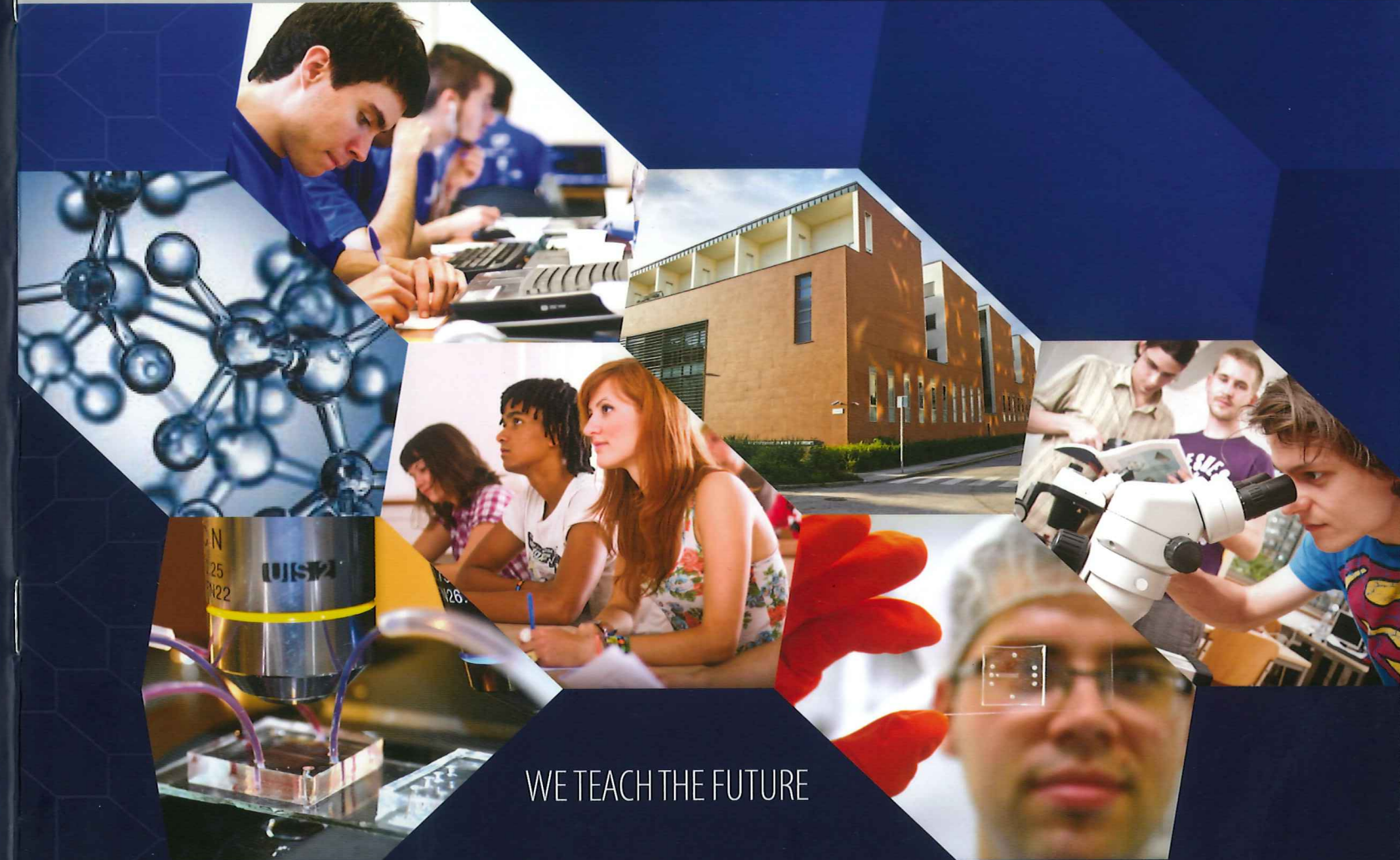


TRADITION & VISION



PÁZMÁNY PÉTER CATHOLIC UNIVERSITY
Faculty of Information Technology and Bionics



TRADITION & VISION

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WE TEACH THE FUTURE

PÁZMÁNY - 1635
since

Introduction

Merging two high-tech fields, electronics and information technology with biotechnology is a brand new direction in science and technology, prevailing in its embryonic form. However, we believe that by exploring and mastering a new discipline, we may achieve something important for the future. Neurobiology, genetics, electromagnetics in nano- and micron-scale, as well as electronic and computer engineering are areas of science undeniably shaping the image of the industry of the 21st century.

