Dear RIGI Applicants,

This document presents nine projects for Robotics Institute Germany Internships (RIGI) 2025. Please go through them carefully and select **a minimum of one and a maximum of three projects** on the application portal. To do this, you will need to enter the **project codes**. These codes are highlighted for each project. Ensure you use the correct codes when filling out the application form. List the projects you are applying for in order of preference, starting with your most preferred project. You will also need to write a short motivation (80 words) for each project you are applying to. While we appreciate conciseness and clear communication, we encourage you to create these texts yourself, rather than using automated tools like chatGPT, to so that they accurately represent your personal interests and motivations.

RIGI Coordination Team

Main Supervisor(s)	Florian Hartmann
Day-to-day Mentor(s)	Giulio Grasso, Yuan Fang
Project Title	Achieving complex motions through origami-based electrostatic actuators
Project Code	**BMM1**
Research Area(s)	soft robotics
Project Description	Our research group focuses on the synthesis of mechanical design and sustainable material development with the aim of creating new bioinspired robotic systems. We are pursuing this through the study of new fabrication processes for soft materials, the formulation of biodegradable alternatives to plastics, and the design of untethered systems including actuation, sensing, energy storage and control. One of our research directions includes the application of origami-inspired folding patterns into the development of thin-film electrostatic actuators capable of complex, multidimensional motions. If you want to merge a creative approach to rigorous analytical thinking, this is the project for you! You will have the chance to explore known origami patterns and to recognize their respective deformation modes, and to design 3D-printable molds and electrode patterns for the fabrication of zipping electrostatic actuators based on these surfaces. You will explore innovative fabrication methods for thin-film functionalized structures, gain experience in modeling strategies for unconventional geometries, and learn to leverage origami deformability for robotic applications.
Required Technical Skills	• Experience with CAD modelling software (Autodesk Fusion & AutoCAD, Solidworks, etc…). • Mastery of Calculus notions (i.e., methods for parametric surface representation). • Good knowledge of coding languages (python, Wolfram Mathematica, MATLAB).

Main Supervisor(s)	Christoph Keplinger
Day-to-day Mentor(s)	Ugur Bozuyuk, Erdost Yildiz, Alp Can Karacakol
Project Title	CELLnROLL - A robotic diagnostic platform
Project Code	**CELL1**
Research Area(s)	mechanical engineering, electrical engineering, robotics
Project Description	In our project, we focus on developing advanced microrobotic systems that automate complex cellular analyses, particularly for immunophenotyping in hematological diseases. By combining robotics and microtechnology we aim to create cost-effective, high-throughput diagnostic solutions that reduce reliance on expensive optical components and specialized operators. As an intern, you will actively contribute to prototype design and development, refining mechanical and electronic components for improved performance of the robotic system. You'll set up and run experiments to validate each design iteration, collecting and analyzing the resulting data. This internship offers a unique opportunity to gain hands-on engineering experience while applying advanced biomedical concepts.
Required Technical Skills	• CAD Design (e.g., SolidWorks): Ability to create and modify mechanical designs for prototype components. • Basic Electronics & Prototyping: Understanding of electronic components, circuit assembly, and hands-on prototyping. • Ability to collect, interpret, and document experimental data (e.g., using Excel, Python, or MATLAB).

Main Supervisor(s)	Katherine J. Kuchenbecker
Day-to-day Mentor(s)	Andrew K. Schulz, Natalia Sanchez-Tamayo
Project Title	Actuation of bio-inspired whisker sensors
Project Code	**HAPTIC1**
Research Area(s)	electrical Engineering, mechanical engineering, robotics, soft robotics
Project Description	In the Haptic Intelligence Department, we are presently investigating new ways to help robots navigate and interact with their environment. We are inspired by how humans and animals use their sense of touch to navigate and interact with the world. Mammals have evolved sensory hairs (also known as whiskers) that emerge from their skin, allowing extension of their sense of touch into the space around their body. In our lab, we are inspired by the whisker structures of animals such as cats and rats. Many animals have the ability to move their whiskers relative to their body. We are curious about whether actuation could also benefit bio-inspired whisker sensors. By taking inspiration from biological sensing, we believe we can create new engineering devices for applications in mobile robotics. As an intern, you will be working on designing, testing, and adapting different actuation methods for bio-inspired whiskers. You will also test different haptic sensors (e.g., accelerometers, force-torque sensors) to experimentally investigate the benefits and drawbacks of actuation on different bio-inspired whisker sensors. Through this project, you will learn about the mechanics of the materials involved in whisker-based touch sensing and how actuation influences bio-inspired sensors. During the internship, you may also work on robotic demonstrations of the whisker-sensor-actuator structure through mobile robots or robotic grippers.
Required Technical Skills	• Experience with 3D printing and CAD • Experience with actuators (e.g., servo motors, stepper motors) • Experience with microcontrollers (e.g., Arduino, ESP boards) • Basic programming skills in Python, C, or C++ • Basic data visualization skills in MATLAB and/or Python • Interest in bio-inspired robotics and sensors

