. Ivan Rozman

Employees: Asst. Prof. Dr. Marjan Heričko; Assoc. Prof. Dr. Bojan Novak; Davor Bonačić, MSc; Asst. Prof. Dr. Romana Vajde Horvat; Asst. Prof. Dr. Branko Matjaž Jurič; Dr. Vili Podgorelec; Aleš Živkovič, MSc; Simon Beloglavec, BSc; Tomaž Domajnko, BSc;
Tomislav Rozman, BSc; Katja Harej, BSc; Gregor Polančič, BSc; Miha Strehar; Boštjan Šumak; Igor Novak

**Database Technology Laboratory**

Head: Assoc. Prof. Dr. Tatjana Welzer Družovec

Employees: Boštjan Brumen, BSc; Izidor Golob, BSc; Štefan Masič, Ing.; Matjaž Planinšič

**Real-Time Systems Laboratory**

Head: Assoc. Prof. Dr. Matjaž Colnarič

Employees: Asst. Prof. Dr. Domen Verber; Dr. Roman Gumzej; Stanislav Moraus, BSc; Bojan Ploj, BSc

**Computer Mediated Communication Laboratory**

Head: Assoc. Prof. Dr. József Győrkös

Employees: Robert Leskovar, BSc; Boris Lahovnik, BSc; Andrej Bregar, BSc; Goran Papić, BSc
RESEARCH PROJECTS

Current research projects

Applied project

L2-0841-0796-98 Adaptive modeliranje programskih procesov in njihova implementacija (Adaptive Modelling and Implementation of Software Process)

Leader: Prof. Dr. Ivan Rozman
Participants: Assoc. Prof. Dr. József Györkös; Prof. Emeritus Dr. Bruno Stiglic; Assoc. Prof. Dr. Tatjana Welzer Družovec; Asst. Prof. Dr. Marjan Heričko; Asst. Prof. Dr. Domen Verber; Asst. Prof. Dr. Branko Marjaž Jurič; Asst. Prof. Dr. Romana Vajde Horvat; Davor Bonačič, MSc; Simon Beloglavec; Dr. Tomaž Domajnko; Boris Lahovnik; Robert Leskovar; Marko Klemenčič; Rado Jensterle; Ljiljana Pretnar; Miha Strehar

Financed by: Ministry of Education, Science and Sport of the Republic of Slovenia, RRC - Računalniške storitve, Zavarovalnica Maribor, GENIS d.o.o., Slovenian Government Centre for Informatics

The goal of this research project is the development of a methodology for the formal definition and continuous improvement of the software process. This developed methodology, together with the knowledge and experience gained in quality systems establishment, will be used for the development of an integral environment, which will support software process implementation. Together with the development of an integrated tool, we also study the usage of modern object-oriented tools and techniques, object databases, and distributed processing.
Research and development project

Metodologija enotnega vzpostavljanja sistemov vedenja kaovosti v informacijski družbi (Methodology for Unified Quality Management System Establishment in Information Society)

Participants: Assist. Prof. Dr. Romana Vajde Horvat, Prof. Dr. Ivan Rozman, Katja Harej, Tomislav Rozman, Gregor Polančič, Boštjan Brumen, Boris Lahovnik, Davor Bonačič

Financed by: Ministry of Education, Science and Sports of Republic of Slovenia and Ministry of Information Society of Republic of Slovenia

This project is financed within the Slovenian program “Competitive position of Slovenia in 2001-2006”.

Goals of the project are:

- development of methodology for process description and description of their relationships in a notation which will be suitable for any organization in information society
- development of methodology for establishment of Quality Management System within any organization in information society
- verification of developed methodology in specific organization (governmental organization), and
- dissemination of the methodology (within governmental organizations and broader).

Industrial projects

Tehnološka prenova sistema COBISS (Technological Reengineering of COBISS System)

Participants: Prof. Dr. Ivan Rozman; Asst. Prof. Dr. Marjan Heričko; Assoc. Prof. Dr. József Győrkös; Asst. Prof. Dr. Branko Matjaž Jurič; Asst. Prof. Dr. Romana Vajde Horvat; Aleš Živkovič, MSc; Simon Beloglavec; Miha Strehar; Boštjan Šumak; Igor Novak

Financed by: IZUM, Maribor, Slovenia

Institute of Informatics is organizing education and qualifications for development teams from IZUM. The goal of these activities is to widen their knowledge of object technology. In the project, the contents related to information system development in Java, distributed object architectures, unified modelling language UML, and object process models, are treated. The
other important goal of collaboration is definition of standard procedures for object
development, with emphasis on reuse on higher levels of abstraction. Related to this,
patterns for software development are introduced.

**Prehod na objektno tehnologijo (NKB) (Transition to Object Technology)**

*Participants:* Prof. Dr. Ivan Rozman; Asst. Prof. Dr. Marjan Heričko; Asst. Prof. Dr. Branko Matjaž Jurič; Aleš Živkovič; MSc; Simon Beloglavec; Miha Strehar; Boštjan Šumak

*Financed by:* Nova KBM, Maribor, Slovenia

The Object Technology Center assists the technological evaluation of pilot projects for the
component-based development of Web object applications using object modelling (UML),
distributed objects, CORBA, Java, JavaBeans and Enterprise JavaBeans, object-relational
database management systems, object transaction monitors, and networked computers. In
addition, special attention is paid to establishing a defined and systematic object-oriented
software development process.

**Šola informatike (Slovenian Information Technology School)**

*Participants:* Prof. Dr. Ivan Rozman; Assoc. Prof. Dr. József Györkös; Asst. Prof. Dr. Marjan Heričko; Asst. Prof. Dr. Branko Matjaž Jurič; Asst. Prof. Dr. Romana Vajde Horvat; Aleš Živkovič, MSc; Irena Žerko - SRC d.o.o.

*Financed by:* SRC d.o.o., Maribor, Slovenia

The SRC d.d. Company established the Slovenian Information Technology School (SITS) in 1997, the aim of which is to educate about information technology related issues. The Laboratory of Information Systems cooperates with this school in two subjects “Quality in Information Technology” and “Object Technology”. Seminars and workshops are held within SITS. SRC d.d. organizes activities and the Laboratory of Information Systems is responsible for the content of the educational activities.

**Posredovanje znanja o objektni tehnologiji in komponentnem razvoju (Knowledge Dissemination on Object Technology and Component Based Development)**

*Participants:* Prof. Dr. Ivan Rozman; Asst. Prof. Dr. Marjan Heričko; Asst. Prof. Dr. Branko Matjaž Jurič; Aleš Živkovič; MSc; Simon Beloglavec; Miha Strehar; Boštjan Šumak; Igor Novak

*Financed by:* Infonet Kranj d.o.o., Slovenia

The aim of this project is collaboration in education and knowledge dissemination in object
technology and component based development. The performer will define a strategy for the transition to object technology and a component based process model. He will develop pilot applications to support the strategy. The knowledge transfer will take place in the form of workshops.

