Freie Universität Bozen
Libera Università di Bolzano
Università Liedia de Bulsan

Faculty of Science and Technology

Ph.D. Programme in ADVANCED-SYSTEMS ENGINEERING

Website: https://www.unibz.it/en/faculties/sciencetechnology/phd-advanced-systems-engineering/
Duration: 3 years
Academic year: 2020/2021

Start date: 01/11/2020

Official programme language: English

Programme contents

The aim of this full-time Ph.D. programme is to provide students with the knowledge and skills that will allow them to conduct independent research in the areas of advanced-systems engineering. The Ph.D. course focuses on the study and development of advanced and intelligent systems through an interdisciplinary approach that responds to recent technological developments (e.g. Cyber-Physical-Systems, Industry 4.0, Internet of Things) by integrating the disciplines of industrial mechanical engineering and information engineering. They are supported by specific skills in mathematics and artificial intelligence.

The Ph.D. student projects pertain to the following research areas, which are actively pursued by research groups at unibz on a long-term basis, and are considered in the Ph.D. on Advanced-Systems Engineering:

Mechanical-and-Manufacturing-Systems Engineering
- Mechanical and Mechatronic Systems
- Advanced Manufacturing Technologies
- Mechanical Engineering Design and Optimization
- Production Systems and Management,
- Smart Factory

Automation and-Electronic-Systems Engineering
- Autonomous systems
- Human-in-the-loop systems
- Embedded Systems (design, testing and reliability)
- Sensors systems
- Robotic Systems
- Automatic Control
- Computer Vision and Image Processing,
- Intelligent Sensor/Actor Networks

System Modelling and Evolution
- Dynamical System Modelling and Simulation
- Complex Networks for System's Evolution
- Operations Research

Students will further improve their ability to clearly and efficiently communicate ideas orally and in writing, as well as to work in research groups. The final thesis must be written in English and shall include translations of its abstract in both German and Italian. Ph.D. students will benefit from the

special multilingual opportunities the University offers, which include activities/events in Italian, German and other languages (seminars, elective courses, social events, etc.). The Ph.D. program comprises lectures and research activities that shall be completed at unibz, together with some components that may be performed at other universities, in Italy and abroad. Each Ph.D. candidate is required to spend a minimum of 3 months (and up to a maximum of 12 months) abroad conducting a part of their research.

The Ph.D. programme is based on the following activities:

- Each student shall develop and organize a research plan and conduct a thorough literature survey, which includes a summary and analysis of the state-of-the-art of their research topic. The literature survey shall be completed within the first 6 months of the course and shall be performed in consultation with their supervisor and any co-supervisors. At the latest after six months, students must present and defend their research plan in front of the Ph.D. Course Committee.
- Students shall present their research results at one or more international conferences. The related research shall be archived in the accompanying conference proceedings as either a paper or a poster.
- Students shall spend at least three months abroad conducting research.
- Students shall attend compulsory courses focused on analysing and writing scientific articles, as well as other courses, workshops or summer schools that will expand their background and deepen their expertise in topics related to their dissertation. These additional courses shall be approved by the Ph.D. Course Committee. The student must pass any relevant exams to receive course credits.

In order to be admitted to the final thesis exam, students must have published at least one article in an international, peer-reviewed, Scopus-indexed, journal as the lead author. Exceptions to this rule shall be evaluated and, if appropriate, approved by the Ph.D. Committee.

Industrial Ph.D. (*Dottorato Industriale*)

These are "co-tutored" positions with companies offered under a company-university agreement on specific topics that enable employees involved in research activities to enter higher education programs, i.e. a doctoral course, when appropriate. The Industrial Ph.D. links the doctoral program to the vision of the companies, their dynamics and their needs. This permits research training to be focused on the growth of the industrial Ph.D. student and on the demands of the company. It also enables the interaction and integration of the student into a university research group, thereby promoting collaboration between the university and companies.

Ph.D. stages

The Ph.D. research activities are organized into five milestones, which shall be completed at months 2, 6, 12, 24 and 36 of the programme. At the end of each stage, each student shall meet the Ph.D. Committee to present his/her project and results. The Ph.D. Committee shall review and assess each student's work and provide recommendations, as needed.

Phase 1 **(first 2 months):** The Ph.D. Committee shall meet with the students and assign each student a supervisor. Together with the supervisor and any co-supervisors the student shall identify his/her research topic (within the areas listed in this advertisement) and develop a study plan, which shall be approved by the Ph.D. Committee. Students may start attending courses that are relevant to their individual study plans.

