UNIVERSITY OF PARDUBICE	
Directive No. 1/2022	
Subject:	Admission rules to the 1st year of doctoral study programme P0788D060002 Electrical Engineering and Informatics for the academic year of 2022/2023
Scope of authority:	Faculty of Electrical Engineering and Informatics and doctoral programme applicants
In effect from:	Date of issue
Elaborated and submitted by:	doc. Ing. Frantisek Dusek, CSc., Vice-Dean for Study Affairs
Approved by:	Ing. Zdenek Nemec, PhD., Dean

Dean of the Faculty of Electrical Engineering and Informatics of the University of Pardubice invites applicants for the entrance exam for the first year of Doctoral Programme for the academic year of 2022/2023 in accordance with the Article No. 48, 49, Act No. 111/1998 Coll. on higher education institutions and on the amendement and supplementto some other acts and sections 6, 7, 9 and 10 on the statuses of the University of Pardubice:
P0788D060002 Electrical Engineering and Informatics

Article 1
Application for studies

(1) Applications for study may be submitted electronically at http://eprihlaska.upce.cz or on a standard form (SEVT form) to the University of Pardubice, Faculty of Electrical Engineering and Informatics, Studentská 95, 532 10 Pardubice.

(2) The deadline for submitting applications for the academic year 2022/23, including payment of the administrative fee, is **15 May 2022**.

3) A copy of the proof of payment of the fee must be attached to the application on form SEVT. An application on Form SEVT without the enclosed proof of payment will be returned for completion. If the applicant fails to submit the document by the deadline, he/she has not fulfilled the admission requirement and the admission procedure will be terminated by resolution.

(4) It is not necessary to send a copy of the electronic application form (hereinafter referred to as the "e-application") by post, and it is not necessary to prove payment of the admissions fee (hereinafter referred to as the "fee") by using the correct payment symbols generated at the end of the e-application.

(5) In addition to the programme of study and the form of study, the application form must list the topic of the dissertation and the name of the supervisor. The list of topics is attached to this Directive.

(6) Applicants for the PhD study programme P0788D060002 Electrical Engineering and Informatics are obliged to send to the Science and Research Department of the Faculty of Electrical Engineering and Informatics of the University of Pardubice the annexes to the application form in paper form, i.e. a structured CV in English, proof of the level of knowledge of the English language, officially certified proof of a previous master's degree and a copy of the passport (in the case of a foreign national applicant).

(7) Address for sending the application form and mandatory attachments:
University of Pardubice
Faculty of Electrical Engineering and Computer Science
Department for Science and Research
Studentská 95
532 10 Pardubice

(8) If the application for studies does not have the prescribed requirements or suffers from other defects, the applicant will be asked to remove them. If the applicant fails to remedy the defects within the time limit set, he/she will not meet the conditions for the opening of the admission procedure and the procedure will be terminated by resolution.

(9) On the basis of the registered application form, applicants will be invited in writing or electronically to take an entrance examination.

(10) A medical certificate is not required.

Article 2
Administrative fees

(1) Administrative fees for the procedure of admission in study programme in English P0788D060002 are:
Application fee: CZK 2000
University Account Name: Univerzita Pardubice
Account number: 37030561/0100
Variable symbol: 6921
Specific symbol: personal university number (generated by e-application)
Banks Name: Komercni banka Pardubice
Bank Address: nam. Republiky 222, 530 78 Pardubice
IBAN: CZ2901000000000003703061
SWIFT: KOMBCZPPPXX

(2) The fee for the admission procedure is non-refundable.

(3) Fee for the assessment of education in the admissions procedure in accordance with the Directive No. 11/2019 Rules for the assessment of foreign secondary and higher education within the admission procedure at the University of Pardubice:
Recognition fee: CZK 600
University Account Name: Univerzita Pardubice
Account number: 37030561/0100
Variable symbol: 6929
Specific symbol: personal university number (generated by e-application)
Banks Name: Komercni banka Pardubice
Bank Address: nam. Republiky 222, 530 78 Pardubice
IBAN: CZ2901000000000003703061
SWIFT: KOMBCZPPPXX

(4) The fee for the admission procedure is non-refundable.