Aiding the blind, actuating the limbs of patients with injured spines using muscle stimulators, improving the communication possibilities of the hearing impaired with mobile phones, drug dispenser chips built into the human body, program controlled industrial measuring systems, adaptive sensory robotic systems – are all but a few special challenges to current technology.

Following the ideas of the late Professor Tamás Roska, founding Dean of our Faculty, around twenty internationally renowned researchers initiated our innovative Electronic and Computer Engineering curriculum with neuroscience flavor, which later resulted in an independent Molecular Bionics program. This new approach was made necessary by the fact that industry is taking a new direction at the frontier of computer technology and biotechnology, resulting in the supply of new products and services.

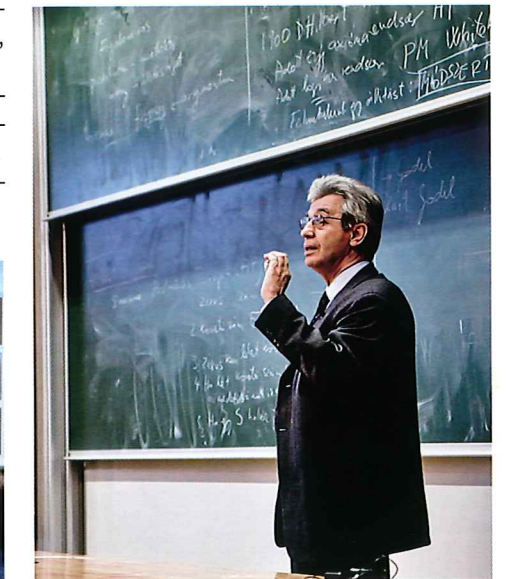
Beside standard computer technology, our students can study the information technology of living organisms, and can design computers even with thousands or more processors. The Molecular Bionics program has been working successfully in the USA. Along with Imperial College London, our faculty is the first in Europe where this new area of industry and research can be studied at undergraduate level.

The two undergraduate programs, Computer Engineering and Molecular Bionics BSc prepare students for the three master courses, Computer Engineering, Info-bionics, and Medical Biotechnology MSc. The Multidisciplinary Doctoral School of Sciences and Technology is accredited in the fields of Electrical Engineering, Computer Engineering (information technology), and Biology.



In addition to the academic subjects, intensive practical, and laboratory work, as well as the high number of individual study hours ensure that our students acquire a marketable knowledge that will improve their chances to find employment in the labor market.

Our goal is to form specialists who, having a profound theoretical knowledge and up-to-date managerial skills, are able to cope with challenges of the constantly developing practical environment.



Undergraduate program

The first phase of the multi-cycle training is the BSc program, where students, after having acquired the theoretical foundations and basic practical skills, can learn how this knowledge may be applied in real-life situations. This is promoted by the fact that individual student work, individual laboratory practice and internship are all part of our curriculum. 210 credits are needed for the BSc diploma, which are distributed over seven semesters according to the curriculum. Those who wish to deepen their expertise in one given field can continue their studies in the MSc program.

BSc in Computer Engineering

Surveys show that there is a significant persistent demand for computer engineers in the coming years both in Hungary and abroad. We intend to satisfy these labor market needs by providing practice-orientated, internationally recognized, high level qualifications.

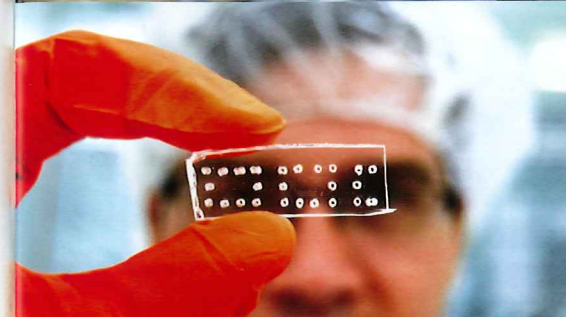
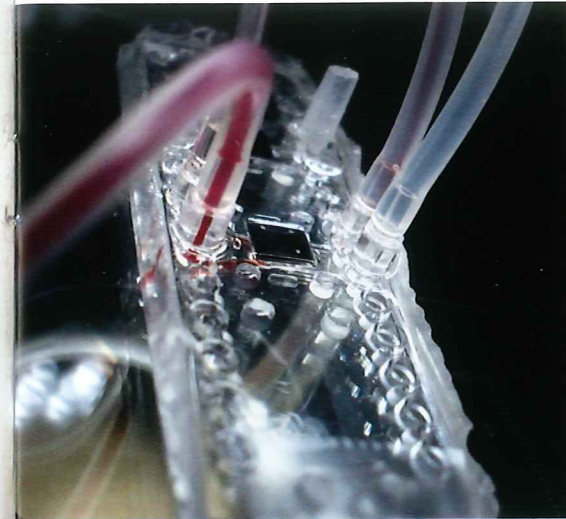
The Computer Engineering program of PPCU is an excellent choice for those who are interested in the fastest developing areas of information technology. The training gives a special insight into those fields where information technology is faced with new, unknown challenges such as medical sciences, human-machine contacts, parallel computation, and the world of nano- and micro-electronics.

Along with the classic questions of computer technology in our curriculum, several uniquely innovative features are introduced. In observing living organisms we would like to study their way of working and apply our findings to the world of microchips and sensors. The revolution of sensors, the growth of chip complexity, the ubiquitous kilo-processor chips, the facilitation of natural human communication, and human language technology are areas where we are able to explore, even internationally, new territories.

Within the practical specialization at the Faculty, thanks to the numerous various topics, every student can find his own area of interest in addition to the academic subjects, which improve employment prospects. Subjects in the fifth semester are taught in English to develop language proficiency of students. The most outstanding students can pursue their studies at one of the leading universities in the given field abroad. An eight-week-long internship, taking place at an industrial company, in a hospital, or at an academic research institute, can further deepen the already acquired knowledge and practical skills and can provide invaluable experience for a job search in the future.

SPECIALIZATIONS:

- Info-bionics, sensing computers and robots
- Microelectronics and info-communication
- Software and language technology



BSc in Molecular Bionics

“We know that the main direction of development today points towards molecular machines. If the tasks of diagnosis, intervention and control could be managed, the healing role of medical doctors would be much facilitated, and the health of the patients also.” (Árpád Csurgay, Member of the Hungarian Academy of Sciences, professor at the Faculty of Information Technology of PPCU)

“This is a new field, where life-sciences and electronics along with computer technology meet. New inventions and services are born, such as fMRI, lab-on-a-chip devices, or prostheses, and body-machine symbioses, like a pacemaker or a neuro-stimulator in the brain. This is a brand new world in which we lay down the foundations of a specialization that will mean a new industry in the future.” (The late Professor Tamás Roska, founding dean of PPCU FIT)

Molecular Bionics is a real novelty in Hungary. It is on the frontiers of biology, molecular physics, chemistry, and computer technology and guides the way for rapidly developing fields of science, such as computer-assisted pharmaceutical industry, medical biotechnology or nanobiotechnology.

THE PROGRAM THAT IS RUN TOGETHER WITH SEMMELWEIS MEDICAL UNIVERSITY HAS FOUR DISCIPLINARY PILLARS:

- molecular biology,
- electromagnetic waves in nano- and micron- scale ,
- foundations of computing and electronics,
- neurobiology.

In their curriculum, students meet lab-on-a-chip technology, computer-aided drug design, complex laboratory practice, physiology measurements, 2-D and 3-D imaging and processing, genome-chip technology, etc. Upon finishing the BSc program, students can pursue their studies at the Info-bionics or Medical Biotechnology master courses to become pioneers of a new industry.

Master Programs

MSc programs provide special knowledge of specialized areas while offering deeper theoretical insight. Admission requirement for the program is a BSc diploma. We also welcome students from other higher educational institutions.

MSc in Computer Engineering

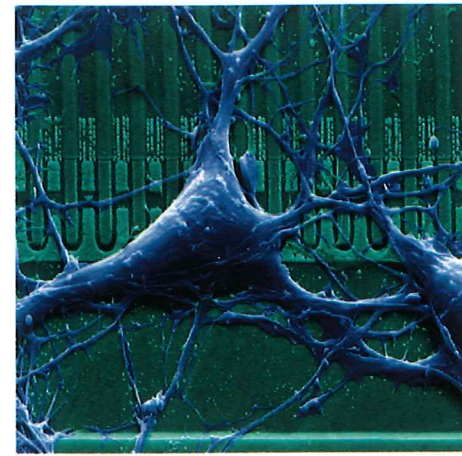
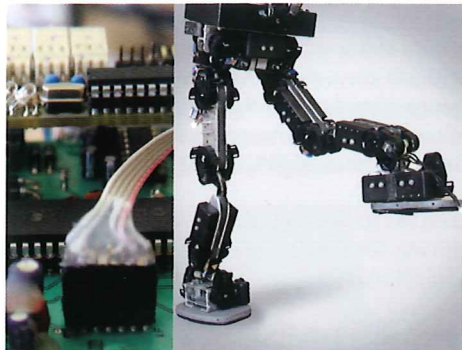
Beside Hungarian companies and institutions, international firms are also interested in our graduates. Those who acquire their diploma at our Computer Engineering program have no problems finding employment. Labor market surveys indicate that there is a growing demand for computer engineering/ informatics graduates.

In addition to the theoretical foundations of natural science, students study several programming languages and their applications in diverse environments. They also get acquainted with methods for designing *complex software systems* as well as the *principles of artificial intelligence*. Unlike other Computer Engineering programs, we put a special emphasis on *hardware* related issues, kilo-processor architectures and preconfigurable architectures, as well.

SPECIALIZATIONS:

- Sensing Computers and Neuromorphic Robots
- Software Technology
- Language Technology
- Info-communication
- Micro- and Nano-technology
- Financial Informatics
- Image Processing and Computer Vision

The International Master Program in **Image Processing and Computer Vision (IPCV Program)** provides specialized training in a field of increasing importance in our daily lives. It is essential in domains such as medicine, surveillance, industrial control, remote sensing, e-commerce, and automation. Three partner universities, with internationally recognized experience in these domains, Pázmány Péter Catholic University, Budapest, Hungary, Universidad Autónoma de Madrid, Spain, and University of Bordeaux, France have pooled their complementary expertise and developed this international postgraduate cooperation initiative. The result is a high-quality, strongly recognized, triple Master degree that respects the 120 ECTS syllabus, and is well adapted to job market criteria. In order to benefit from the knowledge of these three partner universities and their professors, students spend an entire semester in each university. Duration of the program is 2 years (120 ECTS) and the course language is English. Students who successfully complete the IPCV International Master Program, including the compulsory mobility period, receive a national degree from each partner university.



MSc in Info-bionics

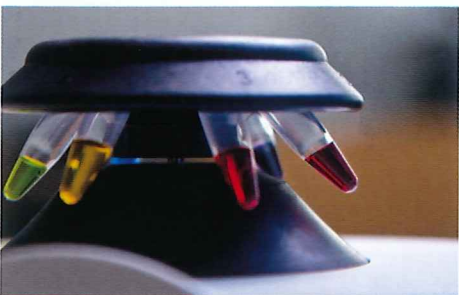
In the last decade we have witnessed the appearance of a new branch of industry, info-bionics, which has achieved great results (gene-chips, cochlea implants for the hearing impaired, personalized medicines, neuromorphic sensing robots) within a short time, and still developing at an amazing pace. It is the encounter of two state-of-the-art technologies, informatics and biotechnology.

We have set two main directions in the program. One of them comprises issues of engineering, electronics, and informatics where data processing of living organisms provide models for the engineering solutions or computational algorithms as well as methods needed to understand life better (e.g.: bioinformatics). The other direction includes procedures, instruments and devices aiding the measurement, control and operation of vital processes, which affect living organisms and the quality of human life. This program is especially important in the context of prostheses and rehabilitation. Examples included are bionic eyeglasses, leg actuation, wheelchair navigation or devices that facilitate invasive operations with only minor intervention.

SPECIALIZATIONS:

- Bionic interfaces
- Bio-nano-measurement and imaging





MSc in Medical Biotechnology

The program, which is run together with Semmelweis University Budapest, gives surpassing theoretical and practical knowledge at the frontiers of medicine and informatics. Medical biotechnologists work in the bio-medicinal field where their responsibilities include research, development, application and management tasks. They are capable of modeling and simulating biological systems on computers, applying the methods and instruments of computational biology and biochemistry, as well as designing, creating, managing and applying databases in the field of medical biotechnology. They will be capable of modeling different biological systems on computer, as well as of handling the data in abundance for such systems. As specialists trained in science, informatics and certain fields of medicine, they can be employed in basic research, in the pharmaceutical industry or in the biotechnology industry.

The theoretical basics for the Medical Biotechnology MSc program can be primarily acquired in the Molecular Bionics BSc program. Graduates with a BSc from the following programs also can apply: medicine, dentistry, pharmacy, chemistry, biology, or teachers with biology major-chemistry minor. Under certain circumstances the following bachelor diplomas can also be accepted: bioengineering, chemical engineering, medical laboratory diagnostics and imaging analyst.

OFFERED COURSES:

- drug design and development
- recombinant DNA techniques
- signal transduction
- cell biology, cell technology
- molecular pathology
- molecular genetics, genomics and systems biology
- computational chemistry and biology
- biological signal processing
- bioinformatics

SPECIALIZATIONS:

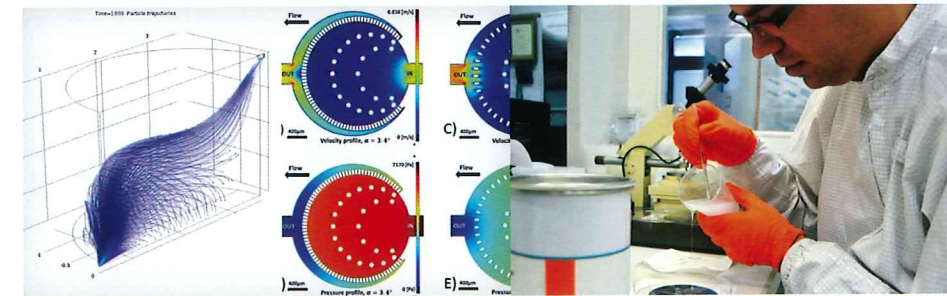
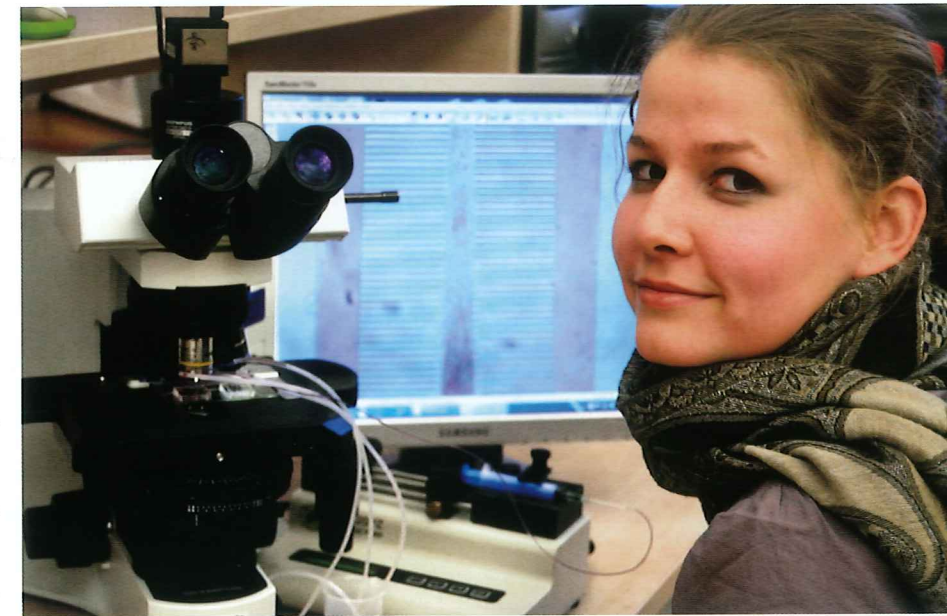
- Molecular Biotechnology Track
- Applied Bioinformatics Track

Research

Students can take part in research actively during their university years. They can work individually or in groups within the framework of the *Research Students' Groups* on a chosen topic with the assistance of a researcher or professor and later join some of the research projects of the *Jedlik Laboratory*, a Research Center at the Faculty.

Jedlik Laboratories is the center of scientific activity at the Faculty, where, in cooperation with PhD and some master students, faculty members do their respective research. This research and educational center was created with the active participation of five research institutes of the Hungarian Academy of Sciences (Institutes of Computer Engineering, of Experimental Medicine, and of Enzymology, Institute for Technical Physics and Materials Science and physiology related research institutes), along with Semmelweis Medical University, and some major and start-up companies.

Linking studies and innovation is realized through major research laboratories and state-of-the-art SME-s, both from Hungary and abroad.



Multidisciplinary Doctoral School of Sciences and Technology

The Multidisciplinary Doctoral School of Sciences and Technology at the Faculty is strongly related to research. Within this framework, several PhD doctoral titles and patents have been awarded. Former students either return to the field of education or join applied research through spin-off companies. At present there are three spin-off companies at our faculty.

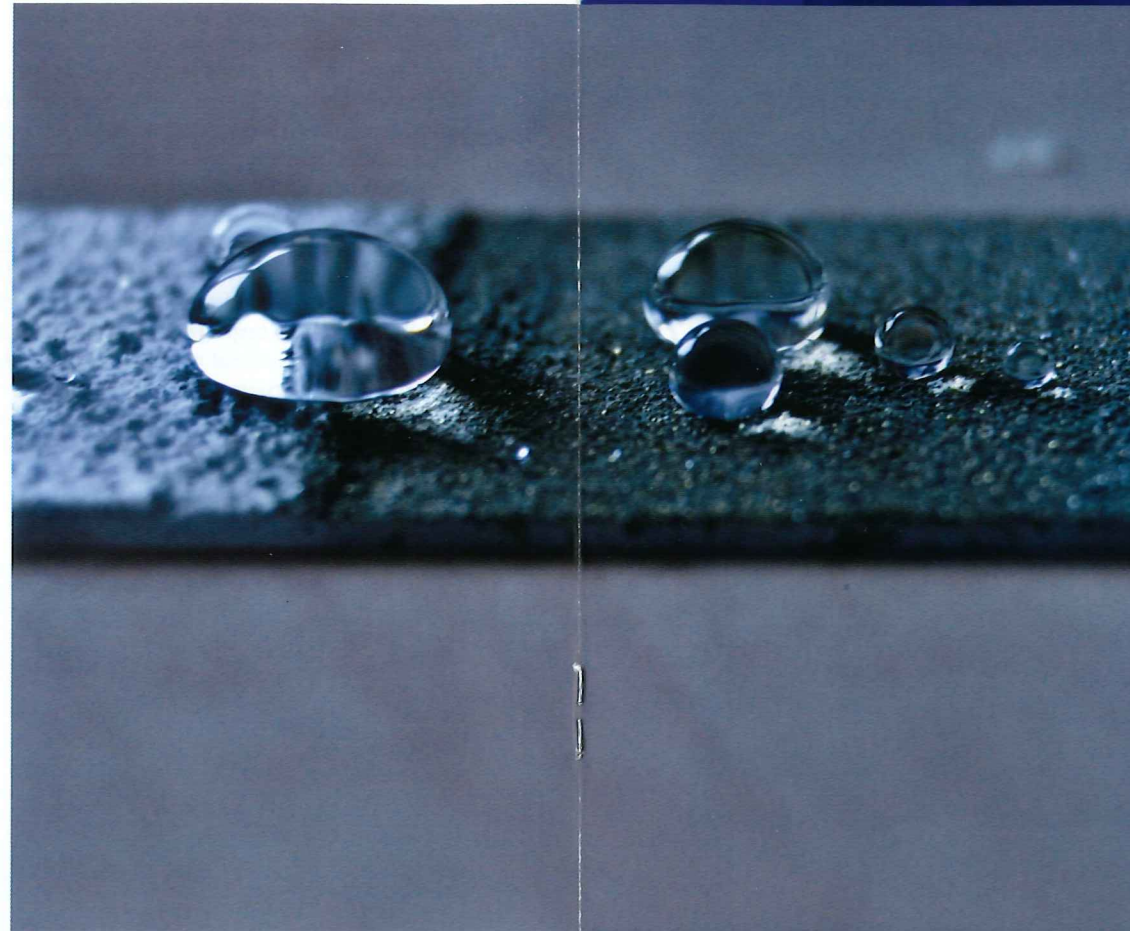
In the last few years we have been given the opportunity to join significant research projects with the participation of prestigious research centers abroad (Berkeley, Notre Dame, Leuven, Munich, Krakow, Turin, Seville, Catania, London, etc.).

Research results

The three main fields of our Multidisciplinary Doctoral School are: Information Science, Electrical Engineering and Biology.

THE PROGRAMS COVER FOUR AREAS:

- Bionics, Bio-inspired Wave Computers, Neuronomorphic Models. Head: SÁNDOR PONGOR
- Computer Technology Based on Many-Core Processor Chips, Virtual Cellular Computers, Sensory and Motoric Analog Computers. Head: PÉTER SZOLGAY
- Feasibility of Electronic and Optical Devices, Molecular and Nanotechnologies, Nanoarchitectures, Nanobionics, Diagnostic and Therapeutic Tools. Head: ÁRPÁD CSURGY
- Human Language Technologies, Artificial Understanding, Tele-presence, Communication. Head: GÁBOR PRÓSZÉKY



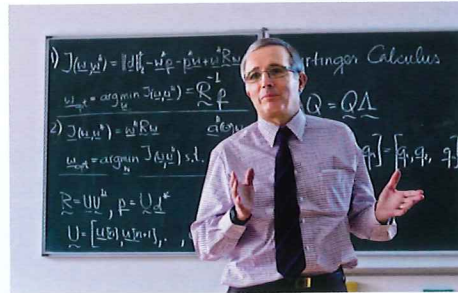
A few results to be mentioned:

