# Pázmány Péter Catholic University
## Roska Tamás Doctoral School of Sciences and Technology
# TRAINING PLAN

2022

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PROVISIONAL TRANSLATION[1]

[1] In the event of a dispute, the Hungarian language version shall prevail with respect to the training plan of the doctoral school.

**Roska Tamás Doctoral School of Sciences and Technology**

**PPCU Faculty of Information Technology and Bionics**

**The Head of the Doctoral School:**
**Gábor Szederkényi, Doctor of the Hungarian Academy of Sciences**
**Chairman of the Disciplinary Doctoral and Habilitation Council:**
**Gábor Prószéky, Doctor of the Hungarian Academy of Sciences**

# Training Plan

**Budapest, September 2022**

***Pázmány Péter Catholic University***

***Faculty of Information Technology and Bionics***

***Roska Tamás Doctoral School of Sciences and Technology***

***Training Plan***

I. Introduction, Principles of Doctoral Training at the RTDSST

The training plan of the Doctoral School is in line with the quality assurance documents for doctoral training at the university level of the PPCU and with the objectives of the Quality Assurance Plan of the Doctoral School, using the tools and methods defined therein to ensure the continuous quality of training and, where internal and external circumstances allow, to raise the quality of training.

In line with our mission statement and good practice, we place great emphasis on the following principles in doctoral training:

- Multidisciplinarity. We believe it is important that our doctoral students are open to these disciplines and are able to systematise, develop and apply their results and their interfaces in a creative way.
- Individual training programmes. This naturally emphasises the responsibility of the PhD supervisor.
- Priority to research work: the most important aim of doctoral training is to enable doctoral students to carry out independent scientific research. Accordingly, we motivate and reward effective research work and the preparation and publication of high-quality scientific publications.
- International and national embeddedness: the quality of the training is also determined by the international links already in place, involving close cooperation with the University of Notre Dame, Indiana, the Catholic University of Leuven and the University of Seville, the Politechnic University of Turin, the University of Bordeaux, the Autonomous University of Madrid, the relevant laboratories of the IFOM Institute in Milan, and some ten other laboratories through joint work or project-level collaborations. In addition, we collaborate intensively with the institutes of ELKH KOKI, SZTAKI, TTK and MFA, as well as with the institutes of OIKI and Semmelweis University, which support the quality of doctoral education and the cultivation of world-class topics for PPCU doctoral students with their teaching, research, subject and laboratory capacities.

Education and Research Unit

II. The disciplines and doctoral programmes of the RTDSST

Disciplines:
- biological science
- electrical engineering
- information science

Doctoral programmes:
- Programme 1: Bionics, bio-inspired wave computers, neuromorphic models
- Programme 2: Kilo-processor chip computing, sensor and motion analogue computers, virtual cellular computers
- Programme No 3: Feasibility of electronic and optical devices, molecular and nanotechnologies, nano-architectures, diagnostic and therapeutic tools for nano-bionics.

- Programme 4: Human language technologies, artificial intelligence and remote sensing
- Programme 5: Research on in-vehicle navigation systems

III. Stages and elements of doctoral training

In accordance with the legislation in force, the 8-semester course may be divided into two stages:

1. study and research phase (maximum 4 active semesters, 120 credits)
2. research-dissertation phase (maximum 4 active semesters, 120 credits)

The doctoral programme shall comprise at least 240 credits, broken down into the following activities
- completion of courses and research seminars: minimum 30 credits, of which minimum 24 credits in the study-research phase,
- independent work on a topic: maximum 80 credits,
- publication activities: minimum of 80 credits, of which at least 20 credits in the study-research phase,
- doctoral dissertation work: maximum 30 credits
- Teaching and teaching support: for doctoral students with a Hungarian State Scholarship, a minimum of 16 teaching credits in the study/research phase, a maximum of 32 credits,
- completion of annual reports: maximum 40 credits,
- attendance of events related to the doctoral procedure (workplace debate of PhD thesis, public debate of PhD thesis): minimum 2, maximum 4 credits

The details of each activity and the corresponding credits are as follows.