Zagotovitev uspešne uporabe objektne tehnologije in komponentnega razvoja (Ensuring Successful Usage of Object Technology and Component Development)

Participants: Prof. Dr. Ivan Rozman; Asst. Prof. Dr. Marjan Heričko; Asst. Prof. Dr. Branko Matjaž Jurič; Aleš Živkovič, MSc; Simon Beloglavec; Miha Strehar; Boštjan Šumak; Igor Novak

Financed by: RRC Računalniške storitve d.d., Slovenia

The goals of collaboration are connected with the successful usage of object technology and component development in the following priority areas: the development of modern, web-based applications, component model deployment and legacy systems integration, and successful management of reuse. The performer will deliver seminars and workshops, thematically connected with object technology, component development, object modelling, UML, object development process, distributed objects, component models, Java, XML, security, m-commerce, and WAP, object-relational databases, SQL, and reuse through patterns.

Vpeljava objektne tehnologije in komponentnega razvoja (Object Technology and Component Development Initiation)

Participants: Prof. Dr. Ivan Rozman; Asst. Prof. Dr. Marjan Heričko; Asst. Prof. Dr. Branko Matjaž Jurič; Aleš Živkovič, MSc; Simon Beloglavec; Miha Strehar; Boštjan Šumak

Financed by: Razvojni center IRC Celje d.o.o., Slovenia

The goals of our collaboration are the initiation of object technology and component development in Razvojni center IRC Celje d.o.o. and the corresponding education process. The performer will develop custom based seminar workshops, in the following topics: introduction to object technology and component development, introduction to Java, object modelling with UML, object development process, component models and distributed objects CORBA.

Izvedba analize zahtev za podatkovno bazo SIST (Requirements analysis for SIST database)

Participants: Prof. Dr. Ivan Rozman, Asst. Prof. Dr. Romana Vajde Horvat, Gregor Polančič, Tomislav Rozman, Katja Harej, Assoc. Prof. Dr. Tatjana Welzer Družovec, Štefan Masič
The two main goals of the project are:

- requirements analysis for an information system which would support the standardization processes of SIST, and
- review of the applicability of different DBMS according to the specifics of standardization processes.

The project will be conducted in following phases:

Phase 1: Analysis of standardization processes within SIST, based on a review of the current state and use of the information technology support.

Phase 2: The development of a conceptual model of SIST database and description of required functionality of the information system to support standardization processes.

Phase 3: Analysis of the applicability of commercial DBMS (Oracle and LotusNotes environment).

Results of the project will be: conceptual model of SIST database and report of the DBMS analysis.

International projects

TEAMWORK IST-2000-28162

Technology Exploitation and Adaptable Methodologies offering new Organisational Models and Practices for e-Working Teams

Participants: Prof. Dr. Ivan Rozman, Asst. Prof. Dr. Romana Vajde Horvat, Assoc. Prof. Dr. Tatjana Welzer Družovec, Gregor Polančič, Tomislav Rozman, Regina Stajnko, Boštjan Brumen, Katja Harej

Financed by: European Union, 5th Framework Project

The main goal of the project is to verify and disseminate the BestregIT methodology (developed within previous EU projects and aims to model the organization’s mission, structure and process workflow) and NQA environment (which enables the automatization of workflow and document management). Both, BestregIT and NQA, have been introduced to members of the project team. Within the second part of the project, University of Maribor team modelled the Socrates Erasmus student exchange process. Further, the model will be supported within NQA and verified and used within a test group of users. Other process models for cooperation of different partners within EU projects and for the cooperation of research institutions will be developed, as well as model for software development support. The results of the project will be disseminated within the broader community. There are 14 partners working within the project. The budget of the project is 1.2 million euro.
Sistemi integracije inteligence v zdravstveno okolje (Intelligent Systems Integration in Medical Environment)

Leaders: Assoc. Prof. Dr. Tatjana Welzer Družovec, Prof. Dr. Lorenzo Moreno Ruiz
Participants: Assoc. Prof. Dr. Peter Kokol, Asst. Prof. Dr. Marjan Družovec, Prof. Emeritus Dr. Bruno Stiglic, Boštjan Brumen, Dr. Špela Hleb Babič, Asst. Prof. Dr. Milan Zorman, Dr. Vili Podgorelec
Partner: Centro Superior de Informatica Universidad de La Laguna – Tenerife
Financed by: Ministry of Education, Science and Sport of the Republic of Slovenia, Ministry of Foreign Affairs of the Kingdom of Spain

In the scope of the project as a first part a simulation of the hospital management will be performed together with our partners. A database, containing all necessary data about administration, hospital resources, schedules, personnel, etc. will serve as a basis for the program. The second part of the project represents a classification system for patients with Alzheimer disease, based on the EEG signals. The analysis will be performed by symbolical representation of EEG signals with fuzzy automata, statistical classification and neural networks.

HEMIS-J Heterogeni medicinski inteligentni sistemi (Heterogeneous Medical Intelligent Systems)

Leaders: Assoc. Prof. Dr. Peter Kokol, Prof. Dr. Ryuichi Yamamoto
Participants: Asst. Prof. Dr. Milan Zorman; Dr. Vili Podgorelec; Mitja Lenič, MSc; Matej Šprogar
Partner: Osaka Medical College, Department of Medical Informatics, Osaka, Japan
Financed by: Ministry of Education, Science and Sport of the Republic of Slovenia

An important problem with the analysis of medical data lies in the fact that data is very dispersed throughout various departments, institutions, and even countries; on different types of computers and operating systems, etc. Therefore, in the scope of the project use of heterogeneous processing over world wide web is explored. An additional advantage of the heterogeneous approach is the increased computational power that helps a lot in the case of complex intelligent analyses.
Completed research projects 2001

**Applied projects**

**L2-1641-99**  Mehko krmiljenje varjenja v zaščitni atmosferi (Fuzzy Welding Control MIG/MAG)

*Leader:* Assoc. Prof. Dr. Bojan Novak  
*Participants:* Dr. Marjan Golob; Dr. Nenad Muškinja; Assoc. Prof. Dr. Boris Tovornik; Aleksander Bon; Prof. Dr. Janez Tušek; Miro Uran, MSc; Dr. Arpad Koveš; Danilo Krapec; Janoš Orban; Aleš Puklavec  
*Financed by:* Ministry of Science and Technology of the Republic of Slovenia, Varostroj, Slovenia  
*Duration:* 1999 – 2001

The problem of implementing an efficient regulation for the fuzzy welding procedure MIG/MAG that is economically successful, is the definition for a suitable mathematical model, because of the problem complexity and achievement of real-time hardware timings. In this project a process model for electrical arch controlling has been developed using fuzzy logic in welding procedure MIG/MAG. The model incorporates linguistic variables, based on welder experience. The welding process is represented using inverse fuzzy model and differential equations. The dependency relationship of stream, block length and distance are shown. The consistency between the model and real-world results has been proved by laboratory measurements. The main advantage of fuzzy current regulation compared to linear regulation is the user-friendly design of the non-linear properties. Using these, we can achieve optimal quality of regulation. Fuzzy regulation also enables us to integrate new extensions such as electricity power, material type, gas type, etc.