- On cellular wave computer chips we have achieved the algorithmic combination of logical, analogue and noise signals along with the application of spatial temporal metrics, and commands for solving nonlinear wave equations
- Designing Cellular Multiprocessor computers for Navier-Stokes and geothermic PDE solving
- Construction of virtual and physical cellular computers and designing equivalent transformations between them
- Detection of audio events with cellular algorithms
- Cellular wave algorithms for tracking multi-target moving objects including immune response inspired algorithms
- Participation in designing nano-antenna elements
- Modeling molecular dynamics on supercomputers
- Visual saliency models in visual perception with human tests
- Designing and characterizing MEMS electrode for cerebral bionic interfaces
- Designing 180 nm and 350 nm parts on CMOS technology, hyper acuity in time
- Electronic phonendoscope as a sensing-computing device for newborn phonocardiography and diagnostics
- Designing, measuring 3-D tactile sensing-measuring device as well as working out its software algorithms
- Mouth movement animation for deaf people on mobile telephones
- Bionic, non-invasive, limb actuation of paralyzed patients with damaged spinal chord
- New language technological devices for Hungarian and English text analysis and computer aided translation

Main research areas

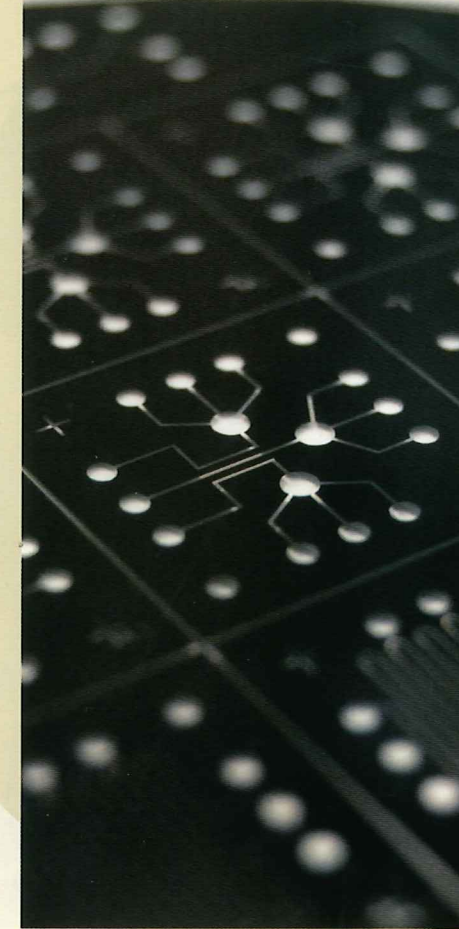
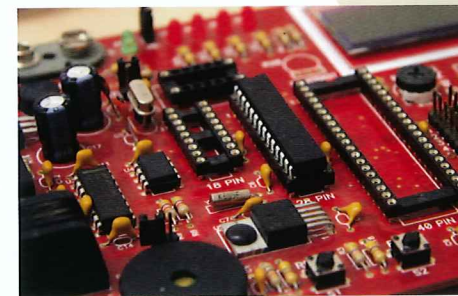
BIOLOGY INSPIRED AND NEUROMORPHIC MODELS, SENSING AND ALGORITHMS – INFO- BIONICS I.

- Vision
- Aural perception
- Tactile sensing
- Multimodal sensing, fusion, navigation
- Actuation
- Attention, memory and plasticity
- Neuromorphic model library
- Genetics-Bioinformatics – coding and structural data
- Immune response inspired models and algorithms



NANO-BIOTECHNOLOGY, MOLECULAR DYNAMICS, PHOTONICS - MODELING, SENSING AND BIO-INTERFACES – INFO-BIONICS II.

- Nano-electronics, nano-magnetics and nano-optics
- Biomolecular dynamics and protein folding
- Biological imaging devices
- Optical sensors, computers and bio-optical devices
- Constructing and measuring bionic interfaces, biocompatibility
- Lab-on-a-chip and drug delivery devices



CELLULAR WAVE COMPUTERS AND THE RELATED HARDWARE-SOFTWARE TECHNOLOGY

- Principles of cellular wave computers defined on image flows – complexity and spatio-temporal, analogue-binary wave-logic
- Physical implementation of cellular wave computers with topographic processor array architectures, mixed architectures and sensor computers
- Software framework systems and software libraries for computers with thousands of processors and memories

MICRO-ELECTRONIC SYSTEMS AND SENSOR DEVICES – DESIGN AND TESTING

- Deep submicron digital, analogue and mixed mode VLSI design and testing
- FPGA design and testing
- MEMS design and testing
- Sensor devices

HUMAN LANGUAGE TECHNOLOGIES AND ARTIFICIAL UNDERSTANDING

- Human language technologies
- Medical language processing
- Semantic embedding for artificial understanding via spatial-temporal sensors

