

Contents

Key nomenclature	7
Preface	9
1. Damping in mechanical systems	11
1.1. Reasons of damping.....	11
1.2. Dissipative forces in discrete systems	12
1.3. General damping model and damping model uncertainty.....	16
1.4. Dissipative forces in continuous systems.....	18
1.5. Optimal damping	22
1.6. Physical criteria of dampers' classification.....	24
2. Magnetorheological dampers	26
2.1. Magnetorheological fluids	26
2.2. Principles of magnetorheological dampers.....	29
2.3. Shock absorber for suspended seat applications.....	34
2.4. Friction damper for experimental use.....	36
2.5. The response time of magnetorheological dampers.....	38
3. Control concepts	43
3.1. Feedback model-based or model-less approaches.....	43
3.2. Finite time linear-quadratic regulator	45
3.3. Simple on-off condition depended controllers	49
3.4. Rule-based controllers	50
3.5. Neural adapted on-line control	52
3.6. Fuzzy control.....	53
4. Real-time control – fundamentals	56
4.1. Real-time operation mode	56
4.2. Real-time operating system	57
4.2.1. Task management. Scheduling and task management	59
4.2.2. Task synchronization and inter-task communication	60
4.2.3. Access to the measurement and control I/O channels	64
4.3. MS-Windows and real-time operating mode	64
4.3.1. Native MS-Windows timer services	64
4.3.2. Real-Time Windows Target	66
4.3.3. xPC target	67

4.4. FPGA-based system-on-a-chip real-time operating mode	68
4.4.1. Architecture of FPGA circuits.....	68
4.4.2. System-on-a-chip.....	69
4.4.3. Xilinx Xilkernel	70
5. Measurement and control equipment	72
5.1. Measurement-control system	72
5.2. Hardware	73
5.2.1. Sensors	73
5.2.2. Power controller.....	76
5.3. Signal conditioning	79
5.4. Signal conversion	81
5.4.1. Off-line processing	82
5.4.2. On-line processing	85
5.4.3. Signal filtering	86
6. Control of a magnetorheological damper in a driver's seat suspension	89
6.1. Model of the system	89
6.2. Algorithms	91
6.3. Experimental setup	93
6.4. Experiments	94
6.5. Microcontroller based control system	100
6.5.1. Microcontroller architecture and integrated development environment	100
6.5.2. Implementation of a selected algorithm and results.....	103
7. