UNIVERSITY OF PARDUBICE	
Directive No. 1/2019	
Subject:	Admission Rules for Doctoral Programme Electrical Engineering and Informatics for the academic year of 2019/2020
Scope of authority:	Faculty of Electrical Engineering and Informatics and doctoral programme applicants
In effect from:	Date of issue
Date of termination:	30.9.2019
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 2019/2020 in accordance with the Article No. 49, Act No. 111/1998 Coll. on higher education institutions and on the amendement and supplementto some other acts and sections 6 and 7 on the statuses of the University of Pardubice: Electrical Engineering and Informatics – Information, Communication, and Control Technologies (full-time study and combined study).

Number of admissions: 21

Deadline for submission: 26.5.2019

Date of entrance exam: 26.6.2019

Applications can be submitted in an electronic form that is available at http://eprihlaska.upce.cz or a printed form (Application for Doctoral Programme). The electronic application is supposed to be printed out and sent to the Department of Study Affairs of the Faculty of Electrical Engineering and Informatics. It is necessary to include the name of the study programme, specialization, the form of study, and topic of dissertation in the application form. A list of topics is an attachment to this directive. Administrative fees for the procedure of admission are not collected.

It is necessary to attach the applicant´s CV to the application, a certified copy of diploma, list of subjects attended, and great point average. Those students who finish their master´s studies in the academic year of 2018/2019 and take the state exams after the deadline for the submission of application can provide a certified copy of their diploma subsequently before the enrollment procedure.

Address for receiving applications:
Univerzita Pardubice
Fakulta elektrotechniky a informatiky
Studentská 95
532 10 Pardubice

On the basis of a registered application applicants will be invited to the entrance exam.

An application with formal imperfections will not be registered and the applicant will be asked to make immediate corrections. If the applicant does not make corrections within required time, they will not be invited to the entrance exam and is not allowed to participate in it.

Certification of health conditions is not required.

Those applicants who graduated abroad are supposed to provide a recognition of their diploma (nostrification - certification of validation of one´s master´s degree in the Czech Republic) (is not required from citizens of countries that have an agreement on higher education recognition with the Czech Republic), a CV, a copy of their passport, letter of recommendation, and a document certifying a sufficient knowledge of English. Those who apply for a study programme in English are supposed to provide all the documents in English, except for the recognition of one´s diploma.

Admission Conditions:

An applicant can be admitted to the doctoral programme under the condition that their master´s studies were completed successfully and the entrance exam was passed. The entrance exam includes:

- oral exam in English
- oral exam based on specialisation within the doctoral studies

The entrance exam requires knowledge of English as advanced as B1+ (intermediate). The exam will take a form of a motivation interview. The applicant is suppsed to prove his ability to interact indepedently in a conversation related to the applicant´s personal and professional life using relevant language means and structures. The interview will be based on a conversation about the applicant´s studies, professional background, work experience, and motivation for further education, scientific activities, and research inthe given field of research. The applicant is also required to comment on the topic of his dissertation and its impact.

At the specialized exam the applicant is required to prove sufficient knowledge corresponding to a master´s degree graduate and the ability to know well the topic of their dissertation.

The Admission Commission may set different admission conditions for foreign applicants. These may not require the applicant´s attendance at the exam.

If there are more applicants applying for the same dissertationt topic, the Commission orders the applicants on the basis of the entrance exam results. At the same time the Commission offers different topics to the applicants, or they modify the topic as advised by the possible supervisor. If a satisfactory conclusion is not reached, applicants are selected according to the above mentioned order.

The applicant has the right to suggest his own dissertation topic after a discussion with his supervisor.

The admission decision will be issued no later than 30 days after the entrance exam date in accordance with Article No. 50, section 5 on higher education institutions.

The applicant will be provided with the result of the admission procedure in a written form in accordance with the Act No. 111/1998 Coll. on higher education Institutions and further will be made public at the University of Pardubice server that can be accessed publicly (at http://stag.upce.cz/apps/prijimacky/index). Within the procedure the principles of personal data protection will be respected.

Not attending the entrance exam will be a subject of further proceedings only if the applicant apologizes for his being absent and the Faculty provides compensatory entrance exam.

In Pardubice, 25. 3. 2019

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

List of topics

Decision support methodology in transport system simulators

Supervisor: doc. Ing. Michael Bažant, Ph.D.

The aim of this dissertation is to design and test a methodology for decision support in simulation models of transport systems with application of various methods that are suitable for decision making (e.g. multi-criteria evaluation of variants, selected soft computing methods, etc.). Decision support in simulation models can be based on different strategies, respectively tools (e.g. exact methods, methods of artificial intelligence, multicriterial analysis, etc.). A multi-purpose case study aimed at monitoring simplified traffic within the selected transport system is expected for testing the proposed methodology.