Article 3
Conditions for admission to study

1) A candidate who successfully completes the study of a follow-up master's degree programme and successfully passes the entrance examination may be admitted to study. If the applicant does not have a certified copy of the diploma by the date of the entrance examination, he/she shall provide a confirmation of the date of the state final examination. The certified copy of the diploma shall be presented immediately after receipt of the diploma, at the latest at the time of enrolment.

2) Applicants for study at the university who have obtained their previous education elsewhere than in the Czech Republic or Slovak Republic are admitted to study in the Czech language under the same conditions as other applicants, provided that
a) their education has been recognised as the education required by law for admission to a doctoral programme
(b) they have complied with the conditions of the admission procedure laid down for other applicants

Applicants' higher education may be recognised for the purposes of the admission procedure in accordance with the Directive No. 11/2019 - Rules for the Assessment of Foreign Higher Education in the Admission Procedure at the University of Pardubice.

(3) Applicants for study at the University with citizenship other than that of the Czech Republic and the Slovak Republic shall be admitted to study in the Czech language under the same conditions as other applicants, provided that
(a) they have demonstrated, no later than on the date of enrolment, linguistic competence for study in a study programme in the Czech language
(b) they have complied with the conditions of the admission procedure laid down for other applicants.

Article 4
Admission procedure

(1) The regular date of the entrance examination is **22 June 2022**.

(2) A condition for admission to study in a doctoral study programme is proper completion of studies in a master's study programme and successful completion of the admission procedure, which includes:
-an oral examination in English,
-an oral professional examination according to the focus of the doctoral study programme.

The English language entrance exam assumes an entry level of B1+ SERR (formerly Intermediate). The exam will take the form of a motivational interview. The candidate will demonstrate the ability to communicate with some degree of independence in oral interaction in a personal and educational areas of language use, using relevant linguistic resources and structures. In terms of topics, the interview will focus primarily on previous study or work experience and motivation for further study and research in the chosen field in the doctoral programme. During the interview, the candidate will also be able to briefly inform about the chosen topic and the aims of his/her dissertation.

The professional examination requires professional knowledge at the level of a completed master's degree programme with a focus on the topic of the doctoral dissertation and the presentation of a thesis on the expected dissertation topic.

(3) In the case of foreign applicants, the Admissions Committee may determine the form and conditions of the entrance examination which do not require the personal presence of the applicant.

(4) If more than one applicant applies for the same doctoral dissertation topic, the committee shall determine the order of the applicants according to the result of the admission procedure. If the next applicants in order successfully pass the entrance examination, the committee shall offer them the unfilled topics or diversify the topic in agreement with the supervisor. In the event that no agreement is reached on the dissertation topic, the candidates will be selected in order of preference.

(5) Absence from the admission procedure will be the subject of a further hearing only if the applicant duly apologises and the faculty announces an alternative date for the admission procedure.

(6) In the event of a change in the form of study within the doctoral study programme Electrical Engineering and Informatics, the candidate will be admitted to the study outside the regular admission procedure and will have the examinations recognised in accordance with the Directive No. 8/2017 of the FEI UPa Rules for Recognition of Completed Courses.

Article 5
Method of deciding on admission

(1) A maximum of 10 applicants will be admitted to study in the order determined during the admission procedure.

(2) The admission decision will be issued within 30 days of the admission examination in accordance with the provisions of Section 50(4) of the Higher Education Act.

(3) The results of the admission procedure will be published on the publicly accessible www server of the University of Pardubice at https://www.upce.cz/studium/pro-uchazece/prijimacky.html. The publication of the results will respect the principles of personal data protection.