III.1. Completion of courses and research seminars
The courses and research seminars offered by the doctoral school are worth 6 credits each. In addition to the chosen subjects, the completion of at least 2 research seminars is mandatory during the study and research phase (12 credits in total). With the written support of the subject leader and the programme leader, the completion of a doctoral subject or training course (e.g. summer school) outside the doctoral school may also be recognised as a subject credit. The Head of the Doctoral School decides on their acceptance and the number of credits to be awarded for external training on the proposal of the subject leader, taking into account the opinion of the relevant programme leader if necessary. The administrative conditions for acceptance are the provision of credible evidence of completion and the completion and submission of the subject form related to the subject (training).
III.2. Independent thematic work
Credit may be awarded for the independent acquisition of additional professional knowledge, skills and abilities required for scientific research. The activity will be recognised and certified by the PhD supervisor according to the amount of work invested. A maximum of 10 credits in total may be awarded for this activity in a given semester.
III. 3. Publication activities
The work devoted to research and the communication of results, mainly through publications, will be recognised by the doctoral school with the following credits:
(1) peer-reviewed publication in English in an international impact factor journal registered in Web of Science with ISSN: 50 credits/article,
(2) peer-reviewed, non-impact factor, international journal with ISSN, registered in Scopus and with Scimago SJR (Q1-Q4) classification, published in English: 30 credits/article,
(3) full-text article (minimum 20,000 characters) published in a refereed conference publication in English: 20 credits/article,

(4) oral or poster presentation in English at an international conference with a refereed conference article or abstract of less than 20,000 characters: 20 credits/article (abstract) for the presenter only.
In the absence of a co-author waiver in categories (1), (2), (3), publication credits will be divided by the number of non-foreign authors (with Hungarian affiliation) without a PhD degree in engineering or natural sciences. Only publications in journals or conferences relevant to a discipline in which the doctoral school is active will be awarded credit. Acceptance of publication credits is subject to the recording of the publication in the MTMT with the affiliation to the doctoral school (also), and to institutional verification and approval. International conference referees must provide a letter of acceptance of the article/abstract. Proof of the presentation and the identity of the presenter is provided by a certificate issued by the conference organisers. Where circumstances make this absolutely necessary (e.g. to obtain a minimum publication credit at the relevant stage of the training), an official editorial acknowledgement (e-mail) of acceptance of the article in final form is acceptable. The desired features and proofreading of journals should be verified by reference to the current MTMT. Approval of publication credits will be decided by the subprogramme leader or the head of the doctoral school, taking into account both disciplinary relevance and formal requirements. Publication credits may be awarded for publications published within a maximum of 3 years prior to the start of doctoral studies as described above. Publication credits for validated and approved publications may be counted in any semester of the doctoral programme not yet completed.
III.4. Completion of annual accounts
In addition to the semesterly short written reports, doctoral students are required to present an annual report on their research activities to a committee in the form of a presentation of at least 15 minutes in English at the PhD Proceedings conference of the doctoral school. The presentation must be accompanied by a conference paper of at least 4 pages in the format specified by the doctoral school and must be approved by the PhD supervisor before submission. 10 credits will be awarded for the submission of the conference article by the deadline and for the presentation of the paper. The successful completion of a complex examination or the presentation of a final institutional UCPD report during the academic year will exempt the doctoral student from the oral part of the annual report organised in that academic year. A successfully completed homework (workplace discussion) during the academic year will result in automatic acceptance of the annual report.
III.5. Work on the doctoral dissertation
30 credits may be awarded for the submission of a doctoral dissertation that meets the formal requirements for a workplace discussion.
III.6. Teaching and educational support
The following credits may be awarded for this activity:
(1) Teaching
1 contact hour of teaching per week (seminar, laboratory tutorial) may be awarded 2 credits. At least 16 credits of teaching must be completed by doctoral students with a Hungarian State Scholarship in the study and research phase.
(2) Teaching support activities
Upon written proposal of the PhD supervisor, a maximum of 3 credits per semester may be awarded for the following activities:
Supervision and correction of thesis of BSc, MSc level (in case of a subject not currently taught); examination, secretarial and/or organisational duties at an independent laboratory report, thesis and diploma examination, TDK conference, ÚNKP conference; other activities supporting teaching (e.g. participation in the organisation and conduct of PPCU-related conferences, open days, external promotional lectures).
For the calculation of the number of credits, the accounting rules of the teaching hours statement apply.
III. 7. Attendance at events related to the doctoral procedure

Credit points can be obtained for this activity as follows:
- Attendance of a workplace debate of PhD thesis (house defence): 1 credit per event,
- attendance of a public debate of PhD thesis: 1 credit per event.
In addition to documented attendance, a short written summary of the event in a given format is required for the award of credits.

