Doctoral Program

The Munich Institute of Robotics and Machine Intelligence

Contents

Introduction

The Munich Institute of Robotics and Machine Intelligence (**MIRMI**) doctoral program aims at providing a framework for doctoral candidates (**DCs**) at the Technical University of Munich with training that specifically focuses on important aspects in robotic and machine intelligence, both for theoretical and practical aspects. Fulfilling the requirements for the graduate program will be accounted for the fulfillment of the mandatory qualification program of TUM graduate centers, e.g., Graduate Center of the School of Computation, Information and Technology (CIT) and of the School Engineering and Design (ED).

Robotics research at TUM is spread across many individual schools, each having specific requirements for its doctoral program. Outside their specific group, there is currently limited educational support for DCs focusing on the skills and training needed for robotics researchers. The goal of this program is to connect DCs from all schools with a specific focus on training, techniques and skills similar across the different disciplines of robotics. This provides a common ground for further interactions, develops educational opportunities at the doctoral level, and provides a potential for coordinating research topics across research groups and schools.

The MIRMI doctoral program is designed to offer DCs at the Technical University of Munich a high-quality and appealing training in robotics and machine intelligence. The primary objective of the MIRMI doctoral program is to connect DCs across the different schools of TUM and provide DCs with a common platform for training, techniques, and skills that are similar across different disciplines of robotics. By participating in the MIRMI doctoral program, DCs will not only acquire a comprehensive set of skills and knowledge in robotics and machine intelligence but they will also be introduced to cutting-edge research and development that will prepare them for future careers in academia or industry. The program's training will focus on both theoretical and practical aspects of robotics research, including topics such as perception, control, planning, and learning.

DCs will have access to MIRMI's network of renowned researchers, industry experts, and leaders in robotics and machine intelligence. Our Principal Investigators (**PIs**), who are experts in their respective fields, will provide guidance, mentorship, and support to DCs throughout the program.

Participation in the MIRMI doctoral program also offers the opportunity for DCs to gain exposure to emerging trends in robotics and machine intelligence through seminars, workshops, and industry events. DCs will have the opportunity to present their research, network with other researchers, and gain valuable insights from industry leaders. In addition, the program encourages collaboration and networking with fellow DCs from various schools, which can lead to interdisciplinary research projects and publications.

The program aims to provide the following benefits for DCs:

- Participate in specific seminars, international graduate courses and robotic clubs, and collaborate with international industry and research centers.
- Learn to identify and respond to ethical and social aspects of robotics, and learn to collaborate with social scientists and ethicists to address these issues.
- Build team spirit amongst DCs in robotics for multidisciplinary collaboration.
- Access to unique and (partly centralized) lab resources for robotics.
- Build critical mass to tackle common projects such as DARPA challenge, Robothon, or support of BSc/Msc DC's initiatives (e.g. hyperloop).
- Develop connections to other scientists and professors at TUM, and stimulate international exchange with MIRMI network/partners.
- Encourage industrial DCs to be embedded into the academic environment and offer them a strong graduate program.

In summary, the MIRMI doctoral program offers DCs a unique opportunity to build excellent knowledge and expertise in robotics and machine intelligence. By completing the program, DCs will be prepared to become leaders in this rapidly growing field, in academia or in industry.

Steering committee

The steering committee is normally composed of the two Education leaders of MIRMI and the MIRMI teaching coordinator. The initial composition of the steering committee is

- Prof. Dr. Daniel J Rixen
- Prof. Dr. David Franklin
- Dr.-Ing. Abdalla Swikir

The main roles of the steering committee are to determine and approve any special cases for admission to the program, and discuss and approve any new requests for content.

Advisory board

The Advisory board of the MIRMI doctoral program consists of six principal investigators and two representatives of the DCs. The board is established such that its members represent different TUM schools and cover different research areas. Members are proposed by the steering committee (except for representatives of DCs who are elected by the MIRMI DCs). The Members are then appointed by the board of directors of MIRMI for 2 years (renewable). The initial composition of the Advisory board is

Prof. Dr.-Ing. Klaus Diepold
Prof. Dr. Markus Ryll
Prof. Dr. Ruth Müller (substituted on occasion by Ms. Svenja Breuer)
Prof. Dr. Angela Schoelling
Prof. Dr. Markus Zimmermann
Dr.-Ing. M. Ali Nasseri
Ms. Theresa Prinz (representatives of DCs)
Mr. Furkan Kaynar (representatives of DCs)

The advisory board meets every six months and their main roles are

- Quality control of the doctoral program
- Recommendation on admitting DCs external to MIRMI

Doctoral candidates

For researchers to be admitted to the MIRMI program, they should be

- TUM doctoral candidates
- Supervised by a MIRMI PI, or have a mentor that is a MIRMI PI

To register in the Graduate Program of MIRMI, a short request must be submitted (over a web-based form). Information can be obtained at gradprog@mirmi.tum.de.