TELE-PRESENCE AND MULTIMEDIA

- Mobile platforms and multimodal sensor mobile networks
- Audio and visual representation and algorithms

SENSORY ROBOTICS AND NAVIGATION

- Fusion of the outputs of multimodal sensor arrays
- Pro-active and adaptive sensing and actuation

SOFTWARE TECHNOLOGY AND DIGITAL COMPUTER ALGORITHMS

- New platforms and programming methodologies for software technology
- Mixed content databases
- Security issues in internet and mixed communication systems

International contacts

One of the best-known and most successful initiatives of Life Long Learning Program of the EU is ERASMUS, promoting international study possibilities for university students. Based on a competent knowledge of a foreign language and good study results, our students can spend a period of 3 months to one year at one of our partner universities. Students receive full academic recognition for their study period abroad as part of their original studies. The ERASMUS program offers support for expenses that occur in course of the study time abroad. We are proud of the fact that the most prestigious universities in Europe in our fields can be found among our ERASMUS partners. These universities always welcome our students and are happy to send their own students to our faculty.

- Katholieke Universiteit LEUVEN (Belgium)
- Ludwig-Maximilians-Universität MÜNCHEN
- Technische Universität DRESDEN (Germany)
- Politecnico di TORINO
- Università Degli Studi di SIENA
- Università de CAGLIARI (Italy)
- CRANFIELD University (United Kingdom)
- Radboud University NIJMEGEN (The Netherlands)
- University of JOENSUU (Finland)
- Universidad San Pablo CEU
- Universidad Autónoma de Madrid
- Universidad Ramón LLull, BARCELONA
- Universidad de Deusto, BILBAO (Spain)
- Istanbul Teknik Üniversitesi (Turkey)
- Tallinn University of Technology (Estonia)
- University of Applied Sciences, Vienna (Austria)
- University of Ljubljana (Slovenia)
- Université de Bordeaux
- Institut Supérieur d'Electronique de Paris (ISEP) (France)

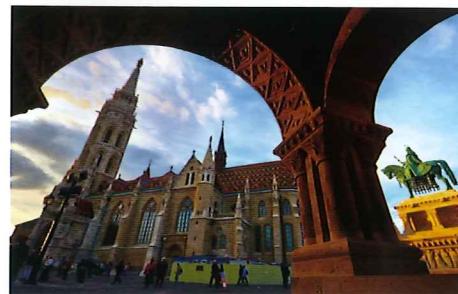


Budapest

Budapest is the capital city of Hungary, the largest city in Central Europe, and the seventh largest in the European Union. The history of Budapest goes back to over one thousand years, when it became the Roman capital of the province Lower Pannonia (under the name Aquincum). The Hungarians arrived to the Carpathian Basin during the 9th century. King Saint Stephen founded the Hungarian state in the year 1000 AD. During the middle ages, Hungary became one of the centres of Renaissance in the 15th century. Following the Turk conquest in the 16th century, Hungary suffered a 150-year rule of the Ottoman empire. A new age of prosperity started after 1873, when Pest, Buda and Óbuda were united into one city under the name Budapest. Nowadays, Budapest has 1,73 million inhabitants. Cited as one of the most beautiful cities in Europe,

its extensive World Heritage Site include the banks of the Danube, the Buda Castle Quarter, Andrassy Avenue, Heroes' Square and the Millennium Underground Railway (second oldest in the world). Other highlights include a total of 80 geothermal springs, the world's largest thermal water cave system, the second largest synagogue and third largest Parliament building. The city attracts about 2.7 million tourists a year, making it the 37th most popular city in the world. Budapest offers plenty of possibilities for cultural and touristic entertainment. Hungarians are fond of music and Budapest is the centre of musical life of Hungary. Concerts are held everywhere: in great concert halls, in little chamber halls, churches, sport arenas, and open-air during the summer period. The works of renowned composers such as Béla

Bartók, Zoltán Kodály or Ferenc Liszt make the Hungarian classical and folk music famous all around the world. The biggest musical event of Budapest is Sziget Festival (organised in August each year). Museums and exhibitions present the history and culture of the Magyars, while featuring many fine examples of contemporary art. There are quite a few museums in Budapest, which also give home to temporary collections from time to time. Margaret Island provides a peaceful hideaway from hectic downtown Budapest with large green areas, flowery gardens, and old trees. The island's attractions include romantic walkways, medieval ruins, a small zoo, musical fountain, a water tower, swimming pools, lido and a relaxing atmosphere.



Contact information



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380 years
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— 1635 - 2015 —