Qualification Goals

Master Robotics

Faculty Applied Natural Sciences and Industrial Engineering

Deggendorf Institute of Technology

Verfasser:

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Gender Neutrality

In order to maintain readability and clarity, the use of double forms or other designations of female, male and diverse genders is largely avoided. All designations for the various groups of university employees refer equally to members of all genders of the groups concerned.

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1 Course Objectives

The consecutive, application-oriented master's programme "Robotics" is to allow diploma or undergraduate students of Robotics, Mechatronics, Mechanical Engineering, Electrical Engineering, Industrial Engineering, Production Engineering, Control Engineering, Computer Science, Electronics, Biomedical Engineering and Automation Engineering or closely related study programmes to substantiate their current findings obtained within theoretical knowledge in order to meet the challenges of modern research and development tasks in particular.

This study programme complements undergraduate or diploma studies in-depth and moreover, broadens the knowledge base. Graduates thus are to be qualified for creative work in research and development departments. Particularly qualified students additionally are to acquire the theoretical fundamentals required to pursue a doctoral programme or work in scientific fields.

The study programme not only extends students' knowledge base on general robotics but also attaches great importance to assistive robotics – a field focusing on developing robots to assist people in their daily lives and provide support to people with limited capabilities. Courses on assistive robotics encompass topics like human-robot interaction, rehabilitation robotics, sensor fusion and perception, biomechanics and soft robotics for students to develop solutions tailored to the users' needs.

2 Learning Outcomes of the Course

The study programme consists of three semesters and is completed by an independent scientific paper (master's thesis). The master's programme is module-based and encompasses three semesters. In total, students can acquire 90 ECTS credit points. The learning outcomes of the individual modules including their detailed objectives as well as the knowledge, skills, and competencies to be acquired by the graduates are further described in the module handbook of the master's programme "Robotics" at DIT. Within the module handbook, all modules are listed according to their respective module number of the study and examination regulations.

3 Study and Qualification Objectives

Professional and Methodological Competence

The international study programme is to allow undergraduates from the study fields listed above to deepen their knowledge on robotics in general and the use of AI in robotics in particular. The connection between the teaching content of robotics, system engineering and human-robot interaction as well as machine learning and computer science allows for the mediation of expert knowledge on the fundamental disciplines of intelligent robotics. Furthermore, students are to acquire technical knowledge in the areas of perception in robotics, modern automated control and decision systems (e.g. motion planning), robot modelling and simulation as well as industrial robotics and automation on the user's end. This enables students to meet and shape the increased use of robot systems in the industry – ranging from development and commissioning over use and interface planning to supporting the end-user. Further essential teaching content includes intelligent, multi-agent systems and project-based case studies in the field of robot programming (ROS). Within the context of assistive robots, students acquire specific skills in developing and using robot systems which support people with disabilities to improve their quality of life. The mediation of competencies in the areas of biomechanics, soft robotics and rehabilitation engineering allows students to develop innovative solutions tailored to individual user needs. Furthermore, teaching content on human-robot interaction and sensor fusion foster the development of user-friendly assistant systems allowing intuitive interaction and integration into users' daily lives. Students acquire the technical knowledge, skills and methods required to independently apply scientific findings and processes in the industry and service economy.

Students additionally acquire fundamental skills and competencies for concepts, results and methods adherent to the current state of science, which allows them to independently work their way through technical developments.
This master's programme is to qualify students for scientifically founded engineering work, amongst others, in the following fields:

- Development, construction and use of robots in various user fields, such as production or assistive robotics
- Development, construction and use of complex robot systems within the production environment
- Leading and management of technical projects

- Research and teaching

A widely varied, qualified and scientifically founded education is to enable graduates to work in multifarious occupations. Career opportunities not only can be found within the industrial sector but also in research and teaching as well as in independent practice.

The master's thesis and the master's seminar account for students' ability to independently apply the skills and knowledge gained within the study course to complex tasks and to present those by writing and speaking in an appropriate form. By this way, students prove that they have acquired the ability for independent scientific work. The skills acquired found the basis for pursuing further studies, i.e., a doctoral degree in Robotics, Mechatronics or another related subject area.