**KALIMO**  Konceptualni miselni vzorci (Conceptual networks)

*Participants:* Assoc. Prof. Dr. Peter Kokol, Dr. Vili Podgorelec  
*Financed by:* Ministry of Education, Science and Sport of the Republic of Slovenia  
*Duration:* 2001

Conceptual network is an upgrade of the usual semantic networks which are used frequently and successfully in educational processes. In the framework of the project a software package has been developed for constructing, editing and using the conceptual networks. With the help of the tool students and scholars are able to improve their learning capabilities, leading to better study results and more comprehensive understanding of study materials.
Industrial projects


Participants: Asst. Prof. Dr. Romana Vajde Horvat; Prof. Dr. Ivan Rozman; Vesna Lešnik, MSc; Tomi Rozman

Financed by: CCIS, participants of seminars/workshops

Duration: 1999 – 2001

Within this project, several seminars and workshops on ISO 9000:2000 topics were conducted in cooperation with the Metrology and Standardization Institute of Slovenia and the Chamber of Commerce and Industry of Slovenia. The content of the seminars and workshops discussed the international and local development of new family ISO 9000:2000 standards. Requirements for new standards were also presented in detail. As the second goal of the project, the validation of new standards was conducted in some Slovenian companies.

Izgradnje informacijskih sistemov v državnih organih CVI-FERI-EMRIS (Information Systems Development in State Agencies)

Participants: Prof. Dr. Ivan Rozman; Asst. Prof. Dr. Marjan Heričko; Assoc. Prof. Dr. József Györkös; Asst. Prof. Dr. Branko Matjaž Jurič; Asst. Prof. Dr. Romana Vajde Horvat; Tomaž Domajnko; Aleš Živkovič, MSc; Boris Lahovnik; Simon Beloglavec; Robert Leskovar; Miha Strehar; Boštjan Šumak; Igor Novak

Financed by: Center Vlade RS za informatiko (CVI), Slovenia

Duration: 2000 – 2001

The goal of the project was advising on, and the development of a unified method for object based information system development with the emphasis on modern accessions, cooperation by the development of other volumes of the unified methodology, and the development of an assessment method for the determination of the size and the cost of software projects.

Metodologija razvoja in vzdrževanja informacijskih sistemov – objektni pristop (MRIS-OP) (Information Systems Development and Maintenance Methodology – Object Accession)

Participants: Prof. Dr. Ivan Rozman; Asst. Prof. Dr. Marjan Heričko; Asst. Prof. Dr. Branko Matjaž Jurič; Asst. Prof. Dr. Romana Vajde Horvat; Tomaž Domajnko; Aleš Živkovič, MSc; Simon Beloglavec; Miha Strehar; Boštjan Šumak; Igor Novak
Within this project, the software development process and the maintenance process have to be re-engineered. Knowledge dissemination has taken place and a methodology framework for software development and for information services has been defined. Quality assurance and cooperation by the quality reviews has been provided. The activities of the MRIS-OP project include the definition and initiation of an object development cycle used in development and maintenance. We developed a custom methodology and delivered it in document form. The methodology will serve as the initialisation, coordination, management and supervision of software projects.

**Vzpostavitev sistema kakovosti za področje informatike s standardnimi postopki**
*(Quality Assurance System for Informatics with Standard Procedures)*

**Participants:** Prof. Dr. Ivan Rozman; Asst. Prof. Dr. Romana Vajde Horvat; Asst. Prof. Dr. Marjan Heričko; Vesna Lešnik, MSc; Tomi Rozman; Gregor Polančič; Katja Harej

**Financed by:** Telekom Slovenije, d.d.

**Duration:** 1999 – 2001

This project was aimed to define and re-engineer the software development process in the Information technology sector of Telekom Slovenia. Seminars and workshops for software process improvement areas were conducted within the project. Representatives of Telekom were trained to conduct the SPI and quality management system activities within their Sector of information technology. The contents of 20 processes were defined. The project was conducted according to PROCESSUS® methodology, which was developed by the Laboratory of information technology.

**International projects**

**SLO-US 015**

*Inteligentni sistemi na osnovi mehkega računanja (Intelligent Systems Based on Fuzzy Computing)*

**Leader:** Assoc. Prof. Dr. Bojan Novak

**Participants:** Prof. Dr. Lotfi A. Zadeh, UC Berkeley, USA

**Financed by:** Ministry of Science and Technology for the Republic of Slovenia

**Duration:** 1999 – 2001

Artificial neural networks (ANNs) can be merged with fuzzy logic to automatically generate membership functions, rules and inference systems. Three basic implementations are:
neural-based fuzzy systems, fuzzy-based neural networks and fuzzy-neural hybrid systems. In this third approach, the best properties from both techniques are used. To this category belong adaptive controllers such as the FALCON (Fuzzy Adaptive Learning Control Network) and the ANFIS (Adaptive Neural Fuzzy Inference System). They are implemented in the form of a radial basis function network (RBFN). Unfortunately these tools are complicated and can generate very complicated error surfaces with multiple local optimums that are traps for the learning algorithm. If the structure of the ANN (the number of neurons in the hidden layer) is improperly defined, the actual error will remain high despite a low training error, i.e., overfitting. These troubles can be avoided through the selection of adequate input variables and proper ANN structure. Different time-consuming methods exist to define optimal structure such as pruning, optimal brain damage etc. The problem, however, of complicated error surfaces with multiple error surfaces still remains. Automatic rule generation and optimal shape of membership functions can be generated with the addition of clustering methods. Basically the idea of clustering is to generate new vectors - cluster centres in the centre of the areas where a cluster of data exists. The cluster centres are the basis for a decision about the rule generation. Another important fact is that in practical applications, very limited sources of the data are available for learning. An ANN is capable of learning on a data set, which is large enough. Different validation techniques exist to construct the ANN with a minimal actual error. These methods must extract a significant amount of data into the validation set, so the training set becomes even smaller which significantly affects the quality of the ANN performance. In this research a different approach is considered. Instead of generating cluster centres, some vectors are chosen by using certain described criteria. The structure of the learning machine is defined during training. The Vapnik Chervonenkis (VC) dimension is introduced as a measure of the capacity of the learning machine. A prediction of the expected error on the yet, unseen examples can be estimated with the help of the VC dimension. The structural risk minimization principle is introduced to construct a machine with the lowest expected error. Validation step is unnecessary since a reliable formulation of the upper bound on the actual error is formulated based on the VC dimension. This is particularly important when the data set is small. The problem is transformed into the reproducing kernel Hilbert space that is a very efficient method of transforming a non-linear problem to the linear. Advantages over other fuzzy-neural hybrid systems are: The architecture of the system doesn't have to be determined before training. Solution of the optimisation problem is unique, whereas conventional ANNs have multiple local minimum error positions.