Phase 2 **(2nd-6th month):** After an exhaustive review of the literature concerning his/her subject area, as well as having completed the first steps in the research topic activity, each student shall:
- prepare his/her research programme that has to be approved by the Ph.D. Committee;
- possibly complete and/or attend courses that are relevant to his/her individual study plan;
- prepare a report of the state of the art of his/her research topic to be reviewed by the supervisor and another researcher nominated by the council.

Phase 3 **(6th -12th month**): Each student shall continue performing research on his/her topic and can also attend courses, summer schools, seminars, or conferences. Each student shall report, in both written and oral, form his/her first-year activities, present the research programme he/she plans to conduct abroad and propose a co-supervisor at the foreign university or research centre to the ASE Ph.D. Committee.

Phase 4 **(12th -24th month):** Each student continues his/her research and finishes any courses that have been started. At this stage, it is likely that some of this time will be spent abroad.

Phase 5 **(24th-36th month):** Each student shall finish: his/her research; any remaining required work abroad; writing and submitting the required journal manuscript(s); and complete his/her (draft) thesis. To be admitted to the final exam, each student shall present a report about his/her third-year activities and final thesis to the Ph.D. Committee.

During Phases 4 and 5, students are also expected to attend international conferences to present the results of the activities developed within the Ph.D. programme, and to start the preparation of the manuscript(s) for publication in peer-reviewed journals. Each student shall report in both written and oral form his/her second-year activities to the Ph.D. Committee.

Proposed General Research topics

Topic	Supervisor(s)
Diffusion dynamics on complex networks	Bertotti, M. Letizia
Structural properties of complex networks and applications	Bertotti, M. Letizia
Interaction and UX with different forms of virtual and physical prototypes to support the design of advanced products	Borgianni, Yuri
Additive Manufacturing: material characterization and advanced modelling techniques	Concli, Franco
Structural health monitoring of mechanical systems	Concli, Franco
Application of Logistics 4.0 technologies to Make-to-Order with subsequent Assembly On-Site processes	Dallasega, Patrick
Development of Data-Driven Aid Systems to support Planning, Scheduling and Monitoring of Projects	Dallasega, Patrick
Agile Methods and tools to support software development of IoT systems	Janes, Andrea
Software testing approaches and tools for IoT systems	Janes, Andrea
Biological transformation of industrial manufacturing	Matt, Dominik
Advances and application of AI in manufacturing systems	Matt, Dominik
Diffusion dynamics on complex networks	Modanese, Giovanni
Structural properties of complex networks and applications	Modanese, Giovanni
Soft biocompatible materials and systems for healthcare applications	Münzenrieder, Niko
3D printing of active electromechanical structures	Münzenrieder, Niko
Intention recognition, shared control and decision making for human-centered robotic systems	Peer, Angelika
Design and optimization of electro-tactile stimulation devices for tactile perception	Peer, Angelika

Digital twin modeling and remote control of cyber-physical production systems	Rauch, Erwin
Development of a Manufacturing Execution System adapted to the needs of small and medium sized enterprises	Rauch, Erwin
Design and development of AI tools for Cyber-Physical systems	Russo, Barbara
AI tools for Traffic flow systems	Russo, Barbara
Optimal motion planning of industrial (collaborative) robotic systems	Vidoni, Renato
Design and development of mechatronic and robotic solutions for agricultural and/or forestry activities	Vidoni, Renato
Advanced nonlinear control of unmanned vehicles	von Ellenrieder, Karl
Stability analysis of remote shared human-robot control systems	von Ellenrieder, Karl
Design optimization of lightweight flexible multibody systems	Wehrle, Erich
Nonlinear topology optimization for large-deformation complaint mechanisms and vibrating systems	Wehrle, Erich

* this is only a partial list of available projects, other topics dealing with the research activity of the members of the Ph.D. Committee can be explored.

Admission Requirements - Evaluation criteria for examinations/qualifications

Degrees from the former Italian university system: all

Master (laurea specialistica/magistrale): all

Foreign degrees
Applicants who have a foreign degree must have a university level education of at least five years (or equivalent) and hold the prerequisites listed below.

Other:
The requisites for admission to doctoral programmes are related to an appropriate educational, and/or scientific background, and/or have worked in the Ph.D. program research fields. Qualifications in <u>engineering</u> and <u>computer science</u> are preferable.