(4) The faculty delivers the decision to applicants for study itself or through a postal service provider. If the decision grants the applicant's application for admission to study, the decision may be delivered to the applicant via the University's electronic information system if the applicant has agreed to this method of delivery in advance in his/her application; in such a case, the date of delivery and notification of the decision shall be the first day following the date on which the decision is made available to the applicant in the University's electronic information system.

In Pardubice, 15. 1. 2022

Ing. Zdenek Nemec, PhD., m. p.
Dean

Doctoral Thesis Topics 2022/2023

1.
Supervisor: ***doc. Ing. Michael Bažant, Ph.D.*** *Michael.Bazant@upce.cz*
Supervisor - specialist: doc. Ing. Pavel Tuček, Ph.D.
Advanced algorithms for predicting road traffic accidents based on video analysis
The dissertation will propose prospective algorithms for detection and prediction of crisis situations in road traffic based on video analysis. For this purpose, various approaches will be used, consisting in the application of mathematical, statistical, or other suitable approaches for solving this problem. On the basis of real data from road traffic, the real applicability of such a solution in practice will be demonstrated. The thesis will also include detailed state of the art in the concerned field in order to map the current state of knowledge.
The aim of the thesis is 1. mapping the current state of knowledge in the field of detection and prediction of crisis situations in road traffic, 2. development of new or optimization of existing algorithms for prediction of crisis situations in road traffic, 3. publication of the research work in professional journals. The contribution of the developed algorithms will be demonstrated and tested on a variety of real-life crisis cases. The prerequisite is therefore cooperation with entities that have access to reality data. The results will also be compared with existing approaches reported in the literature.

2.
Supervisor: ***doc. Ing. Tomáš Brandejský, Dr.*** *Tomas.Brandejsky@upce.cz*
Memorizing evolutionary algorithms
The student will design new evolutionary algorithms, or modifications of existing ones (both genetic algorithms or evolutionary strategies, as well as genetic and memetic algorithms). For testing, he/she will use (or even create) their parallel implementations not only for multicore processors, but also for clusters. The student will re-open the question whether it would not be advantageous, especially in the case of genetic programming algorithms and memetic algorithms, to memorize already evaluated individuals and avoid re-evaluating the same solutions. The use of evolutionary algorithms in the areas of modeling and further processing and analysis of large to "big data" creates much higher demands on the computational power required to compute a fitness function over large training data. While for simple "school" examples it is clearly more convenient to recompute the fitness function than to search large tables of previously explored solutions, this may not be the case for large training data. Moreover, such an analysis of already explored solutions could protect the population of individuals from multiple occurrences of identical (individuals), which could also contribute to the efficiency of the algorithm. Current computers offer many orders of magnitude more memory than than when the consensus was established that it was preferable to recompute fitness functions. Moreover, it is incomparable situation in this respect for continuous problems and discrete problems, which are more convenient to solve with a catalogue of already explored variants. The student will create programs in OpenMP or MPI, but can also choose Cudu, OpenMP, or other model-based approaches such as Intel OneAPI if they choose. The results will be verified by numerical (simulation) experiments comparing the standard approaches and the proposed new solution over a suitably chosen problem set, the definition of which will be included in the thesis.

3.

Supervisor: ***doc. Ing. Petr Doležel, Ph.D.*** ***Petr.Dolezel@upce.cz***

Segmentation and classification of multispectral data using deep learning tools

The aim of this dissertation is to design and implement a system for multispectral data segmentation for precision object classification and detection. The data will be acquired by integrating the outputs from different types of sensors (RGB, NIR, SWIR, ...) in order to obtain comprehensive information about the objects of interest, using different degrees of absorption of radiation by different materials depending on the wavelength. The developed system will be able to be tested on many socially relevant applications where different waste products of human activities, such as microplastics in soil and in the sea, need to be classified and detected.

