



# <u>Underactuated Robotic Hands Underactuated Robotic</u> <u>Hands</u>

Saïd Zeghloul, Med Amine Laribi, Marc Arsicault

#### **Underactuated Robotic Hands Underactuated Robotic Hands:**

Underactuated Robotic Hands Lionel Birglen, Thierry Laliberté, Clément M. Gosselin, 2008-02-11 This is a cornerstone publication in robotic grasping The authors have developed an internationally recognized expertise in this area Additionally they designed and built several prototypes which attracted the attention of the scientific community The purpose of this book is to summarize years of research and to present in an attractive format the expertise developed by the authors on a new technology for grasping which has achieved great success both in theory and in practice Design and Analysis of Selectively Compliant Underactuated Robotic Hands Daniel McConnell Aukes, 2013 A balance between complexity and functional capabilities has been explored since the first years of multi fingered robotic hands In an age where DC motors are the de facto standard for actuation in robotics the problem of needing to operate in a human sized world puts severe constraints and limits on actuator size and placement in hands While many successful examples of fully actuated designs exist these designs generally reflect the trade offs and sacrifices imposed by such constraints In that light underactuation employing fewer actuators than degrees of freedom has gained attention as a method to achieve many of the functional capabilities of fully actuated hands with fewer constraints on actuators and transmissions Underactuated hands also have distinct advantages over fully actuated hands especially when used on mobile robots due to their reduced weight and control complexity and the potential for increased robustness However there is typically a trade off in terms of reduced controllability or manipulability when handling grasped objects When designing underactuated hands extra care must be taken during the design process to ensure that such hands will grasp a wide range of object sizes and shapes robustly particularly when friction is low and uncertain Despite these concerns underactuated hands have become increasingly popular in robotic and prosthetic applications Robotic hands are also a venue in which novel secondary mechanisms are often found Devices such as differentials valves clutches and low power shape changing actuators have been used to improve grasp robustness on a wider range of objects and allow users more grasping and manipulation options However the location and placement of secondary actuators has not been studied in a comprehensive way with respect to the types of actuation methods possible This is due in part to the lack of general analytic tools which enable designers to rapidly investigate their designs prior to the prototyping stage Additionally much of the analysis in the field of robotic hands is done once basic design choices have already been made making subsequent analyses specific only to a set of design parameters specific to those choices The same point can be made regarding quality metrics which suffer from fragmented utilization due to the many different emphases placed on different design requirements The primary goal of this thesis is to provide a framework for the analysis and evaluation of underactuated robotic hands The first chapter discusses both the broad motivations for studying robotic hands and the specific contributions of this thesis The next chapter reviews relevant designs from literature analyses that have accompanied them uses of secondary devices in underactuated hands and the progress that dynamics simulators

have made towards representing reality In the next chapters the issues related to modeling abstract generic hand designs is discussed and a kinematic framework is introduced to derive the force relationships between actuator and grasped object for many mechanisms commonly encountered in underactuated hands Chapter 6 discusses difficulties associated with solving static force equations and several methods are introduced to accomplish this The last of these options relies on three dimensional rigid body dynamic simulations to evaluate the performance of compliant underactuated mechanisms which may encounter conditions such as coulomb friction in contact and and damping at the joints In the next chapters these force relationships are derived and discussed for specific hand designs in the context of a force field representation and several performance metrics are derived which measure a hand s ability both to acquire and retain objects The benefits of secondary actuation mechanisms are then discussed with two specific examples First is the SRI Stanford Meka hand a tendon driven compliant underactuated hand capable of locking individual joints Second is a mechanism implemented on the Seabed Hand which increases the range of graspable objects and allows users to selectively change grasp properties based on their specific control needs Finally the impacts of friction are discussed and the trends from simulations are compared with experimental data From these experiments the benefits of secondary mechanisms can be demonstrated in a frictional world Analysis and Control of Underactuated Robotic Hands Lionel Birglen, 2004 **Human and Robot Hands** Matteo Bianchi, Alessandro Moscatelli, 2016-02-24 This book looks at the common problems both human and robotic hands encounter when controlling the large number of joints actuators and sensors required to efficiently perform motor tasks such as object exploration manipulation and grasping The authors adopt an integrated approach to explore the control of the hand based on sensorimotor synergies that can be applied in both neuroscience and robotics Hand synergies are based on goal directed combined muscle and kinematic activation leading to a reduction of the dimensionality of the motor and sensory space presenting a highly effective solution for the fast and simplified design of artificial systems Presented in two parts the first part Neuroscience provides the theoretical and experimental foundations to describe the synergistic organization of the human hand The second part Robotics Models and Sensing Tools exploits the framework of hand synergies to better control and design robotic hands and haptic sensing systems tools using a reduced number of control inputs sensors with the goal of pushing their effectiveness close to the natural one Human and Robot Hands provides a valuable reference for students researchers and designers who are interested in the study and design of the artificial hand Intelligent Robotics and Applications Ming Xie, Youlun Xiong, Caihua Xiong, Zhencheng Hu, 2009-12-16 The market demands for skills knowledge and personalities have positioned robotics as an important field in both engineering and science To meet these challenging mands robotics has already seen its success in automating many industrial tasks in factories And a new era will come for us to see a greater success of robotics in n industrial environments In anticipating a wider deployment of intelligent and auto mous robots for tasks such as manufacturing eldercare homecare edutainment search and rescue de mining surveillance