Main Supervisor(s)	Katherine J. Kuchenbecker
Day-to-day Mentor(s)	Yijie Gong
Project Title	Evaluating Naturalistic Haptic Feedback on a Teleoperated Humanoid Robot
Project Code	**HAPTIC2**
Research Area(s)	robotics, haptics, computer science, data analysis
Project Description	In the Haptic Intelligence Department, we often work to understand haptic (touch) feedback and discover new opportunities for its use in interactions between humans, computers, and machines. In our research on advancing teleoperation interfaces, we leverage scientific knowledge about the sense of touch to create haptic interfaces (mechatronic devices that combine sensors, actuators, and computation) that enable a user to interact with distant environments as though they were within reach. Teleoperated robots can be used for minimally invasive surgery (e.g., Intuitive da Vinci robot) and handling hazardous materials. As an intern, you will work on integrating AiroTouch, our naturalistic vibrotactile feedback system, onto a humanoid robot such as NAO or Baxter. Together with your mentor, you will design, run, and analyze a user study to explore the effects of this type of haptic feedback on the experience of a human who is teleoperating the robot to perform various tasks. This work will primarily involve planning and then conducting the user study, as well as starting to analyze the data you collect.
Required Technical Skills	• Basic knowledge about sensors and actuators • Interest in technologies for human users • Data analysis and visualization skills in MATLAB or Python

Main Supervisor(s)	Katherine J. Kuchenbecker
Day-to-day Mentor(s)	Vani Sundaram
Project Title	Evaluating Wearable Sensors for Personalized Gait Retraining Outside the Lab
Project Code	**HAPTIC3**
Research Area(s)	electrical engineering, human-computer interaction, data analysis, machine learning
Project Description	The Haptic Intelligence Department explores a wide range of topics, including human-robot interaction, the design of wearable haptic devices, and the development of teleoperation interfaces. These innovative projects arise from an interdisciplinary fascination with how humans move, perceive, and interact through touch. Our research seeks to bridge engineering, robotics, neuroscience, and materials science to redefine the possibilities and applications of digital technology. As an intern, you will be working on evaluating and analyzing wearable sensing systems to measure human joint angles, targeted toward enhancing a promising rehabilitation technique for patients with knee osteoarthritis. You will gain familiarity with sensing systems that leverage inertial measurement units and cameras, learn to process the data from such sensors and interpret their outputs in the context of human movement, and integrate haptic feedback mechanisms for closed-loop guidance during the gait cycle.
Required Technical Skills	• Proficiency in Python for data analysis and visualization • Basic knowledge of sensor technology (e.g., cameras, accelerometers, gyroscopes, magnetometers) • Basic understanding of signal processing • Analytical and problem-solving skills

Main Supervisor(s)	Katherine J. Kuchenbecker
Day-to-day Mentor(s)	Natalia Sanchez Tamayo
Project Title	Haptic feedback for wearable devices
Project Code	**HAPTIC4**
Research Area(s)	mechanical engineering, haptics, data analysis, human-computer interaction
Project Description	Our lab leverages scientific knowledge about the sense of touch to create haptic interfaces that enable a user to interact with virtual objects and distant environments as though they were real. We aim to elevate our understanding of touch cues while discovering new opportunities for their use in interactions between humans, computers, and machines. As an intern, you will be working on designing, testing, and adapting actuation methods for wearable haptic feedback devices like our recently published CUTE device. You will also be interfacing actuators and sensing modalities (e.g., force sensors, motors, etc.) to experimentally investigate human perception of diverse tactile cues. Through this project you will learn about haptic feedback to contribute to the understanding of tactile perception in wearable devices.
Required Technical Skills	• Programming in MATLAB or Python • Experience and/or interest in mechatronic hardware (e.g., Arduino, sensors and actuators) • Experience in data analysis and visualization • Interest in haptics and perceptual studies