The system will be based on deep learning principles, in line with the current state of the art, and the work will develop different topologies based on the convolutional principle (convolutional neural network or fully-convolutional network in encoder-decoder mode) and on the Attention mechanism (e.g. Transformer).

4.

Supervisor: ***doc. Ing. Aleš Filip, CSc.*** ***Ales.Filip@upce.cz***

Safety architectures for self-driving cars

The student will deal with the design and analysis of safety architectures for automated car driving. The design of the architectures will be driven by harmonised safety targets based on the socially acceptable risk of future users of self-driving cars. The aim of this thesis will be to demonstrate, by means of examples of the proposed architectures, how high levels of safety can be achieved in automated driving systems. In solving the above tasks, comparative analysis methods and safety techniques adopted from other modes of transport, such as railways or aviation, will be used. Artificial intelligence methods will also be considered for processing sensor information in order to detect, classify and determine the position of objects in road traffic. The proposed solution will comply with the relevant automotive safety standards ISO 26262, ISO/PAS 21448 (SOTIF) etc. The results obtained will be verified by comparison with results published by other authors in this research area.

5.

Supervisor: ***prof. Ing. Simeon Karamazov, Dr****.* ***Simeon.Karamov@upce.cz***

Supervisor - specialist: prof. Ing. Pavel Bezoušek, CSc.

MIMO radar signals coding and filtering

The thesis is aimed at optimal MIMO radar signal and regarding digital filters design. Since MIMO radars employ multiple transmitting and receiving antennae, an independent and easily distinguishable signal is required, and appropriate filters must be used by the receiver for each transmitting antenna. For differentiation, signals with basic linear or nonlinear frequency modulation (LFM or NLFM) multiplied by pseudorandom codes (Gold, Walsh-Hadamardovy, Zadoff-Chu), or frequency diversity (FD) codes will be used. Appropriate signals filtered by various compress filters will be verified by comparing correlation characteristics and the eligible signal coding will be suggested with regard to Doppler shift. Esential part of the work will be reduction (parallel computing) of the computational time durig filtering proces.

6.

Supervisor: ***prof. Ing. Antonín Kavička, PhD.*** ***Antonin.Kavicka@upce.cz***

Methodology of rapid prototyping of agent-oriented simulators

The aim of this work is to design and test a methodology for rapid prototyping of software agent-oriented simulation systems reflecting service, transport or logistics systems. Rapid prototyping of simulation models will be based on the application of declarative approaches (based, for example, on Petri nets) applied in the formalization of built agent-oriented simulators. To verify the proposed methodology, the use of its own software demonstrator is expected, which will include a suitable integrated development environment supporting both the rapid construction of the relevant simulation system and its formal verification and subsequent implementation of simulation experiments.

7.

Supervisor: ***doc. Ing. Dušan Kopecký, Ph.D.*** ***Dusan.Kopecky@upce.cz***

Supervisor - specialist: Ing. Tomáš Zálabský, Ph.D.

Development of methodology and apparatus for measuring the shielding efficiency of flexible shields of electromagnetic interferences

Modern flexible shields of electromagnetic interferences (EMI) based on composites of polymeric materials and conductive fillers suffer from inhomogeneities and defects caused by mechanical fatigue of the material or due to its aging. Current standard methods used to evaluate the shielding efficiency of EMI shields have limited options for locating and evaluating these faults.

The aim of this work is therefore to develop a new methodology and equipment for measuring and mapping the shielding efficiency of thin EMI shields based on organic substances. The work will develop a unique device using visualization of the distribution of the electromagnetic field in the near zone, including the methodology of measuring and interpreting the results. The device will also include newly developed software that will allow the visualization of scattering parameters and localization of faults and inhomogeneities. The result of the work will be an advanced method for the study of shielding efficiency, which can be applied in materials research and in the optimization of chemical, mechanical and electrical properties of EMI flexible shields. The work will take place in collaboration with the University of Chemistry and Technology in Prague.

8.