INMES

Intelligent Medical Systems

Co-ordinators: Assoc. Prof. Dr. Peter Kokol, Prof. Dr. Lenka Lhotska
Participants: Assoc. Prof. Dr. Tatjana Welzer Družovec, Asst. Prof. Dr. Milan Zorman, Dr. Vili Podgorelec, Dr. Špela Hleb Babič, Matej Šprogar
Project partners: Czech Technical University of Prague
Financed by: Ministry of Education, Science and Sport of the Republic of Slovenia
Duration: 1999 – 2001
In order to design successful intelligent systems to be used in medical applications, we designed them with an appropriate design methodology. Therein lies another weakness – very few, if any, such methods exist in the world. Therefore the goals of our research were to develop successful design methods, to use these methods in designing real-world intelligent medical systems that are also based on hybrid approaches, and to use these systems in a manner that “invents” new medical knowledge in selected medical fields.

**PUBLICATIONS**


Vili Podgorelec, Peter Kokol, “Evolutionary decision forests - decision making with multiple evolutionary constructed decision trees,” *Problems in applied mathematics and computational intelligence (Mathematics and computers in science and engineering)*, pp. 97-103.


PRESENTATIONS BY THE LABORATORY MEMBERS


CONGRESSES, MEETINGS, AND COMMITTEES


Prof. Dr. Ivan Rozman, Asst. Prof. Dr. Marjan Heričko, Asst. Prof. Dr. Matjaž Branko Jurič, Aleš Živkovič, MSc, Dr. Tomaž Domajnko, Simon Beloglavec, Miha Strehar, Boštjan Šumak, Igor Novak: Program committee and organizing committee members, The 6th Conference “Objektna tehnologija v Sloveniji OTS 2001”, Maribor, Slovenia, June 20–21, 2001.


Prof. Dr. Ivan Rozman, Asst. Prof. Dr. Romana Vajde Horvat, Regina Stajnko: Organizing committee members, TEAMWORK workshop, Maribor, Slovenia, Oct. 15-16, 2001.


Prof. Dr. Ivan Rozman: Chair of National Committee for Higher Education of Slovenia and Committee for Higher Education of University of Maribor, Slovenia.

Asst. Prof. Dr. Marjan Heričko: Member of the State Subject Commission for Computer Science.

Prof. Dr. Ivan Rozman, Asst. Prof. Dr. Matjaž Branko Jurič: Guest editors of the journal Informatica, Slovenian Informatics Society.

Asst. Prof. Dr. Matjaž Branko Jurič: Reviewer for Information and Software Technology Journal, Elsevier Science.

Asst. Prof. Dr. Romana Vajde Horvat: Technical committee member, ISO 176/SC2.


Asst. Prof. Dr. Romana Vajde Horvat: Vice-Chair of the Quality Board, Chamber of Commerce of Slovenia – Maribor Regional Department, Slovenia.

Davor Bonačić, MSc: Editorial board member of the journal Win.Ini.


Dr. Vili Podgorelec: Referee for Information Processing Letters, Elsevier Science.

VISITS TO OTHER INSTITUTIONS


Dr. Vili Podgorelec: Project SQUAB-I, University of Udine, Mathematics and Informatics Department, Udine, Italy, March 5–9, 2001.


Dr. Vili Podgorelec: Project INMES, Charles University Prague, Prague, Czech Republic, June 2–5, 2001.

Prof. Dr. Ivan Rozman, Asst. Prof. Dr. Romana Vajde Horvat: Workshop in the scope of the 5th framework program TEAMWORK, TecNet, Ireland, July 13–16, 2001.


Prof. Dr. Ivan Rozman: Meeting of the representatives of the national and university committees for higher education, Krakow, Poland, Oct. 11–14, 2001.

GUESTS AND VISITORS


Brian Foley (TecNet, Ireland): Revision of the cooperation possibilities between Irish and Slovenian research institutes.

DECORATIONS, AWARDS, AND HONOURS

Dr. Vili Podgorelec, SIAM Student award, First SIAM International Conference on Data Mining SDM ’01, Chicago, USA, April 2001.


Dr. Vili Podgorelec, Award for the Best PhD Article, The 10th Electrical and Computer Science Conference ERK 2001, Portorož, Slovenia, Sept. 2001.
DATABASE TECHNOLOGIES LABORATORY

Head:
Assoc. Prof. Dr. Tatjana Welzer Družovec
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RESEARCH PROJECTS

Current research projects

Applied project

L2-0841-0796-98 Adaptivno modeliranje programskih procesov in njihova implementacija (Adaptive Modelling and Implementation of Software Process)

Leader: Prof. Dr. Ivan Rozman
Participants: Assoc. Prof. Dr. József Györkös; Prof. Emeritus Dr. Bruno Stiglic; Assoc. Prof. Dr. Tatjana Welzer Družovec; Asst. Prof. Dr. Marjan Heričko; Asst. Prof. Dr. Domen Verber; Asst. Prof. Dr. Branko Marjaž Jurič; Asst. Prof. Dr. Romana Vajde Horvat; Davor Bonačič, MSc; Simon Beloglavec; Dr. Tomaž Domajnko; Boris Lahovnik; Robert Leskovar; Marko Klemenčič; Rado Jensterle; Ljiljana Pretnar; Miha Strehar

Financed by: Ministry of Education, Science and Sport of the Republic of Slovenia, RRC - Računalniške storitve, Zavarovalnica Maribor, GENIS d.o.o., Slovenian Government Centre for Informatics

The goal of this research project is the development of a methodology for the formal definition and continuous improvement of the software process. This developed methodology, together with the knowledge and experience gained in quality systems establishment, will be used for the development of an integral environment, which will support software process implementation. Together with the development of an integrated tool, we are also studying the usage of modern object-oriented tools and techniques, object databases, and distributed processing.
Industrial project

Metodologija enotnega vzpostavljanja sistemov vodenja kakovosti v informacijski družbi (Methodology for Unified Quality Management System Establishment in Information Society)

Participants: Assist. Prof. Dr. Romana Vajde Horvat, Prof. Dr. Ivan Rozman, Katja Harej, Tomislav Rozman, Gregor Polančič, Boštjan Brumen, Boris Lahovnik, Davor Bonačič


This project is financed within the Slovenian program “Competitive position of Slovenia in 2001-2006”.