IV. Doctoral students' semester work plan and end-of-semester report

The individual curriculum and work of doctoral students in the doctoral school is organised and guided by the PhD supervisor. The progress of the doctoral students' studies is based on an individual model curriculum, which is documented in the work plans and reports prepared each semester: both the work plans and the reports must be prepared by the doctoral student under the guidance of the PhD supervisor and must be approved by the head of the programme concerned in addition to the PhD supervisor. The reports shall be commented in writing by the PhD supervisor, who shall give a grade on a traditional five-point scale for the doctoral student's semester performance.

V. The complex exam

V. 1. Conditions for applying for the examination and its approval
The conditions of admission to the examination for participants in an organised doctoral programme are as follows:
1) the completion of at least 90 credits in the first stage of doctoral studies, including at least 20 publication credits, 2) a statement of support from the PhD supervisor for the application for the complex examination.
For individual candidates, the application for the complex examination is conditional upon the fulfilment of the minimum publication requirements for the degree. The application for the complex examination is approved by the MMTDHT.
V. 2. PhD Supervisor evaluation and doctoral student report
The PhD supervisor will be invited to the complex examination and, prior to the examination, will send a brief written evaluation of the candidate's performance to the Doctoral Office, including a specific statement on whether he/she recommends that the candidate should be allowed to start the second stage of the doctoral programme under his/her supervision. The candidate shall submit to the Doctoral Office, at least one week before the examination, a short summary of his/her scientific achievements and ongoing research in the first phase of the training, in electronic form, in approximately 2500-4000 characters, divided into thesis points, and any articles submitted or published.
V. 3. Conduct and assessment of the complex examination
The complex examination must be taken in public before a board. The examination board shall consist of at least three members, at least one third of whom shall not be employed by the PPCU. The chairperson of the examination board shall be a professor or Professor Emeritus, or a researcher with the title of Doctor of the Hungarian Academy of Sciences. All members of the examination board hold an academic degree.
The PhD supervisor of the PhD student taking the examination may not be a member of the examination board.
The first 'theoretical part' of the complex examination shall cover at least two subjects (one core subject and one subsidiary subject). These subjects may be chosen from among the subjects completed for academic credit or subjects related to the candidate's field of research. A basic subject which the doctoral candidate has previously completed as a subject may be chosen for the complex examination. The list of core subjects for each programme is approved by the MMTDHT (Annex 1).

In the theoretical part of the complex examination, the examination board shall assess each subject examination on a five-point scale (1- unsatisfactory, ..., 5 - excellent). The percentage of the theoretical part is the average of the percentage of the subjects. The theoretical part of the examination is graded in two steps: 'pass'/'fail'. The second part of the complex examination is the 'dissertation part', in which the candidate gives a presentation of about 20 minutes on his/her scientific progress: knowledge of the literature, his/her research results, his/her research plan for the second phase of doctoral studies, and the timetable for the preparation of the dissertation and publication of the results. The dissertation section is also assessed by the committee on a two-point 'pass'/'fail' scale. The complex examination as a whole is passed ('passed') if both the theoretical part and the dissertation part are assessed as 'passed'. The complex examination is recorded in a written evaluation report. Successful completion of the complex examination is a prerequisite for entry to the second stage of the training.

Individual candidates who meet the minimum publication requirements for the degree will be admitted to the second stage of the course on passing the complex examination and will receive 120 credits for their prior professional and scientific activity.

Annex 1

Core subjects for the complex examination for training programmes

Programme 1: Bionics, bio-inspired wave computers, neuromorphic models
- Bioinformatics
- Neurobiology
- Cellular engineering and experimental cellular models

Programme 2: Kilo-processor chip computing, sensor and motion analogue computers, virtual cellular computers
- Cellular wave computers
- Parallel computer architectures

Programme 3: Feasibility of electronic and optical devices, molecular and nanotechnologies, nano-architectures, diagnostic and therapeutic tools for nano-bionics
- Cellular wave computers
- Physical principles of nanotechnology

Programme 4: Human Language Technologies, Artificial Intelligence and Remote Sensing
- Statistical methods in machine translation and text processing
- Fundamentals of natural language processing
- Neural networks

Programme 5: Research on in-vehicle navigation systems
- Neural networks
- Parallel computer architectures

***Introduction***

The Training Plan of the Doctoral School is in accordance with the provisions of the PPCU university-level quality assurance documents as well as the targets laid out in the Doctoral School's quality assurance plan. The Training Plan uses the tools and methods of the latter to ensure the ongoingquality of training and, if made possible by both internal and external circumstances, to improve the quality thereof.

