

Contents

<i>Foreword</i>	9
<i>Preface</i>	11
Part 2 The contribution of computer science	17
<i>Chapter 2.1 A description of teleoperation systems</i>	19
Introduction, 19	
Teleoperation with mechanical transmission, 19	
Teleoperation with electrical transmission (unilateral control or bilateral servocontrol), 23	
Computerized teleoperation, 24	
Comments on this description, 30	
The overall function of data processing in teleoperation, 30	
Conclusions, 36	
<i>Chapter 2.2 The operator substitution function by computer</i>	37
Introduction, 37	
Elimination of the human operator upon request, 38	
Parallel action of the operator and the computer on different systems to ensure their coupling, 40	
Modification to the master-slave transmissions for movement or force (to help manipulation), 51	
Conclusions, 74	
<i>Chapter 2.3 The use of computer feedback to the operator</i>	75
Introduction, 75	
Making use of the senses, 75	
The choice of data to be transmitted to the operator, 76	
Whether, and in what form, to present visual signals to the operator, 78	
Redundancy and complementarity of vision and touch, 82	
Conclusions, 83	
Part 3 Performance and the man-machine interface	
<i>Chapter 3.1 Performance evaluation of teleoperation systems</i>	87
How can the performance of a teleoperation system be defined and assessed?, 87	
Qualitative performance: manipulator properties, 88	
Towards quantitative performance measurement, 98	
Conclusions, 114	

<i>Chapter 3.2</i>	The human operator in the teleoperation system	115
	Introduction, 115	
	The man-manipulator interface, 118	
	Demands of the remote manipulation task, 123	
	Strategy for task execution, 126	
	The design of the workstation, 130	
	Analysis of work in real situations and evaluation of the work load, 132	
	Performance evaluation of remote manipulator systems under different experimental conditions, 135	
	Comparison of the different models of mechanical master-slave manipulators in experimental situations, 137	
	Ergonomic consequences of the technological advances in teleoperation, 147	
Part 4	Applications of teleoperation	153
<i>Introduction</i>		155
<i>Chapter 4.1</i>	Nuclear applications	157
	Research and pilot facilities, 157	
	Operation and maintenance of industrial nuclear facilities, 161	
	Decommissioning and dismantling nuclear facilities, 175	
	Emergency intervention, 178	
	Conclusions, 186	
<i>Chapter 4.2</i>	Underwater applications	189
	Manned submarines, 189	
	Cable-controlled devices (Busby, 1981), 192	
	Free-swimming underwater vehicles, 195	
	Inspection, maintenance and construction of underwater facilities, 196	
	Undersea mining: polymetallic nodules, 201	
	Conclusions, 204	
<i>Chapter 4.3</i>	Space applications of teleoperation	205
	Planetary exploration and experimentation, 205	
	Satellite maintenance and servicing, 208	
	Assembly and maintenance of large space stations, 210	
	Conclusions, 212	
<i>Chapter 4.4</i>	Medical applications of teleoperation	213
	Teleoperation for handling and transporting patients in hospital, 213	
	Applied teleoperation for patients with motor handicaps, 213	
	Telesurgery, 217	
	Conclusions, 219	
<i>Chapter 4.5</i>	Industrial applications of teleoperation	221
	Applications in metallurgy and forging, 221	
	Public works applications, 221	
	Mining applications, 223	

Handling objects that cannot be modelled by computer, 223	
Work on high voltage power lines, 225	
Conclusions: promises of industrial servicing robotics, 225	
<i>Chapter 4.6 Applications in security and civil protection</i>	227
Fighting fires and saving lives, 227	
Applications in bomb defusing and disposal, and the police force, 227	
Applications of legged locomotion, 229	
<i>Chapter 4.7 Conclusion</i>	231
<i>Bibliography</i>	233
<i>Index</i>	253