Goals of the project are:

• development of methodology for process description and description of their relationships in a notation which will be suitable for any organization in information society
• development of methodology for establishment of Quality Management System within any organization in information society
• verification of developed methodology in specific organization (governmental organization), and
• dissemination of the methodology (within governmental organizations and broader).

International projects


Participants: Prof. Dr. Ivan Rozman, Asst. Prof. Dr. Romana Vajde Horvat, Assoc. Prof. Dr. Tatjana Welzer Družovec, Gregor Polančič, Tomislav Rozman, Regina Stajnko, Boštjan Brumen, Katja Harej

Financed by: European Union, 5th Framework Project

The main goal of the project is to verify and disseminate the BestregIT methodology (developed within previous EU projects and aims to model the organization’s mission, structure and process workflow) and NQA environment (which enables the automatization of workflow and document management). Both, BestregIT and NQA, have been introduced to members of the project team. Within the second part of the project, University of Maribor
team modelled the Socrates Erasmus student exchange process. Further, the model will be supported within NQA and verified and used within a test group of users. Other process models for cooperation of different partners within EU projects and for the cooperation of research institutions will be developed, as well as model for software development support. The results of the project will be disseminated within the broader community. There are 14 partners working within the project. The budget of the project is 1.2 million euro.

**Valeurtech**

**Highlighting Professional Experience in Europe in Undergraduate Curricula**

**Head:** Jacques Fleck  
**Participants:** Assoc. Prof. Dr. Tatjana Welzer Družovec, Boštjan Brumen, Regina Stajnko  
**Financed by:** European Union, SOCRATES-LEONARDO Program Project

Participants in this project have a task to coordinate Slovenian partners in their execution of the student's industrial placements abroad program. Within the project, first of all a survey will be developed and carried out. Then, the survey will cover the involved enterprises. The Internet Web page will be developed, containing all the data for the partners involved as well as for the coordinator's needs.

The survey's results will be analyses. Based on the survey's results, the criteria for the evaluation of the students' results and progress through industrial placements and for the international recognition will be developed.

**Sistemi integracije inteligence v zdravstveno okolje**

**Intelligent Systems Integration in Medical Environment**

**Leaders:** Assoc. Prof. Dr. Tatjana Welzer Družovec, Prof. Dr. Lorenzo Moreno Ruiz  
**Participants:** Assoc. Prof. Dr. Peter Kokol, Asst. Prof. Dr. Marjan Družovec, Prof. Emerit. Dr. Bruno Stiglic, Boštjan Brumen, Dr. Špela Hleb Babič, Asst. Prof. Dr. Milan Zorman, Dr. Vili Podgorelec  
**Partner:** Centro Superior de Informatica Universidad de La Laguna - Tenerife  
**Financed by:** Ministry of Education, Science and Sport of the Republic of Slovenia, Ministry of Foreign Affairs of the Kingdom of Spain

Firstly a simulation of the hospital management will be performed together with our partners within the scope of this project. A database, containing all necessary data about administration, hospital resources, schedules, personnel, etc. will serve as a basis for the program. The second part of the project represents a classification system for patients with Alzheimers disease, based on the EEG signals. The analysis will be performed by symbolical
representation of EEG signals with fuzzy automata, statistical classification and neural networks.

**Industrial project**

**Izvedba analize zahtev za podatkovno bazo SIST (Requirements Analysis for SIST Database)**

**Participants:** Prof. Dr. Ivan Rozman, Asst. Prof. Dr. Romana Vajde Horvat, Gregor Polančič, Tomislav Rozman, Katja Harej, Assoc. Prof. Dr. Tatjana Welzer Družovec, Štefan Masič

**Financed by:** Slovenian Institute for Standardization

The two main goals of the project are:
- requirements analysis for an information system which would support the standardization processes of SIST, and
- review of the applicability of different DBMS according to the specifics of standardization processes.

The project will be conducted in following phases:

Phase 1: Analysis of standardization processes within SIST, based on a review of the current state and use of the information technology support.

Phase 2: The development of a conceptual model of SIST database and description of required functionality of the information system to support standardization processes.

Phase 3: Analysis of the applicability of commercial DBMS (Oracle and LotusNotes environment).

Results of the project will be: a conceptual model of SIST database and report of the DBMS analysis.

**Completed research projects 2001**

**Applied project**

**PISUM**

*Prenova informacijskega sistema Univerze v Mariboru (Renovation of Information System of the University of Maribor)*

**Leader:** Assoc. Prof. Dr. Tatjana Welzer Družovec

**Participants:** Štefan Masič, Izidor Golob, Boštjan Brumen
This project for renovation of the Information System (IS) of University of Maribor included an improvement of its academic, financial, and human resources sub-components.

The first part of the project included the following activities:

- a preparation of legacy system review
- a preparation of a strategic plan for the main organizational and functional areas and a data scheme for the entire IS
- preparation of all methodological documents needed (software requirements specification documentation, review of information engineering methodology, review of conceptual design of databases and modelling environment, and standardization of the modelling environment) and the introduction of the project group.

The second part included practical activities resulting from the analysis and the preparation of functional specifications that will be a basis for the project leader’s decision when estimating the costs and determining project priorities and aid software designers when planning, implementing, testing, delivering, and documenting the process. We prepared the required methodological documentation and produced functional specifications and the data and functional models for the human resources part of the IS. We also managed communication among human resources department leaders who represented the end users of the human resources IS.

