

Project Proposals for Doctoral Researcher Positions 2025

ID02: Close proximity human-robot interaction in medical interventions - combining robot control and data science approaches (Katja Mombaur, Jan Stallkamp)

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Global healthcare systems are under immense pressure due to aging populations and persistent staff shortages, a situation amplified by events like pandemics. While existing hospital robots primarily handle surgery, cleaning, and logistics, there's a growing need for intelligent robots to assist with more routine tasks like patient admission, medical testing, and general hospital operations. This shift would free up human caregivers to focus on more complex, patient-centered care.

However, enabling robots to perform such tasks requires a significantly higher level of machine intelligence and advanced skills. These robots must be able to autonomously navigate complex environments, perceive individuals, understand situational requirements, and perform dexterous fine manipulation with human tools, all while interacting safely and efficiently in close proximity to people.

This PhD project will contribute crucial initial steps towards integrating humanoid robots for medical testing in hospitals. It will define a suitable benchmark for these actions, develop novel concepts and computational methods for robot control in such dynamic situations, and conduct human-robot interaction experiments in both laboratory and clinical settings. The project will utilize a TiagoPro humanoid robot to implement and test these skills. The innovative methods will combine efficient robot control algorithms that account for the robot's physical embodiment with data science approaches based on foundation models, allowing robots to manage real-world variability and interact safely and efficiently. This thesis is designed to initiate a larger collaboration aimed at bringing humanoid robots into hospitals for broader medical testing and interventions, with a specific focus on supporting the unique demands of intensive care.

Requirements:

- Master in Computer Science, Engineering, Mathematics, or Physics
- Experience with or a profound understanding of robotic / mechatronic systems required. Previous research experience with humanoid robots is a plus.
- Advanced Programming skills
- Knowledge in optimization and control
- Knowledge in mechanical modeling
- Experience with machine learning and human movement experiments are a plus
- Experience with medical applications / BME is a plus

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