At the Doctoral School, PhD supervisors organize and direct the work of doctoral students. The academic advancement of doctoral students takes place on the basis of individual model curricula as documented by work plans and reports prepared every semester: both work plans and reports have to be prepared by doctoral students under the direction of their PhD supervisors, and they shall beapproved by both their PhD supervisor and the head of respective program. The PhD supervisors provide writtencomments for reports.

In agreement with the doctoral student, the PhD supervisor may request an advisor to head certain projects and/or specialized fields. In addition to central funding, the financial resources necessary for the development of projects are provided by research contracts as well as the own funds of the Jedlik Laboratory.

The quality of training is defined by existing international relations, which includes close cooperation with the laboratories of the University of California, Berkeley; University of Notre Dame in Indiana; the Catholic University of Leuven; the University of Seville; and the Polytechnic University of Turin, as well as approximately ten other laboratories in the form of collaboration in joint works and projects.

This has led to a significant portion of doctoral students spending study trips of various lengths and the active participation of professors conducting research at these locations in doctoral programs (L.O. Chua, Berkeley; W. Porod, Notre Dame; Josef Nossek, Munich; F.S. Werblin, Berkeley; J. Vandewalle, Leuven; A. Rodríguez-Vázquez, Seville; etc.). For years, Árpád Csurgay has been spending lengthy periods of time at Notre Dame.

The foundations of this extensive international cooperation were laid earlier: the result is not only the exceptional international success in the field of publications by doctoral students, but also a large number of research contracts coming from abroad. A number of foreign doctoral students, postdocs, and professors have spent longer and shorter periods of time at Jedlik Laboratory as part of such programs. Another consequence is the large number of important conferences where the Laboratory's professors, postdoctoral researchers, and doctoral students have held lectures and prepared publications together.

The selection of lecturers and researchers helps uphold the principle that new postdoc/professor colleagues who join us should acquire the title of Doctor of the Hungarian Academy of Sciences and/or should have special training in their field of expertise.

It is of fundamental importance that brief visits by renowned foreign professors and the participation of foreign doctoral students at the School should become a natural part of everyday work.

In addition to the relatively stable presence of feeder courses and seminar series in the list of available subjects, new subjects also make regular appearances. We also provide a possibility for subject registration in the form of supervised individual studies. The work of doctoral students extends to holding examinations, preparing biannual progress report-type written reports, and

evaluating the report and research work connected to the year-end presentation.

***Changes in doctoral programs***

Starting from September 1, 2016, the doctoral program consists of 8 semesters. PhD students obtain 240 credits to receive their final certificates. The 8 semesters are broken down into two sections of 4 semesters each. The aim of the first “study and research stage” is to prepare for the complex examination. This stage requires doctoral students to obtain 120 credits (recommended composition: 20 teaching/academic organization, 40 study, and 60 research credits) to take a complex examination.

The complex exam

The complex exam consists of two parts, divided into 'theoretical' and 'dissertation' parts. The PhD supervisor receives an invitation to the complex exam and sends a prior written assessment of the candidate to the Doctoral Office. They also suggest whether the candidate should begin the second phase of doctoral training.

The first 'theoretical part' of the complex exam covers at least two topics (subjects). These topics / subjects are the subjects completed with study credits, respectively. Topics related to the candidate's field of research form groups in a mandatory and optional format and are part of the training plan, broken down by program. In the theoretical part of the complex examination, the examination committee evaluates all subject tests on a five-point scale (1 - insufficient,…, 5 - marked). The percentage result of the theoretical part is the average of the percentage results of the subjects. The final assessment of the theoretical sub-exam is of two levels: 'passed' / 'failed.' A theoretical sub-exam will receive a 'pass' assessment if all subject assessments are at least sufficient (2).

The second part of the complex exam is the 'dissertation,' where the candidate reports on their scientific progress in the form of a lecture: their knowledge of the literature, reports on their research results, their research plan for the second phase of doctoral training. The committee also evaluates the dissertation on a two-point scale 'passed' / 'failed.' The complex exam as a whole is successful ('passed') if both the theoretical part and the dissertation part are 'passed.'

The doctoral student may repeat the failed complex exam once in the same exam period.

PhD students preparing individually will enter the training program upon successfully passing the complex examination. The successful complex examination is followed by the second, “research and dissertation” stage of the doctoral program. The purpose of the second stage is to prepare the dissertation, provide a successful defense, and obtain the doctoral degree. In this stage, doctoral

students need to obtain 120 credits (recommended composition: 60 research credits and 60 dissertation credits). The majority of the research credits are made up of the "Directed Research" that lasts a total of 4 semesters: it includes regular consultations with the PhD supervisor, which is reflected in the

work plan and report that is prepared every semester, as well as any presentations held in a foreign language at international conferences and summer school and workshop participation, if acknowledged by the PhD supervisor as preparation for the dissertation. Dissertation credits can be acquired for preparatory works on publications for supporting theses, publications in high impact factor scientific journals, and for submitting dissertation chapters.