exploration and security missions it is necessary for us to push the frontier of robotics into a new dimension in which motion and intelligence play equally important roles After the success of the inaugural conference the purpose of the Second Inter tional Conference on Intelligent Robotics and Applications was to provide a venue where researchers scientists engineers and practitioners throughout the world could come together to present and discuss the latest achievement future challenges and exciting applications of intelligent and autonomous robots In particular the emphasis of this year's conference was on robot intelligence for achieving digital manufact ing and intelligent automations This volume of Springer's Lecture Notes in Artificial Intelligence and Lecture Notes in Computer Science contains accepted papers presented at ICIRA 2009 held in Singapore December 16 18 2009 On the basis of the reviews and recommendations by the international Program Committee members we decided to accept 128 papers having technical novelty out of 173 submissions received from different parts of the world Intelligent Robotics and Applications Caihua Xiong, Yongan Huang, Youlun Xiong, 2008-10-14 These two volumes constitute the refereed proceedings of the First International Conference on Intelligent Robotics and Applications ICIRA 2008 held in Wuhan China in October 2008 The 265 revised full papers presented were thoroughly reviewed and selected from 552 submissions they are devoted but not limited to robot motion planning and manipulation robot control cognitive robotics rehabilitation robotics health care and artificial limb robot learning robot vision human machine interaction mobile robotics micro nano mechanical systems manufacturing automation multi axis surface machining realworld applications

Intelligent Robotics and Applications YongAn Huang, Hao Wu, Honghai Liu, Zhouping Yin, 2017-08-04 The three volume set LNAI 10462 LNAI 10463 and LNAI 10464 constitutes the refereed proceedings of the 10th International Conference on Intelligent Robotics and Applications ICIRA 2017 held in Wuhan China in August 2017 The 235 papers presented in the three volumes were carefully reviewed and selected from 310 submissions The papers in this second volume of the set are organized in topical sections on industrial robot and robot manufacturing mechanism and parallel robotics machine and robot vision robot grasping and control Intelligent Robotics and Applications Zhiyong Chen, Alexandre Mendes, Yamin Yan, Shifeng Chen, 2018-08-03 The two volume set LNAI 10984 and LNAI 10985 constitutes the refereed proceedings of the 11th International Conference on Intelligent Robotics and Applications ICIRA 2018 held in Newcastle NSW Australia in August 2018 The 81 papers presented in the two volumes were carefully reviewed and selected from 129 submissions The papers in the first volume of the set are organized in topical sections on multi agent systems and distributed control human machine interaction rehabilitation robotics sensors and actuators and industrial robot and robot manufacturing The papers in the second volume of the set are organized in topical sections on robot grasping and control mobile robotics and path planning robotic vision recognition and reconstruction and robot intelligence and learning

Mapping Human Sensory-Motor Skills for Manipulation onto the Design and Control of Robots Matteo Bianchi, Gionata Salvietti, 2019-03-25 Humans are endowed with extraordinary sensory motor capabilities that enable a

successful interaction with and exploration of the environment as is the case of human manipulation Understanding and modeling these capabilities represents an important topic not only for neuroscience but also for robotics in a mutual inspiration both to inform the design and control of artificial systems and at the same time to increase knowledge on the biological side Within this context synergies i e goal directed actions that constrain multi DOFs of the human body and can be defined at the kinematic muscular neural level have gained increasing attention as a general simplified approach to shape the development of simple and effective artificial devices The execution of such purposeful sensory motor primitives on the biological side leverages on the interplay of the sensory motor control at central and peripheral level and the interaction of the human body with the external world This interaction is particularly important considering the new concept of robotic soft manipulation i e soft adaptable yet robust robotic hands that can deform with the external environment to multiply their grasping and manipulation capabilities Under this regard a preeminent role is reserved to touch being that skin isour primary organ to shape our knowledge of the external world and hence to modify it in interaction with the efferent parts This Research Topic reports results on the mutual inspiration between neuroscience and robotics and on how it is possible to translate neuroscientific findings on human manipulation into engineering guidelines for simplified systems able to take full advantage from the interaction and hence exploitation of environmental constraints for task accomplishment and knowledge Mechanism Design for Robotics Saïd Zeghloul, Med Amine Laribi, Marc Arsicault, 2021-05-08 This book acquisition presents the proceedings of the 5th IFToMM Symposium on Mechanism Design for Robotics MEDER 2021 held in Poitiers France 23 25 June 2021 It gathers contributions by researchers from several countries on all major areas of robotic research development and innovation as well as new applications and current trends. The topics covered include theoretical and computational kinematics mechanism design experimental mechanics mechanics of robots control issues of mechanical systems machine intelligence innovative mechanisms and applications linkages and manipulators micro mechanisms dynamics of machinery and multi body systems Given its scope the book offers a source of information and inspiration for researchers seeking to improve their work and gather new ideas for future developments

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