# Contents

1 Introduction ......................................... 1  
Matteo Bianchi and Alessandro Moscatelli

Part I Neuroscience

2 Dexterous Manipulation: From High-Level Representation to Low-Level Coordination of Digit Forces and Positions ........ 9  
Qiushi Fu and Marco Santello

3 Digit Position and Force Synergies During Unconstrained Grasping ........................................... 29  
Abdeldjallil Naceri, Marco Santello, Alessandro Moscatelli and Marc O. Ernst

4 The Motor Control of Hand Movements in the Human Brain: Toward the Definition of a Cortical Representation of Postural Synergies ........................................... 41  
Andrea Leo, Giacomo Handjaras, Hamal Marino, Matteo Bianchi, Pietro Pietrini and Emiliano Ricciardi

5 Synergy Control in Subcortical Circuitry: Insights from Neurophysiology ........................................ 61  
Henrik Jörntell

6 Neuronal “Op-amps” Implement Adaptive Control in Biology and Robotics ........................................ 69  
Martin Nilsson

7 Sensorymotor Synergies: Fusion of Cutaneous Touch and Proprioception in the Perceived Hand Kinematics ........ 87  
Alessandro Moscatelli, Matteo Bianchi, Alessandro Serio, Antonio Bicchi and Marc O. Ernst

vii
Part II Robotics, Models and Sensing Tools

8 From Soft to Adaptive Synergies: The Pisa/IIT SoftHand ........ 101
Manuel G. Catalano, Giorgio Grioli, Edoardo Farnioli,
Alessandro Serio, Manuel Bonilla, Manolo Garabini,
Cristina Piazza, Marco Gabiccini and Antonio Bicchi

9 A Learn by Demonstration Approach for Closed-Loop,
Robust, Anthropomorphic Grasp Planning ......................... 127
Minas V. Liarokapis, Charalampos P. Bechlioulis,
George I. Boutselis and Kostas J. Kyriakopoulos

10 Teleimpedance Control: Overview and Application ............ 151
Arash Ajoudani, Sasha B. Godfrey, Nikos Tsagarakis
and Antonio Bicchi

11 Incremental Learning of Muscle Synergies:
From Calibration to Interaction ...................................... 171
Claudio Castellini

12 How to Map Human Hand Synergies onto Robotic Hands Using the SynGrasp Matlab Toolbox ................. 195
Gionata Salvietti, Guido Gioioso, Monica Malvezzi
and Domenico Prattichizzo

13 Quasi-Static Analysis of Synergistically Underactuated
Robotic Hands in Grasping and Manipulation Tasks ............ 211
Edoardo Farnioli, Marco Gabiccini and Antonio Bicchi

14 A Simple Model of the Hand for the Analysis of Object Exploration ......................................................... 235
Vonne van Polanen, Wouter M. Bergmann Tiest
and Astrid M.L. Kappers

15 Synergy-Based Optimal Sensing Techniques for Hand Pose Reconstruction ............................................. 259
Matteo Bianchi, Paolo Salaris and Antonio Bicchi
Human and Robot Hands
Sensorimotor Synergies to Bridge the Gap Between
Neuroscience and Robotics
Bianchi, M.; Moscatelli, A. (Eds.)
2016, XI, 283 p. 97 illus., 66 illus. in color. Hardcover
ISBN: 978-3-319-26705-0