**International project**

**INMES**  
**Inteligentni sistemi v medicini (Intelligent Medical Systems)**

**Co-ordinators:** Assoc. Prof. Dr. Peter Kokol, Prof. Dr. Lenka Lhotska  
**Participants:** Assoc. Prof. Dr. Tatjana Welzer Drežovec, Asst. Prof. Dr. Milan Zorman, Dr. Vili Podgorelec, Dr. Špela Hleb Babič, Matej Šprogar  
**Project partners:** Czech Technical University of Prague  
**Financed by:** Ministry of Education, Science and Sport of the Republic of Slovenia  
**Duration:** 1999 – 2001

In order to design successful intelligent systems for use in medical applications, we designed them with an appropriate design methodology. Therein lies another weakness – very few, if any, such methods exist in the world. Therefore the goals of our research were to develop successful design methods, to use these methods in designing real-world intelligent medical systems that are also based on hybrid approaches, and to use these systems in a manner that “invents” new medical knowledge in selected medical fields.
Industrial projects

Podatkovno skladišče (Data Warehouse)

Participants: Izidor Golob, Assoc. Prof. Dr. Tatjana Welzer Družovec Družovec, Boštjan Brumen, Štefan Masič

Financed by: InfoNet Kranj d.o.o., Slovenia

Duration: 2000 – 2001

We were involved in a data warehousing project for Infonet Kranj Ltd., one of the leading Slovenian companies in the area of medical and pharmacy information systems. Over 5000 people, in hospitals and pharmacies in Slovenia and abroad, are now using the company’s computer applications. Recent introduction of a health-care insurance card in Slovenia has increased the importance of software capable of analysing administrative and medical data.

The operational database has been built according to the European medical standard HISA (Healthcare Information System Architecture), which is limited to the identification of a set of common services capable of supporting those parts of the information system related to the treatment of the subjects in care. The core of our cooperation is a transformation of the production database into a dimensional model that enables some vital analyses to be done faster and smoother, including analysis of data in healthcare record systems, relevant and common to the whole healthcare organization.

The laboratory provides education, cooperates in analysis, design and specification phases of the data warehouse, and in the technical infrastructure implementation phase.

Priprava izgradnje središnje podatkovne baze Viator&Vektor (Preparation for Central Database Development for Viator&Vektor)

Participants: Štefan Masič, Assoc. Prof. Dr. Tatjana Welzer Družovec, Izidor Golob, Boštjan Brumen

Duration: 2000 – 2001

A project for the preparation for development and implementation of a central database system was conducted in a co-operative framework with the Viator&Vektor company. This system was planned to include all present and future activities of the company. This project included an analysis of the key business areas and requirements of the whole information system. The complexity of a database, DBMS and corresponding application systems were estimated. A proposal was made regarding the appropriate software and hardware platform for data and other company servers was given. This proposal included a study of the appropriate software development tools to be used.
PUBLICATIONS


**PRESENTATIONS BY THE LABORATORY MEMBERS**


Tatjana Welzer Družovec, “Data Reusability,” lecture at the University of Madeira, Funchal, Portugal, Nov. 12–16, 2001.


**CONGRESSES, MEETINGS, AND COMMITTEES**


Assoc. Prof. Dr. Tatjana Welzer Družovec: Organizer of the SOCRATES coordinator meeting, Maribor, Slovenia, April 2001.
Assoc. Prof. Dr. Tatjana Welzer Družovec: Member of the Steering Committee of ISM 2001 - International Conference on Information Systems Modelling, Hradec nad Moravici, Czech Republic, May 9–11, 2001.

Assoc. Prof. Dr. Tatjana Welzer Družovec, Prof. Dr. Ivan Rozman: Co-chair of Program Committee and Conference Chair at EJC 2001 - 11th European-Japanese Conference on Information Modelling And Knowledge Bases, Maribor, Slovenia, May 29 to June 1, 2001.


Assoc. Prof. Dr. Tatjana Welzer Družovec: Member of the Steering Committee of ReTIS 2001 - 7th ReTIS International Conference on Reengineering Technologies for Information Systems, Lyon, France, July 4–6, 2001.

Assoc. Prof. Dr. Tatjana Welzer Družovec: Member of the Program Committee of SCI 2001 - 5th World Multiconference on Systemics, Cybernetics and Informatics, Orlando, USA, July 22–25, 2001.

Assoc. Prof. Dr. Tatjana Welzer Družovec: Member of the Program Committee of MEDINFO 2001 - Tenth World Congress on Health and Medical Informatics, London, Great Britain, Sept. 2–5, 2001.

Assoc. Prof. Dr. Tatjana Welzer Družovec: Member of Program and Steering Committee ADBIS 2001 – Advances in Databases and Information Systems, Maribor, Slovenia, Sept. 2001.
VISITS TO OTHER INSTITUTIONS

Assoc. Prof. Dr. Tatjana Welzer
Družovec,
Boštjan Brumen:
A visit within “teaching staff mobility” program, SOCRATES-ERASMUS, Tampere University of Technology, Pori School of Technology and Economics, Pori, Finland, Aprill 19–30, 2001.

Assoc. Prof. Dr. Tatjana Welzer
Družovec:
A visit within “teaching staff mobility” program, SOCRATES-ERASMUS, University of Vaasa, Vaasa, Finland, April 19–30, 2001.

Assoc. Prof. Dr. Tatjana Welzer
Družovec:
A visit within “teaching staff mobility” program, SOCRATES-ERASMUS, University of La Laguna, Spain, May 10–17, 2001.

Assoc. Prof. Dr. Tatjana Welzer
Družovec:
A visit within “teaching staff mobility” program, SOCRATES-ERASMUS, University of Madeira, Funchal, Portugal, Nov. 12–16, 2001.

GUESTS AND VISITORS

Hannu Jaakkola,
Timo Varkoi
(Tampere University of Technology, Pori School of Technology and Economics, Pori, Finland):
A visit within “teaching staff mobility” program, SOCRATES-ERASMUS, Jan. 3–8, 2001.

Hannu Jaakkola
(Tampere University of Technology, Pori School of Technology and Economics, Pori, Finland):

Filipe Monteiro
(University of Minho, Braga, Portugal):
A visit within “student mobility” program, SOCRATES-ERASMUS, April to July 2001.

Kimmo Salmenjoki
(University of Vaasa, Vaasa, Finland):
A visit within “teaching staff mobility” program, SOCRATES-ERASMUS, May 23 to June 1, 2001.

Jose Luis Sanchez (University of La Laguna, Spain): A visit within “teachnig staff mobility” program, SOCRATES-ERASMUS, June 23–29, 2001.

DECORATIONS, AWARDS, AND HONOURS

Assoc. Prof. Dr. Tatjana Welzer Družovec, IIAS 2001 Meritorious Award.

Boštjan Brumen, IIAS Award in Scholarly Research in Recognition of High Quality innovative Research Work.

Assoc. Prof. Dr. Tatjana Welzer Družovec, IGIP Title of European Engineering Educator, ING-PAED IGIP.

Boštjan Brumen, IGIP Title of European Engineering Educator, ING-PAED IGIP.

