# Preface

This monograph is based on my Ph.D. thesis written at the Institute of Robotics and Mechatronics of the German Aerospace Center (DLR) in Oberpfaffenhofen. The thesis was defended at the Technical University of Munich (TUM) in October 2015.

The book addresses the topic of whole-body impedance control of wheeled humanoid robots. Such systems are usually characterized by a large number of actuated degrees of freedom, which can be utilized to execute several subtasks at the same time. One example is to manipulate an object while simultaneously moving through a room in an energy-efficient way, avoiding collisions with the environment, and preventing the arms from reaching singular configurations. The goal of the present research is to design a control task hierarchy to achieve all of these objectives following a given order of priority. In other words, tasks with lower priority must not disturb tasks with higher priority and will be performed in the best possible way under this restriction. In the present work, several control tasks are developed and integrated into such a hierarchical framework. Besides experimental validations on a mobile humanoid robot, the first formal proof of stability for a hierarchical torque controller is presented. While several aspects treated in this book consider wheeled systems in particular, most of the concepts are deliberately presented in a generic way and can be used on mobile systems with other locomotion principles as well, for example on legged humanoid robots, underwater vehicles, or flying systems. Household chores from the field of service robotics are chosen as benchmark to experimentally validate the presented approach in relevant real-world applications.

During my research, many people accompanied me with advice and technological support. In particular, I would like to express my deep gratitude to my supervisor and mentor Prof. Alin Albu-Schäffer for his guidance and the inspiring discussions we had throughout the course of this work. Furthermore, my special thanks go to Dr. Christian Ott, who supported me and introduced me to the exciting field of stability theory in robotics. Moreover, I wish to thank Daniel Leidner and Dr. Thomas Wimböck, with whom I collaborated in a very productive way resulting in several valuable publications in the field of whole-body control.

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