Methodology of rapid prototyping related to agent-based simulators

Supervisor: prof. Ing. Antonín Kavička, PhD.

The main goal of PhD-thesis is to design and verify the methodology of rapid prototyping related to agent-based simulators namely reflecting service, transportation or logistic systems. The issue of rapid prototyping can be associated with declarative approaches (e.g. based on Petri nets) applied to formalisations of developed simulators. The application of an original software demonstrator is expected in order to verify the designed methodology. The demonstrator will include a suitable integrated development environment supporting rapid constructions of relevant simulating systems and their formal verifications. In addition, simulation experiments are supposed to be carried out within the demonstrator.

Improvement of continuous genetic programming algorithms

Supervisor: doc. Dr. Ing. Tomáš Brandejský

The aim of PhD work is to design and elaborate original algorithm of continuous genetic programming of model identification (symbolic regression) of complex systems. Continuous genetic programming eliminates non-linearity (step-wise changes) of developed models behaviors known from standard genetic programming algorithms. Thus it can be theoretically more efficient than standard genetic programming algorithms after is finishing and more advantageous for modeling of complex systems described by data sets of „Big Data“ category. The goal of this work is to verify this expectation. For designed algorithm testing, design of own pallel implementation of this algorithm is expected as well as its verification on computer clusters (supercomputers).

The use of genetic programming algorithms in „big data analytic“ systems

Supervisor: doc. Dr. Ing. Tomáš Brandejský

The goal of this PhD work is to design and implement hierarchical evolutionary algorithm for analytic of "Big Data", to implement it in languages like Java or Scala in environment Apache Spark with training data stored in graph and NoSQL databases. The application of standard evolutionary algorithms onto very large multidimensional training sets typical for „Big Data“ field is very inefficient. The main aim of this work is to find concept of parallel operation with vector of these data subsets using MapReduce mechanism and development of hierarchical evolutionary algorithm for this environment. For testing of developed algorithm the design of own implementation using parallel programming and complex examples set on computer clusters (supercomputers) is expected.

Monitoring of web application users' behavior

Supervisor: Ing. Lukáš Čegan, Ph.D.

The aim of the thesis is to design and implement appropriate procedures, structures and algorithms to obtain real time information about web application users' behavior. The thesis examines various factors influencing the interaction of the user and the computer in the area of the www, works with formal methods of description of user interfaces and applies statistical methods for evaluation of multidimensional experimental data. The validity of the proposed procedures and algorithms will be verified by the implementation of the experimental application.

Non-linear predictive control

Supervisor: doc. Ing. František Dušek, CSc.

The dissertation thesis will deal with the design of a discrete-time predictive controller for a Single-Input Singe-Output (SISO) nonlinear system. The nonlinear system will be approximated by a dynamic neural model, which will be transformed into a linear model with time-variable parameters (LTV). Part of the thesis will be the verification of acquired and derived theoretical knowledge by simulation in the MATLAB / SIMULINK environment.

State-space predictive control of MIMO systems

Supervisor: doc. Ing. František Dušek, CSc.

Subject of PhD. thesis will be focused on a discrete-time control design of a linear constrained Multi-Input Multi-Output MIMO systems. The predictive control method based on state-space model will be used. The attention will be given on systems with a non-square systems where the desired outputs can be achieved with the any combination of the inputs. This type of task allows the inclusion of additional requirements in the control objective formulation.

Verification of theoretical results will be done by using simulations in MATLAB/SIMULINK environment and by experiments on laboratory models. It is assumed that the student will also participate in the development or modification of the laboratory models and implementation of the real-time software in MATLAB/SIMULINK.

Modelling dynamics of robot manipulators with a higher number of joints and effective utilization of the mathematical model in robot control algorithms

Supervisor: doc. Ing. Jan Cvejn, Ph.D.

In the scope of this thesis, methods of constructing dynamic models of robot manipulators with 6 and more joints will be studied, as well as efficient computational algorithms of terms of the motion equations. Besides simulation of motion, these results will be applied in the model-based robot feedback control methods. An effort will be made to objectively compare these methods with respect to attainable quality of control in real conditions, eventually to propose enhancements of the methods described in literature. Influence of the model inaccuracies on stability and control quality will be considered as well.

Advanced Mathematical Methods for Biomedical Data Analysis

Supervisor: doc. Ing. Jan Mareš, Ph.D.

Biomedical data analysis is a very desired but non-trivial mathematical problem. Results can forward the research in the field of biomedicine to more precise and accurate diagnostics. The work assumes (i) the study of advanced mathematical methods, (ii) the proposal of specific methods and algorithms for analysis of selected biomedical data.