Assoc. Prof. Dr. Tatjana Welzer Družovec, Day of Faculty Award in Recognition of Influential Talks and Contributions at International Conferences.
COMPUTER MEDIATED COMMUNICATION LABORATORY

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RESEARCH PROJECTS

Current research projects

Applied project

L2-0841-0796-98  Adaptivno modeliranje programskih procesov in njihova implementacija (Adaptive Modelling and Implementation of Software Process)

Leader: Prof. Dr. Ivan Rozman
Participants: Assoc. Prof. Dr. József Györkös; Prof. Emerit. Dr. Bruno Stiglic; Assoc. Prof. Dr. Tatjana Welzer Družovec; Asst. Prof. Dr. Marjan Heričko; Asst. Prof. Dr. Domen Verber; Asst. Prof. Dr. Branko Marjaž Jurič; Asst. Prof. Dr. Romana Vajde Horvat; Davor Bonačič, MSc; Simon Beloğlavec; Dr. Tomaž Domajnko; Boris Lahovnik; Robert Leskovar; Marko Klemenčič; Rado Jensterle; Ljiljana Pretnar; Miha Strehar

Financed by: Ministry of Science and Technology for the Republic of Slovenia, RRC–Računalniške storitve, Zavarovalnica Maribor, GENIS d.o.o., Slovenian Government Centre for Informatics

The goal of this research project is the development of a methodology for the formal definition and continuous improvement of the software process. The developed methodology, together with the knowledge and experience gained in quality systems establishment, will be used for the development of an integral environment, which will support software process implementation. Together with the development of an integrated tool, we are also studying the usage of modern object-oriented tools and techniques, object databases, and distributed processing.
Research and development project

Metodologija enotnega vzpostavljanja sistemov vodenja kaovosti v informacijski družbi (Methodology for unified Quality Management System establishment in information society)

Participants: Asst. Prof. Dr. Romana Vajde Horvat, Prof. Dr. Ivan Rozman, Katja Harej, Tomislav Rozman, Gregor Polančič, Boštjan Brumen, Boris Lahovnik, Davor Bonačič

Financed by: Ministry of education, science and sports of Republic of Slovenia and Ministry of information society of Republic of Slovenia

The project is financed within Slovenian program “Competitive position of Slovenia in 2001-2006”.

Goals of the project are:

- development of methodology for process description and description of their relationships in a notation which will be suitable for any organization in information society
- development of methodology for establishment of Quality Management System within any organization in information society
- verification of developed methodology in specific organization (governmental organization), and
- dissemination of the methodology (within governmental organizations and broader).

Industrial projects

Tehnološka prenova sistema COBISS
(Technological Reengineering of COBISS System)

Participants: Prof. Dr. Ivan Rozman; Asst. Prof. Dr. Marjan Heričko; Assoc. Prof. Dr. József Győrkös; Asst. Prof. Dr. Branko Matjaž Jurič; Asst. Prof. Dr. Romana Vajde Horvat; Aleš Živkovič, MSc; Simon Beloglavec; Miha Strehar; Boštjan Šumak; Igor Novak

Financed by: IZUM, Maribor, Slovenia

Institute of Informatics is organizing education and qualifications for development teams from IZUM. The goal of these activities is to widen their knowledge of object technology. In the project, the contents related to information system development in Java, distributed object architectures, unified modelling language UML, and object process models, are treated. The
other important goal of collaboration is definition of standard procedures for object development, with emphasis on reuse on higher levels of abstraction. Related to this, patterns for software development are introduced.

Šola informatike (Slovenian Information Technology School)

*Participants:* Prof. Dr. Ivan Rozman; Assoc. Prof. Dr. József Győrkös; Asst. Prof. Dr. Marjan Heričko; Asst. Prof. Dr. Branko Matjaž Jurčič; Asst. Prof. Dr. Romana Vajde Horvat; Aleš Živkovič, MSc; Irena Žerko - SRC d.o.o.

*Financed by:* SRC d.o.o., Slovenia

The SRC d.d. Company established the Slovenian Information Technology School (SITS) in 1997, the aim of which is to educate about information technology related issues. The Laboratory of Information Systems cooperates with this school in two subjects “Quality in Information Technology” and “Object Technology”. Seminars and workshops are held within SITS. SRC d.d. organizes activities and the Laboratory of Information Systems is responsible for the content of the educational activities.

Completed research projects 2001

**Industrial projects**

**Uveljavljanje sistemov kakovosti v naročniško/dobaviteljskih odnosih na področju informacijskih sistemov (Establishment of Quality Systems in Customer/Supplier Relationships for Information Technology)**

*Participants:* Assoc. Prof. Dr. József Győrkös, Vesna Lešnik, Boris Lahovnik, Robert Leskovar, Andrej Bregar, Goran Papić, Barbara Wohinz (CVI)

*Financed by:* Government Center for Informatics, Republic of Slovenia

*Duration:* 1997 – 2001

Within the scope of this project three main goals have been achieved. The first was the establishment of a Quality System (QS) for Informatics at the Slovenian Government Centre. The framework of this QS was set up in August 1997. It was then integrated with the Project Management Methodology in Slovenian Government Offices. In December 1999 the QS was ready for the certification process by an authorized certification agency, which issued the ISO 9001 certificate next year (with a consideration of ISO 9000-3 and ISO 9004-2). In the year 2001, after receiving the certificate, the first internal QS assessment of the whole QS was accomplished. Directives for upgrading the QS to the newest version of ISO 9001 and for
integration of certain QS processes were set up.

The second goal was an assessment of a Quality System of IT Service Suppliers. The suppliers of IT services for the Slovenian government are qualified according to the PROCESSUS assessment model. The third goal was an assessment of software/IT services provided by suppliers. The product assessment methodology and PRO+ (the SW Product Assessment Tool) were developed for this purpose, and they are already in use in Government Centre for Informatics.

**Presoja projektov GURS - Geodetska uprava Republike Slovenije (Audit of the Projects of the GURS)**

*Participants:* Assoc. Prof. Dr. József Györkös; Dr. Borut Žalik; Robert Leskovar; Boris Lahovnik; Peter Fajfar, MSc (CVI)

*Financed by:* Ministry of the Environment and Spatial Planning of the Republic of Slovenia

*Duration:* 2000 – 2001

(1) An estimation of a project: “A consultation to the prototype establishment of a central database of buildings and making the prototype of a program solution” from the viewpoint of quality assurance.

(2) An estimation of the project: A completion of software solutions at the Surveying and Mapping Authority of Republic of Slovenia in the connection with a Law about special conditions for registration of a private ownership on individual parts of building in the land cadastre.