Main Supervisor(s)	Christoph Keplinger
Day-to-day Mentor(s)	Sophie Kirkman, Lawrence Smith
Project Title	Building an energy harvesting demo using HASEL electrostatic generators
Project Code	**RM1**
Research Area(s)	mechanical design, electrical engineering
Project Description	In our lab we develop soft artificial muscles, sensors, and generators using HASEL (Hydraulically-Amplified, Soft, ELectrostatic) transducers. We are an experimental lab and spend a lot of time designing, building, and testing (and breaking!) actuators, generators, and robotic systems. HASEL generators are a promising alternative renewable energy technology. As an intern, you will help us design and build the one of the first energy harvesting demonstrations using HASEL generators. We aim to harvest energy from either ocean waves or human motion, but we are open to all creative ideas for a compelling energy harvesting demonstrator. This project will comprise both a mechanical and an electrical component – you could focus on either aspect or both, depending on your background. • On the mechanical side, you will design and build the mechanical connections between the generators and their casing and the interface with the energy source. • For the electronics, you will help us design a circuit for charging the generators and storing the harvested energy. You will work with researchers in our lab to brainstorm possible demonstrator ideas and follow design ideation processes to select suitable candidates for design and fabrication. You will have the opportunity to learn how to fabricate HASEL generators by screen printing and sealing, work with high voltage amplifiers, run experiments and analyze data using MATLAB and NI-DAQ. You will be able to collaborate with different workshops, and therefore have access to a wide range of fabrication devices such as 3D printers, laser cutters, a pick-and-place machine, hand tools, and PCB mills etc.

Required Technical Skills	• Basic knowledge of MATLAB
	• Experience with basic design processes including brainstorming, design communication, prototyping, and test development
	• If you want to work on the mechanical design:
	  ○ Computer Aided Design (CAD) experience (Solidworks, Inventor, or similar)
	  ○ Familiarity with design for rapid prototyping processes including additive manufacturing and laser cutting
	• If you want to work on the circuit design
	  ○ Knowledge of electronic circuit design and analysis
	  ○ Experience with soldering and cable fabrication

Main Supervisor(s)	Buse Aktas
Day-to-day Mentor(s)	Buse Aktas
Project Title	Robotic Structures Inspired by Traditional Crafts
Project Code	**ROCOCO1**
Research Area(s)	mechanical engineering, soft robotics, haptics
Project Description	In our lab we focus on the design, fabrication, modeling, and testing of active composite metamaterials, which can operate as adaptive and dynamic structural components for robotics applications, such as minimally-invasive surgical procedures, human-material interaction, and sustainable circular manufacturing. We develop dynamic composite material systems with actively tunable properties - such as stiffness, elasticity, and shape memory – to enable safe, adaptive, and versatile robot-environment and robot-human interactions. Programmable mechanical tunability is key for robots to perform complex tasks in unstructured, dynamic, and sensitive environments such as our homes or our bodies. As an intern, you will be design, fabricate, and test different robotic structures loosely inspired by fiber-based traditional crafts methods such as broom-making and basket-weaving. You will develop dynamic and robotically actuated versions of these traditionally static structures. At the end of your internship, we will make an interactive art installation with your structures where visitors can engage with your work. During this internship you will learn about robot component design, mechanical testing and analysis, and gain practice with different prototyping techniques.
Required Technical Skills	• Basic understanding of physics or mechanics, demonstrated through coursework (e.g., bachelor's level physics/mechanics, AP Physics) or hands-on experiences (e.g., DIY projects, robotics clubs). • Familiarity with CAD design (introductory level; any experience with software such as SolidWorks, Fusion 360, or Tinkercad is sufficient). • Basic experience with microcontrollers (e.g., Arduino programming)

Main Supervisor(s)	Jelena Zinnanti
Day-to-day Mentor(s)	Pouria Esmaeili-Dokht
Project Title	Robotically assisted on demand hyperthermia for tissue ablation
Project Code	**ZWEMS1**
Research Area(s)	medical imaging, robotics
Project Description	In ZWE Medical Systems we focus on developing small robots that can be used for drug delivery or hyperthermia in combination with magnetic resonance imaging (MRI). For example, we created a capsule robot that can be navigated using magnetic field gradients during MRI. Once on desired location, this capsule can be remotely heated for tissue ablation, or the heat can be utilized for on demand drug release. As an intern, you will be working on manufacturing different robots, control them using magnetic field gradients and navigate them based on the imaging feedback from the MRI scanner. As an intern, you will learn some basics of MR imaging as part of your daily routine, with an opportunity to learn more about computed tomography (micro-CT) and X-ray devices (based on the interest). The intern will be able to choose if he/she would like to focus more on the programming part of the project (Python and Matlab are needed) or on hands on manufacturing of small devices and MRI.
Required Technical Skills	There are no required skills for this particular project, but it will be advantage to have some knowledge of Matlab and Python.