Social and Personal Competence

The master's programme "Robotics" fosters social competence, communication, and presentation skills. Upon entry into professional life, the high level of practical relevance prepares students for socialisation and operational as well as scientific work environments. In addition to technical and methodological knowledge, corresponding team skills and social competencies are equally conveyed. Emphasis on social skills is put within the context of assistive robotics where social competencies are indispensable for developing user-friendly and secure systems. Modules such as Soft Robotics, Sensor Fusion and Perception for Assistive Robotics and Human-Robot Interaction equip students with competencies to grasp the needs and limits of users and to design corresponding assistant systems. Working in interdisciplinary teams as required in modules like Rehabilitation Robotics and Case Study Assistive Robotics for Improvement of Life Quality also fosters empathy and the ability to develop technical solutions for people's daily use.

The module Technical Project Management and case studies in two modules also solidify technical, personal and social competencies. The case studies offer the ideal opportunity to apply theoretical knowledge gained from the respective modules into practice. Small student groups deal with individual scenarios. In the process, different solution approaches collide, which demands discussion to find a practical solution within the group eventually. Decision-making competencies are equally trained. Moreover, these case studies offer students the opportunity to consider problems from different angles. Theoretical knowledge relates to the analyses elaborated to understand and explain the respective scenario.

The case studies also prepare students ideally for their everyday working life by collaborating within a team. A group presentation on the findings obtained is also part of the case studies. Graduates of the master's programme "Robotics" are skilled to present work results in a structured manner and to further discuss their findings in front of an expert audience. Furthermore, graduates are qualified to organise themselves independently and to demonstrate team skills as well as high leadership competence for interdisciplinary collaboration.

4 Learning Outcomes of the Modules / Module Objectives / Target Matrix

The individual modules, their adherent detailed objectives and the competencies graduates need to acquire are further described in the module handbook of this master's programme. The following table establishes the link between the individual modules and the objectives of the master's programme described in the previous section.

Target Matrix of the Modules within the master's programme "Robotics"												
Module	Objectives											
	Knowledge				Skills				Competencies			
	Scientific / Technical Fundamentals	Engineering Methodology	Engineering Practice and Product Development	Interdisciplinary	Scientific / Technical Fundamentals	Engineering Methodology	Engineering Practice and Product Development	Interdisciplinary	Scientific / Technical Fundamentals	Engineering Methdology	Engineering Practice and Product Development	Interdisciplinary
Module MRO-01 Robot Dynamics	x	xx			x	xx	x		x	xx	x	
Module MRO-02 Advanced Methods in Control Engineering		xx	xx			xx	xx			xx	xx	
Module MRO-03 Statistics and Machine Learning for Computer Vision	xx	xx			xx	xx			xx	xx		
Module MRO-04 Technical Project Management		x	x	xx		x	x	xx		x	x	xx
Module MRO-05 Embedded Systems		xx	xx			xx	xx			xx	xx	
Module MRO-06 Cross Cultural Development for Engineers			x	xx			x	xx			x	xx
Module MRO-07 Advanced Methods in Robotics		xx	xx			xx	xx			xx	xx	
Module MRO-08 Image Processing and Computer Vision		xx	xx			xx	xx			xx	xx	
Module MRO-09 Robot Modeling & Simulation		xx	xx			xx	xx			xx	xx	
Module MRO-10 Industrial Robotics and Automation		xx	xx	x		xx	xx	x		xx	xx	x
Module MRO-11 Case Study ROS Robot Programming		xx	xx	x		xx	xx	x		xx	xx	x
Module MRO-12 Intelligent Multi-Agent Systems		xx	xx			xx	xx			xx	xx	
Module MRO-13 Soft Robotics	xx	x		x	xx	xx		x		x	xx	x
Module MRO-14 Sensor Fusion and Perception for Assistive Robotics	xx	xx			xx	xx		x		xx	x	x
Module MRO-15 Biomechanics	xx	x	x		x	x	x		x	x	x	
Module MRO-16 Rehabilitation Robotics	x	xx		x		xx	xx	x	x	xx		
Module MRO-17 Case Study Assistive Robotics for Improvement of Life Quality			xx	x			xx	xx		x	xx	xx
Module MRO-18 Human-Robot Interaction			xx	xx		x	xx	x		x	xx	xx
Module MRO-19 FWP		x	xx	x		x	xx	x		x	xx	x
Interdisciplinary Area												
Module MRO-20 Master module			xx	xx			xx	xx			xx	xx

Key: xx strong reference; x intermediate reference