*Participants:* Asst. Prof. Dr. Romana Vajde Horvat; Prof. Dr. Ivan Rozman; Vesna Lešnik, MSc; Tomi Rozman

*Financed by:* CCIS, participants of seminars/workshops

*Duration:* 1999 – 2001

Within this project, several seminars and workshops on ISO 9000:2000 topics were conducted in cooperation with the Metrology and Standardization Institute of Slovenia and the Chamber of Commerce and Industry of Slovenia. The content of the seminars and workshops discussed the international and local development of new family ISO 9000:2000 standards. Requirements for new standards were also presented in detail. As the second goal of the project, the validation of new standards was conducted in some Slovenian companies.
Izgradnje informacijskih sistemov v državnih organih CVI-FERI-EMRIS (Information Systems Development in State Agencies)

Participants: Prof. Dr. Ivan Rozman; Asst. Prof. Dr. Marjan Heričko; Assoc. Prof. Dr. József Györkös; Asst. Prof. Dr. Branko Matjaž Jurič; Asst. Prof. Dr. Romana Vajde Horvat; Dr. Tomaž Domajnko; Aleš Živkovič, MSc; Boris Lahovnik; Simon Beloglavec; Robert Leskovar; Miha Strehar; Boštjan Šumak; Igor Novak

Financed by: Center Vlade RS za informatiko (CVI)
Duration: 2000 – 2001

The goal of the project was advising on, and the development of a unified method for object based information system development with the emphasis on modern accessions, cooperation by the development of other volumes of the unified methodology, and the development of an assessment method for the determination of the size and the cost of software projects.

Vzpostavitev sistema kakovosti za področje informatike s standardnimi postopki (Quality Assurance System for Informatics with Standard Procedures)

Participants: Prof. Dr. Ivan Rozman; Asst. Prof. Dr. Romana Vajde Horvat; Asst. Prof. Dr. Marjan Heričko; Vesna Lešnik, MSc; Tomi Rozman; Gregor Polančič; Katja Harej

Financed by: Telekom Slovenije, d.d.
Duration: 2000 – 2001

The project was aimed to define and re-engineer the software development process in Information technology sector of Telekom Slovenia. Within the project the seminars and workshops for software process improvement areas were conducted. Representatives of Telekom were trained to conduct the SPI and quality management system activities within their Sector of information technology. The contents of 20 processes were defined. The project was conducted according to PROCESSUS® methodology, which was developed by the Laboratory of information technology.

PUBLICATIONS


**CONGRESSES, MEETINGS, AND COMMITTEES**

REAL-TIME SYSTEMS LABORATORY

Head:
Assoc. Prof. Dr. Matjaž Colnarič
Phone: +386 2 220 74 30
E-mail: colnaric@uni-mb.si

RESEARCH PROJECTS

Current research projects

Basic research project

**Z2-3493-0796 Holistic Embedded Control Systems Design**

**Leader:** Dr. Roman Gumzej

**Financed by:** Ministry of Education, Science and Sport of the Republic of Slovenia

In the project, methods for holistic embedded control systems hardware and software design will be devised and joined in a methodology, with the goal of enhancing their reliability, safety and maintainability. Areas of hardware and software architecture (co-)specification, verification and validation of the design with regard to its feasibility will be covered. An existing real-time programming language will be enhanced for use with the mentioned methodology. Tool prototypes will be implemented to check the suitability of these novel concepts.

This project outlines an approach to co-design of hardware and software which has the goal of achieving a better quality of real-time systems. The syntax was defined for a specific meta-language to describe the hardware and software configuration of the system. The standard PEARL for distributed systems (DIN 66253, Part 3 [PEARL89]) is considered the basis for our research. It defines the syntax of the hardware and software configuration description language, which is meant to be used for systems that are programmed in PEARL [PEARL81, PEARL82]. The above mentioned specification language was enhanced to enable the specification of asymmetrical architecture and diverse multiprocessor systems' architecture as well as a precise description of peripheral devices, attached to them.

Graphical constructs with the same semantics as the formerly described syntax are defined and a tool, enabling specification and code production in the formerly mentioned syntax, is
being developed. The possibility of using this tool as a development framework for producing the specification of hardware and software architectures (taking the visual CASE tools as an example) is being considered. It was extended with timed state transition diagrams to be able to build prototypes of applications. These diagrams have the semantics of timed state transition automata. They contain the framework of the application as well as all its real-time constraints. The feasibility of the applications' architecture (program model) on the designed systems' architecture (the virtual machine) is to be checked by co-simulation.

**Applied project**

**L2-3446-0796**  
Dependability of Embedded Control Systems  
**Leader:** Dr. Domen Verber  
**Participants:** Aleksander Polutnik, MSc (Ultra d.o.o.); Bor Prihavec, MSc (Ultra d.o.o.)  
**Financed by:** Ministry of Education, Science and Sport of the Republic of Slovenia, Ultra d.o.o.

A typical control system today consists of physical process components, sensors, actuators, distributed computers with communication networks, and several thousands of lines of code. Examples of these are control systems in industrial plants, nuclear reactors, avionics, etc. The size and the complexity of such systems increases every year and so does the probability of fault in one of many components. Each fault in such a system can cause severe material loss or even endanger human lives. Most of the research dealing with the problem of fault-tolerant computing is only providing partial solutions. However, for appropriate consideration of all problems, the holistic approach is necessary. The main aim of the project is the study and development of methods and tools for hierarchically organised fault-tolerant control systems. Such systems consist of hierarchically an organised function unit. At the lowest level, they are connected with the network of sensors and actuators, through which the control system communicates with its environment. The proposed model can deal with faults in the environment, in the hardware and software of the embedded system, etc. Basic research topics covered by the project are fault detection, fault localisation and isolation, graceful degradation of the functionality of the system in a case of a minor fault, and control and safety shut-down of the system in the case of severe defects.

**PUBLICATIONS**


CONGRESSES, MEETINGS, AND COMMITTEES

Assoc. Prof. Dr. Matjaž Colnarič: Program committee member and reviewer at the International IFAC Workshop on Real-Time Programming WRTP, Hong Kong, Nov. 2001.

Assoc. Prof. Dr. Matjaž Colnarič: Vice-chair of technical committee for real-time software engineering at IFAC (annual meeting), Hong Kong, Nov. 2001.

VISITS TO OTHER INSTITUTIONS


GUESTS AND VISITORS

Prof. Dr. Wolfgang Halang (Fernuniversität Hagen, Germany): Visit to the Centre for distance education development, TEMPUS project, invited opening lecture for Real-time systems, Maribor, Slovenia, Oct. 2001.