Supervisor: ***doc. Ing. Jan Mareš, Ph.D.*** ***Jan.Mares@upce.cz***

Supervisor - specialist: doc. Ing. Petr Doležel, Ph.D., Ing. Mgr. Pavel Kříž, Ph.D.

Advanced methods of voice analysis for diagnosis of neck illnesses

Voice analysis for medical diagnostics is currently a very expanding field where modern methods of multichannel data analysis and modern statistical methods play the key role. Student will deal with the design and implementation of new and modified methods of voice analysis for the needs of (i) diagnosis of cervical diseases and (ii) analyses of vocal cords rehabilitation.

The aim of the work is to develop a unique diagnostic method using a complex software tool that will automate the analysis. Two approaches will be considered and tested for analysis: 1) Deep learning and 2) Advanced statistical methods.

The software tool will be developed in cooperation with the Faculty Hospital Královské Vinohrady, Clinic of Otorinolaryngology, which will ensure the access to patients and subsequent verification of results.

9.
Supervisor: ***doc. Mgr. Jiří Tuček, Ph.D.*** ***Jiri.Tucek@upce.cz***
Supervisor - specialist: Mgr. Jaroslav Marek, Ph.D.

Mathematical Models and Their Applications for Analysis of Magnetization Measurements

Iron-oxide-based magnetic nanoparticles are still of eminent interest from the viewpoint of both basic and applied research. They have been frequently chosen as model system for building the theory of nanomagnetism, i.e., magnetic phenomena emerging in the nanoworld. Currently, they are predominantly exploited in the diverse fields of medicine, in particular, for a design of carries of various chemically and biologically active compounds and molecules providing diagnostics and therapy. Besides biochemical properties, these nanoparticles should exhibit application-promising magnetic features. In order to assess their magnetic behavior, magnetization measurements are often employed and the properties of the studied nanosystems are studied in the varying temperature under constant applied magnetic field or in the varying induction (or intensity) of the external magnetic field under constant temperature. A series of models and functions have been proposed so far to analyze the measured magnetization data. The aim of the proposed dissertation thesis is to critically assess, applying the approaches of mathematical and statistical analyses, the relevance and significance of the existing models and functions for evaluating data coming from magnetization measurements of the nanoparticle systems based on iron oxides. Moreover, it is expected to propose mathematical and physical approaches providing determination of values of relevant magnetic parameters and quantities of the systems, considering the accuracy and statistical significance. Analysis of magnetic data of mixture samples with two or more magnetic components is currently regarded as an emerging and often discussed experimental problem to tackle with; here, an attention will be focused on construction and validation of the models which will enable separation of individual contributions. The theoretical models, proposed and discussed within this thesis, will then be critically evaluated with the help of experimental data for selected nanoparticle systems, predominantly based on iron oxides.

10.
Supervisor: ***doc. Mgr. Jiří Tuček, Ph.D.*** ***Jiri.Tucek@upce.cz***
Supervisor - specialist: Mgr. Jaroslav Marek, Ph.D.

3D Scanning of Objects

When 3D scanning of objects, several problem may emerge which must be solved in the applied research. It may be necessary to find the boundaries and areas of objects, including their mathematical parameterization. The 3D model is constructed by a fusion of the so-called clouds of points acquired from scanning from various sites. In this task, it is necessary to find the identical points based on their matching in HSV or RGB color scheme. The most important goal is then to estimate the unknown transformation parameters of displacement and rotation between coordinate systems. Based on these estimates, all measurements can be corrected and transformed into the appropriate coordinate system. In order to solve the above-described registration problem, several methods have been proposed so far, including ICP Algorithm, Normal distribution transform, Feature based registration, Probabilistic iterative correspondence method, Likelihood-field matching.
The aim of the proposed dissertation thesis is to study and compare these methods. It is also expected to propose new approaches based on regression models with constrains. The theoretical models constructed and discussed in the present dissertation work will then be tested in a software-programmed application.
1.