The aim of the work is to develop a semi-automatic estimator of selected biomedical data for diagnostics. Developed software will be implemented and verified in university hospital.

Stochastic Methods of Image Analysis in Biomedicine

Supervisor: doc. Ing. Jan Mareš, Ph.D.

Biomedical image analysis is a very desired tool because it provides semi-automatical detection of pathological findings from CT and MR. Modern approach can be represented by point processes with density, especially interacting particle systems. The work assumes (i) the study of advanced methods for image analysis, (ii) the study of interacting particle systems (iii) the proposal of specific algorithms for analysis of selected biomedical images, The aim of the work is to develop a semi-automatic estimator of biomedical images for diagnostics. Developed software will be implemented and verified in university hospital.

Safe car position determination for automated driving

Školitel: doc. Ing. Aleš Filip, CSc.

Safe car position determination for automated driving represents a safety-related function, whose required reliability, i.e. integrity, has to be met in the usual road environment. The guarantee of the estimated car position error for the required level of automation cannot be usually achieved using a single sensor. For this purpose, multiple information processing from several different sensors based on physically diverse principles is required. Ph.D. student will deal with safe information processing from the selected sensors for car position determination with the aim to meet the required operational requirements in road transport. The objective of the student's work will represent elaboration of the system model for position determination and error estimation for the required safety integrity. The novelty of the solution will mainly consist in demonstration of the excessive systematic errors mitigation due to a common cause in a given environment. The student will employ suitable stochastic modelling methods. The results achieved by the student will be verified by comparison with corresponding results disseminated within international R&D projects focused on automated car driving.

Train position determination based on GNSS for the European Train Control System

Školitel: doc. Ing. Aleš Filip, CSc.

Train position determination based on GNSS and intended for the European Train Control System (ETCS) represents a safety-related function, whose required reliability, i.e. integrity, has to be met in the usual rail environment. The guarantee of the estimated train position error for the required high safety integrity level (SIL 4) cannot be achieved using a single sensor. For this purpose it is necessary to employ multiple information processing from several different sensors based on physically diverse principles. Ph.D. student will deal with safe information processing from the selected sensors for train position determination with the aim to meet the required railway operational and safety requirements. The objective of the student's work will represent elaboration of the system model for position determination and error estimation for the required safety integrity. The novelty of the solution will mainly consist in demonstration of the excessive systematic errors mitigation due to a common cause in the railway environment. The student will employ suitable stochastic modelling methods with the usual sensor error distributions. The results achieved by the student will be verified by comparison with the corresponding results disseminated within R&D international projects focused on GNSS application in railway signalling.

Model of GNSS-based train position determination system for certification of GNSS application in ERTMS/ETCS

Supervisor: doc. Ing. Aleš Filip, CSc.

The student will deal with procedures supporting safety evidence of a new constituent – GNSS within ERTMS/ETCS (European Rail Traffic Management System/European Train Control System). Each change in a safety-related system such as ERTMS represents a risk that could threaten safety. This risk must be evaluated within the certification process, which is a key to the introduction of these new systems to operations. The objective of the student's work will be elaboration of a model case for certification of the electronic train Location Determination System (LDS) according to the Common Safety Method required by the Commission Regulation (EU) 402/2013. The novelty of the solution will consist in the evidence of the required safeguard against excessive random and systematic GNSS and LDS errors in a given environment. The student will employ suitable stochastic methods for modelling of tolerable hazard within LDS. The results achieved by the student will be verified by comparison with the results disseminated within European R&D projects in this field.

Indirect Microwave Holography

Supervisor: prof. Ing. Vladimír Schejbal, CSc.

The basic theory of indirect microwave holography and how it can be used for the determination of antenna far field patterns and the reconstruction of antenna aperture fields. Analyses how the technique can be used for both planar scanning and cylindrical scanning. Measurement analyses for medium gain antennas of wide spectral extent and imaging of concealed metal and dielectric objects. That allows imaging of a metallic gun concealed in a pouch. That could be used for security imaging applications such airport and bus and railway stations.

Frequency synchronization of multistatic radar receivers

Supervisor: doc. Ing. Ondřej Fišer, CSc.

The theme of the dissertation is frequency synchronization of receivers of an active multistatic coherent radar system. The aim of the thesis is to select and optimize methods of synchronization, enabling achievement maximum of suppression of interfering reflections in these systems, which is essential for the good detection of weak and slow-moving targets. After thorough research of synchronization methods, the student will theoretically express their properties and evaluate their impact on system parameters. Selected methods and algorithms will be optimized and verified on real data, obtained from an industrial partner. The detection of weak targets on synthetic data will be verified.