

Contents

<i>List of contributors</i>	<i>ix</i>
<i>Introduction and acknowledgments</i>	<i>xi</i>
1. High-performance soft wearable robots for human augmentation and gait rehabilitation	1
Antonio Di Lallo, Shuangyue Yu, Tzu-Hao Huang, Thomas C. Bulea and Hao Su	
1.1 Introduction	1
1.2 Actuation technologies for physical human—robot interaction	2
1.3 Applications to wearable robots	7
1.4 Discussion	34
Acknowledgments	35
References	35
2. Development of different types of ionic polymer metal composite-based soft actuators for robotics and biomimetic applications	39
Ravi Kant Jain	
2.1 Introduction	39
2.2 Literature survey on IPMC as actuators and sensors and its applications	40
2.3 Development of IPMC base soft actuator by different approaches	44
2.4 Results and discussions	50
2.5 Development of robotic system using different types of IPMC actuators	80
2.6 Conclusion	82
Acknowledgment	83
References	83
3. Soft actuators and their potential applications in rehabilitative devices	89
Alexandrea Washington, Justin Neubauer and Kwang J. Kim	
3.1 Introduction	89
3.2 Overview of soft robotic actuators	91
3.3 Applications of soft robotic actuators	101
3.4 Conclusions	106
Acknowledgments	107
References	107

4. An optimized soft actuator based on the interaction between an electromagnetic coil and a permanent magnet	111
Nafiseh Ebrahimi, Paul Schimpf and Amir Jafari	
4.1 Introduction	111
4.2 Solenoid magnetic field and force calculation	113
4.3 Solenoid geometry design optimization	120
4.4 Manufacturing aspects and limitations	125
4.5 The influence of solenoid section deformation on the magnetic field and force	128
4.6 Discussion and conclusion	131
Acknowledgment	132
References	132
5. Cable-driven systems for robotic rehabilitation	135
Rand Hidayah, Tatiana Luna and Sunil Agrawal	
5.1 Introduction	135
5.2 Cable-driven leg exoskeleton for gait rehabilitation	149
5.3 A perturbation study using Robotic Upright Stand Trainer	156
5.4 Conclusion	159
Acknowledgments	159
References	159
6. XoSoft: design of a novel soft modular exoskeleton	165
Jesús Ortiz, Christian Di Natali and Darwin G. Caldwell	
6.1 Introduction	165
6.2 User-centered design	166
6.3 Requirements	169
6.4 Actuation principle	172
6.5 Sensing and control	175
6.6 Prototypes	179
6.7 Testing and validation	184
6.8 Conclusions and future works	195
References	196
7. TwAS: treadmill with adjustable surface stiffness	199
Amir Jafari and Nafiseh Ebrahimi	
7.1 Introduction	199
7.2 Actuator with Adjustable Stiffness mechanism	201

7.3	Experimental results for stiffness adjustment of Treadmill with Adjustable Stiffness	224
	References	238
8.	An artificial skeletal muscle for use in pediatric rehabilitation robotics	241
	Ahad Behboodi, James F. Alesi and Samuel C.K. Lee	
8.1	Introduction	241
8.2	Method	245
8.3	Results	246
8.4	Discussion	253
8.5	Conclusion	256
	References	256
	<i>Index</i>	259