Training program

The MIRMI doctoral program is intended to fulfill (at least partly) the requirements of the TUM graduate school. The purpose is to provide a consistent qualification offer that is designed specifically for DCs involved in Robotics and Machine Intelligence, with the objective to provide high-quality training and opportunities for scientific exchange between researchers involved in this highly multidisciplinary field. Therefore, the program was conceived to include the following essential components:

- International experience and exchange
- Strengthening scientific networks and collaboration across projects
- Developing skills specific to Robotics for concerning ethical and social aspects of robotics, patenting, entrepreneurship, and interdisciplinary communication and collaboration

In addition to the doctoral certificate from TUM graduate school, a certificate of completion of the MIRMI doctoral program will be handed to the DCs by the Education Leaders of MIRMI upon fulfilling all requirements laid out in this document.

The program consists of 4 main areas, each of which needs to be validated by the DC (for instance by a minimum number of hours). The summary of the components and minimum requirements are summarized in Table 1 and explained next:

The sum of all activities should amount to a minimum of 80 hours[1]. Attendance to those activities must be confirmed by an exam or by a certificate of participation (as required for and registered by the GC). Activities that a DC wants to be counted for a certain component but that is not mentioned here should be agreed upon by the steering board of the MIRMI Graduate Program, upon recommendation of the supervisor of the candidate.

Registration of activities for this graduate program will be handled by DocGS and administered by the candidate's Graduate Center. Communication and information related to the MIRMI graduate program should be addressed to gradprog@mirmi.tum.de.

International/Industrial Field Training

This module is a central element of the proposed program, in which the DC should have spent time in a setting different from his/her research group at TUM in order to experience a different research environment (international as a rule). It requires a stay of a minimum of 2 months in a research and/or development group at a foreign research institution, industry, or start-up. In case it is not possible for the candidate to be away from TUM for a longer period (e.g. for family-related reasons), this component can also be validated by spending 2 months (in total) at a national research institution, industry, clinic, start-up, or in another TUM research group.

Subject-Related Training

This component must cover at least 15 hours. Here the DC will acquire new and advanced expertise in theoretical and practical aspects directly or indirectly related to his/her research topic. This can include Seminars, MSc. courses (if recommended by the supervisor), doctoral courses, international summer schools or workshops, a compulsory participation in at least one MIRMI symposium of the DC. Each active participation (presentation, poster) will count for 10,5 hours.

[1] One hour here means 60 minutes.

Those activities can be organized by TUM or by another reputable academic institution or scientific association.

Scientific outreach

This component is included to ensure that the DC has presented and discussed his/her work with international scientific peers. It requires attending at least one international scientific conference (presentation or poster) or participating actively in a fair or exhibition (e.g. presentation at a booth, demonstrations …).

Seminar series

MIRMI organizes a series of seminars dedicated to important aspects (ethics, entrepreneurship, …) related to engineering and management in the field of robotics and machine intelligence. The title of the seminar series in the MIRMI doctoral program is “Making an impact in robotics and machine intelligence”. The seminar topics are guided by the UN Sustainable Development Goals (SDGs). The series consists of 12 seminars and runs for 2 years, where each seminar is 2 hours. The areas covered by this seminar series can include Ethics (Ethics in robotics, how to write ethics proposals, design human studies, safety, data protection, etc.) Social and political aspects of Robotics and Machine Intelligence Product development, standardization, etc. including Sustainability Patenting, IP, open source in research and Research Data Management Entrepreneurship and Innovative management resources Communication in multicultural environments.
In addition to the areas of Social and political aspects and Ethics (minimum 2 seminars), two additional areas need to be covered by the DC. Current details on the organized seminars are published on the website of the graduate program (Link).

Scientific Clubs

DCs are expected to attend MIRMI scientific clubs. Each club is expected to have between 8 and 15 DCs. Each club should be held at least once a month

for 2 hours. Each DC should attend at least 10 club meetings and make one presentation at a club meeting. Activities for such clubs can for instance include organizing workshops or MIRMI-wide seminars, participating in a Hackathon, discussing papers, or developing topics for future research proposals. Clubs must be approved by the advisory board of the graduate program. Finally, the clubs will be supported by several MIRMI's principal investigators (PIs). For example, DC can invite MIRMI's PIs for panel discussions or to give talks on interesting robotics and machine intelligence topics.

Training Module	Examples	Hours
International/Industrial Field Training	2 months (minimum) stay at a foreign research institution, industry, clinics, or start-up (in special cases, can be fulfilled in Germany).	
Scientific outreach	Presenting at least once (presentations, posters) at scientific conferences[2].	
Subject Related Training	● Subject-related seminars. Master courses[3], Doctoral courses.[4] ● Int. summer school and workshop[5]. Active participation once in annual MIRMI Forum[6]	15+
Seminar series	MIRMI Seminar series “Making an impact in robotics and machine intelligence”	10+
MIRMI’s Scientific Clubs	Journal clubs, Hackathon/Robothon, Workshops, Demos. [7]	20+

Table 1: Summary of Training Program Requirements

[2] Compulsory item and counted for 7 hours per day.
[3] Only with recommendation of the supervisor; attendance is sufficient.
[4] The related hours are defined by the respective graduate center.
[5] Only max. 8 hours per day for summer school/workshops.
[6] Compulsory item and counted for 10,5 hours per Forum.
[7] Compulsory item. Each DC should attend at least 10 club meetings and present once