Admission to the program is based on the assessment of applicants through:

- CV and academic qualifications;

- a cover letter explaining the student's motivation for applying to this Ph.D. programme;

- a technical interview.

During the interview, the knowledge of the English language will be also assessed.

The candidates' profile will be evaluated based on the quality, as well as the potential synergy with the research areas of the Ph.D. programme.

To apply for the Ph.D. programme, applicants shall submit the following documents:

- A personal statement, written in English (max. 2 pages). In this document, the candidates shall indicate which of the proposed research areas and topics they are interested in. They may mention why they think unibz and this Ph.D. programme is the right place for their tertiary education and research activities.

- Curriculum vitae (CV) (in English and preferably following the EU format, which can be downloaded here https://europass.cedefop.europa.eu/en/documents/curriculum-vitae).

- Master's degree certificate or equivalent with final mark (if applicable) and the transcripts of exams taken with their marks (transcript of records). The certification of Italian university titles MUST be substituted by a self-declaration or by the Diploma Supplement; **for admission, the (exams) average grade of a master's degree (or equivalent) must be greater than or equal to 24/30.** For foreign degrees, the mark (overall grade point average) will be converted to an equivalent one out of 30 points.

Industrial Ph.D. (*Dottorato Industriale*)
For those applying to the Dottorato Industriale positions, the following additional document is necessary:
- A copy of the contract of employment at the company or self-declaration.

Other documents to be included by applicants, when available:

- Up to a maximum of 2 reference letters, written in Italian, German or English provided by a university lecturer or a researcher from a research institute, describing the work carried out and its quality. In lieu of letters, the names and institutional contact information of up to 2 professional references can be provided.
- A list of publications (published, being published or submitted for publication) and the digital copy of at most 3 selected publications from the past 5 years (note that most weight is given to articles indexed in Scopus and/or on the Web of Science).

The application process consists of three stages:

1. The applications are first reviewed for administrative completeness and eligibility.

2. Those complete applications, which fulfill the base admission requirements, are then evaluated by the ASE PhD Programme Evaluation Committee, which shall consider the applicant's CV, cover letter, qualifications (including any publications), and the alignment between the candidate's profile/interests and the Ph.D. programme research areas. The Evaluation Committee shall then create a list of applicants to be admitted to the 3rd stage of the selection process.

3. Each candidate will be interviewed to assess his/her basic/fundamental technical knowledge in one or more of the Ph.D. programme's research areas, as well as her/his ability to orally communicate in English. The interview may be conducted via live video conference, if necessary. The Evaluation Committee shall rank the applicants via a comparative assessment.

The following scores will be awarded:
- up to 10 points for: the applicant's CV, cover letter and qualifications,
- up to 10 points for the appropriateness of the CV regarding the research areas of interest for the Ph.D. programme,
- up to 20 points for the interview.

The final score is the sum of the points awarded for the 3 categories described above, with a max of 40. The final score shall be used to define the ranked list of candidates, and to determine which candidates will be offered a research scholarship. The lowest score to be admitted in the rank-list is 20/40.

Scholarships financed by external institutions

If interested in one of the scholarships financed by external institutions, the applicant must explicitly state his/her interest in the letter of motivation and application.

Separate rankings may be drawn up for such grants. In any case, these separate rankings will only include candidates who have already been included in the general ranking of merit and who have a scientific curriculum that is particularly appropriate to the project in question.

The final ranked list will be published on the unibz website www.unibz.it.

Examination dates

Description	Date	Place
Personal Interview	Between 23 to 31 July, 2020 (depending on the number of applications)	Videoconference – Microsoft TEAMS

Positions and grants

Total number of positions available: 11

Number of full general scholarships awarded by unibz: 5

Dottorato industriale – Industrial Ph.D.			
Area/Topic	Positions	Company	Supervisor
Main Research Area: Manufacturing engineering Topic: Comparative use of systems to detect and subsequently counteract defects in die-cast components.	1	Alupress S.p.A., Bressanone, BZ	Borgianni, Yuri

Other types of position awarded:

1 AR – Assegnista di Ricerca (Research Fellowship)

PhD scholarships bound to specific research topics/areas (funded 50%company/ 50% unibz):			
Topic	Positions	Funding Source	Supervisor
Sustainable sensors based on printing techniques for food applications	1	Thales Alenia	Petti, Luisa
Development of waveguide antennas based on additive manufacturing technology	1	Istituto Italiano di Tecnologia	Petti, Luisa

Number of positions awarded without scholarship: 2