Freie Universität Bozen
Libera Università di Bolzano
Università Liedia de Bulsan

Faculty of Engineering

Ph.D. Programme in ADVANCED-SYSTEMS ENGINEERING

Website: https://www.unibz.it/en/faculties/engineering/phd-advanced-systems-engineering/

Duration: 3 years
Academic year: 2023/2024

Start date: 01/11/2023

Official programme language: English

Programme contents

This international PhD program trains a new generation of researchers who focus on Mechanical and Manufacturing Systems, Automation and Electronic Systems and Computer Systems to carry out independent research in the areas of Advanced-Systems Engineering and to give them the opportunity to transfer and exchange knowledge with national and international research centers and industries.

The three-year PhD programme 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 mechanical engineering, manufacturing engineering, information engineering and computer science. They are supported by specific skills in mathematics and artificial intelligence.

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
- Thin-film devices and sensors
- Flexible and wearable electronics, smart textiles
- Micro and nano technology
- Soft biocompatible sensor systems
- Robotic Systems
- Automatic Control
- Intelligent Sensor/Actor Networks

Computer Systems Engineering
- Systems of Systems
- Complex Networks
- Distributed Systems and Security

- Self-Adaptive Software Systems
- Development and Operation of IoT Systems
- Operations Research

The main features of the PhD are an interdisciplinary scientific approach and the participation of internationally renowned scientists on the Scientific Committee.

Students will further improve their ability to clearly and to 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.

To be admitted to the final thesis exam, students must have had at least one article accepted for publication 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.

Note that the program is full-time only and for its duration students are expected to devote their efforts to completing their doctoral project.

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.

A list of potential research topics and faculty supervisors to be funded by general UniBZ scholarships can be found in the following table. In addition, a list of three externally-sponsored PhD scholarships bound to specific research projects can be found at the end of this document.

Proposed General Research topics*

Project Title	Supervisor
Analytical and numerical treatment of differential equations modelling complex systems	Bertotti
Deterministic and stochastic dynamics on complex networks	Bertotti
Development of a system for design ideation providing sources of inspiration based on real-time biofeedback	Borgianni
Study of the impact of different interactive representation media on user-product interaction	Borgianni
Organic electronics devices (light emitting and photovoltaic diodes) on soft hydrogels for biomedical applications	Cacialli
Biocompatible, biodegradable and bioresorbable light emitting and photovoltaic diodes for in-vivo theragnostic	Cacialli
Graph methods for joint optimal control/estimation on dynamic robots	Camurri

Deep learning methods for accurate surface reconstruction with noisy data and deformable surfaces	Camurri
Wearable sensors for sport and e-health applications	Costa Angeli
Processing, fusion, and analysis of printed sensor data	Costa Angeli
Human-Factors and Ergonomics in Advanced Industrial Human-Machine Interaction	Dallasega
Extended Reality to support operator training in industry	Dallasega
Path and motion planning for intelligent vehicles and robots	Frego
Control and optimization in presence of uncertainties in gamification and game theory	Frego
Next-Generation Interfaces for the automotive industry	Haller
Smart Textile Interfaces for wearables	Haller
Real-Time Optimization of Quality-Based Wood Cutting for Improved Yield Recovery in Wood Manufacturing	Hosseini
Machine learning for Three-dimensional Wood Cutting Pattern Generation in Sawmills	Hosseini
Analytical and numerical treatment of differential equations modelling complex systems	Modanese
Deterministic and stochastic dynamics on complex networks	Modanese
Integrated circuits on flexible substrates	Münzenrieder
Thin-film electronics on 3D substrates	Münzenrieder
AI engineering for distributed systems	Pahl
Intelligent resource management for IoT and edge computing	Pahl
Context-aware intention recognition, shared control and decision making in human-robot collaboration	Peer
Brain and body computer interface-controlled systems and robots	Peer
Bioelectronics and bioprinting for engineered hybrid living systems	Petti
Synaptic soft devices for neuromorphic computing	Petti
Auditory displays and multimodal interaction in the automotive field	Pretto
New interfaces for the Internet of Sound	Pretto
Security in software systems: Detecting and predicting security breaches and automatically recommended fixes	Russo
Security in cyber-physical systems: intelligent systems for tracing attacks and implementing defense	Russo
Dynamic simulation and design optimization of flexible multibody systems	Vidoni
Optimal motion planning for redundant industrial collaborative robots	Vidoni
Use of control barrier functions for safety critical control of uncrewed ground vehicles	von Ellenrieder
Nonlinear control of low power robotic systems with time delay	von Ellenrieder

* this is only a partial list of potential 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 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.

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 by the competent UniBZ offices.

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	22-23 June 2023 4 July 2023 (if needed to accommodate a large number of applicants)	At UniBZ or via MS Teams according to one's availability - if not otherwise communicated

Positions and grants

Total number of positions available: 8

Number of full general scholarships awarded by UniBZ: 3

Number of positions with other type of support: 3

Number of positions awarded without scholarship: 2

PhD scholarship bound to specific research topics/areas:

1) scholarship bound to a specific research topic with a minimum 6-month study period abroad requirement pursuant to DM 118/2023 funded by PNRR:

1. Biodegradable, near-infrared (NIR), or tattooable organic light-emitting diodes (OLEDs) (supervisor Prof. Franco Cacialli)

2) (50% grant supported/50% UniBZ supported) scholarships bound to specific research topics with a minimum 3-month/maximum 12-month study period abroad requirement:

1. Active Thin-Film Electronics for Circular Electronics (supervisor Prof. Giuseppe Cantarella/co-supervisor Prof. Niko Münzenrieder)
2. Transient electronic devices based on inorganic materials (supervisor Prof. Niko Münzenrieder/co-supervisor Prof. Giuseppe Cantarella)