Project title: Control, Optimization, Learning and Smart Robotic Hardware for Safe and Fast Human-Robot Interaction

Project leader: Dr. Yuquan Wang

Promotors: Dr. Rico Möckel, Prof. Dr. Gerhard Weiss.

Proposal (250 words):

Introduction: There are a variety of robotic applications where robots must operate close to humans, such as collaborative robots in industries, assistive robots, and exoskeletons. We want to make these robots safer and faster so that these robots can be of true added value to humans.

Hypothesis and Objectives: The goal of this project is to enhance human-robot interaction by advancing state-of-the-art control design, optimization, cognition and learning techniques, and mechanical structures. We envision that future robots also can understand their surrounding environment and adapt their behaviors to the predicted consequences of their own behavior and those of others, thereby making human-robot collaboration safer and faster.

Setting and Methods: The team involved has a strong track record in artificial intelligence and robotics, with several completed Ph.D. projects. The new Ph.D. student will be embedded in laboratories of the Brightlands Robotics Initiative of the Department of Advanced Computing Sciences. The laboratories are well-equipped with state-of-the-art technologies. The department is internationally recognized and has received many awards.

Impact: Robots and computer systems that can understand themselves and are aware of their environment and those humans they interact with will lead to a new generation of fault-tolerant, adaptive, cognitive machines that can operate under various unforeseen conditions and adapt to the needs of their human operators. The developed techniques will allow for advanced human-robot interaction and improve the self-diagnostic capabilities of machines, thus allowing for safety improvements. Therefore, we expect a significant impact on both science and society.

Requirements candidate: Highly motivated student with good English communication skills and a proactive and persistent attitude. Background (at the level of M.Sc.) in engineering, computer science, or physics. Excellent programming skills. Good knowledge of control, optimization, and robotics.

Keywords:

前沿技□ / Frontier Technologies
信息技□ / Information Technology
支撑信息技□□展的科学基□ / Scientific Basis for Development of Information Technology
Robotics, Mechatronics, Machine learning, Deep learning

Top 5 selected publications:
1. Y. Wang, and A. Kheddar (2019). "Impact-friendly robust control design with task-space quadratic optimization." *Robotics: Science and Systems* Conference.
2. A. Sprowitz, A. Tuleu, M. Ajallooeian, M. Vespignani, R. Mockel, ... A.J. Ijspeert (2018). "Oncilla Robot: A Versatile Open-Source Quadruped Research Robot With Compliant Pantograph Legs". Frontiers in Robotics and AI, 5, [67].
3. Y. Wang, and L. Wang (2020). Whole-body collision avoidance control design using quadratic programming with strict and soft task priorities. *Robotics and Computer-Integrated Manufacturing*, Vol. *62*, p. 101882.

4. F. Fraenz, J. Paredis, R. Moeckel (2017). "On the Combination of Coevolution and Novelty Search", IEEE Congress on Evolutionary Computation. **(Best Paper Award)**

5. A. Spröwitz, R. Moeckel, J. Maye, A.J. Ijspeert (2008). "Learning to move in modular robots using central pattern generators and online optimization". International Journal of Robotics Research