***The structure of programs; required and optional subjects***

The Doctoral School deals with the following disciplines:

Information sciences
Electrical engineering sciences
Biological sciences

**Programs:**

Program 1: Bionics, bio-inspired wave computers, neuromorphic models

Program 2: Computer technology based on kilocore processor chips; sensory and motoric analog computers; virtual cellular computers

Program 3: Feasibility of electronic and optical devices; molecular and nanotechnologies; nano-architectures; nano-bionic diagnostic and therapeutic tools

Program 4: Human language technologies, artificial understanding, and telecommunication

Program 5: Study of vehicle on-board navigation systems

***Program 1*** requires PhD students to study the information technology of live systems.

This is also reflected by the following program that serves the preparation of the complex examination. The program follows the structure of the complex examination. The complex examination consists of a theoretical and a dissertation part. The theoretical part consists of two subjects/topics.

The program includes required and optional subjects.

Required subjects:

Cellular and analogic computers

- Chapters from the topics of non-linear spacetime dynamics and emerging calculations
- Infobionic models and prostheses

Optional subject: of the subjects available beforehand, with a wider outlook.

Optional subject from neurosciences: The functional structure of the nervous system,

- the functioning of the neuron (ion channels, membrane potential, etc.)
- synaptic neurotransmission
- the functional structure of the nervous system
- the retina and the visual system, or another sensory module
- multimodal fusion

The applicable optional subjects available to neurobiologist and medical doctoral students cooperating with the Doctoral School can be selected from among the subjects of the present program or Semmelweis University's doctoral-level subjects; elective and optional subjects are the reverse of the above list.

In program 1, the subjects to be taken serve to provide a foundation for the "theoretical part" of the complex examination.

***The title of program 2:*** *Computer technology based on kilocore processor chips; sensory and motoric analog computers; virtual cellular computers* prepares PhD students for understanding the physical functioning and the design methodology of sensors, processors, memories, transmission equipment, displays, and the systems consisting of these components, with special consideration given to systems built of nanoelectronics tools and synthesized with the use of molecules.

This also includes the issues of designing 80-180 nanometer CMOS integrated circuits.

In general, the architecture of the systems in program 2 is cellular as well, and the supplementary traditional processor and the mathematical models of the tools are non-linear in the nano-range and the molecular realm, which means the "Cellular Nonlinear Network" (CNN) paradigm plays an important part in program 2 as well.

Building on the physics of these new tools, the program considers its main objective to study the methods used to design integrated systems. In the nano-range, the physical basics extend beyond

the limits of traditional physics, with the role of quantum effects playing a fundamental part. PhD students therefore have to be familiar with the basics of quantum physics and quantum chemistryand the related technologies in addition to field theory and the physics of solid-state physics.

The electronic application of nanotechnologies opens up new possibilities for the electronic implementation of the principles taken from molecular biology information technology systems. The successful maintenance of quantum effects also entices with the possibility of realizing quantum computers.

The program prepares doctoral students for the complex examination. The first, “theoretical part” of the complex examination consists of 2 subjects. (The majority of lectures and literature is in English.)

Required subjects in program 2:

- Foundations of Nanotechnology and Molecular Electronics
- Sensing and Sensor Technologies
- Analogic Cellular Wave Computing

Optional subjects:

- Circuit Theory
- Physics of Information Technology
- Realizability of Quantum Computers
- Quantum Optics and its Applications
- And other subjects related to the doctoral student’s topics

***Program 3*** *Feasibility of electronic and optical devices; molecular and nanotechnologies; nano-architectures; nano-bionic diagnostic and therapeutic tools*

The program prepares doctoral students for the complex examination. The subjects that provide the foundations for the “theoretical part” of the complex examination form two groups: one announcedas required subjects and one as optional.

Required subjects in program 3:

- Physics for Information Technology
- Physics for Nanobio-Technology

Optional subjects in program 3:

- Spin 1/2 Quantum Systems: Dynamics and Circuit
- Bio-electromagnetism and Complexity
- Introduction to Nanotechnology
- And other subjects related to the doctoral student's topics

The first, theoretical part of the complex examination consists of two topics/subjects. The two subjects are selected from among the required and the optional subject groups. (The majority of lectures and literature is in English.)

***Program 4*** *Human language technologies, artificial understanding, and telecommunication*

The first, theoretical part of the complex examination consists of two topics/subjects. The following required and optional subjects prepare doctoral students for meeting the requirements of the theoretical part.Required subjects in program 4:

- Foundations of Human Language Technology

or

- Foundations of Telepresence in Local and Global Scale

Optional subjects:

- Systems of Language Processors
- Main Concepts and Constructs in Programming Languages
- Neural network and AI Methods in Language Technology
- Analogic Cellular Wave Computing
- Sensing and Sensor Technologies
- The Communications Subjects of Telepresence

***Program 5*** *Study of vehicle on-board navigation systems*

Required subjects in the program:

- Analogic Cellular Wave Computing
- Parallel Computer Architectures
- Sensing and Sensor Technologies
- Neurobiology

Optional subjects:

- Circuit Theory
- Physics of Information Technology
- Realizability of Quantum Computers
- Quantum Optics and its Applications
- And other subjects related to the doctoral student's topics

The majority of lectures and literature is in English. Two subjects/topics are selected from the listed required and optional subjects for the theoretical part of the complex examination.

**Topic areas and the participating core members**

Biology-Inspired and Neuromorphic Models, Senses, and Algorithms

- Sight
- Hearing
- Touch
- Multimodal Sensing, Fusion, and Navigation
- Moving
- Attention and Plasticity, Memory - Hippocampus
- Neuromorphic Model Library
- Genetics-Bioinformatics - Coding and Structural Data
- Immune Response-Inspired Models and Algorithms

Core member PhD supervisors: Csaba Benedek, Attila Csikász-Nagy, Tamás Freund, Péter Földesy, Zoltán Gáspári, Sándor Pongor, Gábor Szederkényi, István Ulbert, Ákos Zarándy

Nanotechnology, Molecular Dynamics, Optics - Modelling, Sense, and Biointerfaces

- Nanoelectronics, Nanomagnetics, and Nanophotonics
- Biomolecular Dynamics and Protein Folding
- Biological Imaging Tools
- Optical Sensors, Computers, and Bio-Optic Tools
- The Construction and Measurement of Bionic Interfaces, Biocompatibility
- Lab-on-a-chip and Pharmaceutical Delivery Systems

Core member PhD supervisors: Árpád Csurgay, Mihály Kovács, Gábor Szederkényi, Zsolt Sazbó, Péter Szolgay,István Ulbert, Ákos Zarándy

The Basics of Cellular Wave Computers and the Connected Hardware and Software Technologies

- The Basics of Image Stream-Defined Cellular Wave Computers – Complexity and Spacetime, Analog-Binary Wave Logic
- The Physical Implementation of Cellular Wave Computers with Topographical Processor Block Architectures, Mixed Architectures, and Sensory Computers
- Software Framework Systems and Software Libraries in Computers with Thousands of Processors
- Information systems

Core member PhD supervisors: Csaba Benedek, Péter Földesy, Géza Kolumbán, Mihály Kovács, Csaba Rekeczky,Gábor Szederkényi, Péter Szolgay, Ákos Zarándy

Micro-Electronic Systems and Sensory Tools – Design and Measurement

- Deep-Submicron Digital, Analog, and Mixed-Mode VLSI Design and Measurement
- FPGA Design and Measurement
- MEMS Design and Measurement
- Sensory Equipment

Core member PhD supervisors: György Cserey, Péter Földesy, Péter Szolgay, Ákos Zarándy

Human Language Technologies and Artificial Understanding

- Human Language Technologies
- Artificial Languages
- Artificial Understanding Using Semantic Embedding Sensors

Core member PhD supervisors: Géza Kolumbán, Gábor Prószéky

Telepresence and Multimedia

- Mobile Platforms and Multimodal Sensory Mobile Networks
- Audio and Visual Representation Algorithms

Core member PhD supervisors: Gábor Prószéky, Ákos Zarándy

Sensory Robotics and Navigation

- Fusion of the Output of Multimodal Sensory Blocks
- Proactive and Adaptive Sensory and Movement

Core member PhD supervisors: György Cserey, Gábor Szederkényi, Ákos Zarándy

Software Technology and Digital Computer Algorithms

- New Software Technology Platforms and Programming Methodologies
- Mixed-Content Databases

Core member PhD supervisors: Géza Kolumbán, Mihály Kovács, Gábor Prószéky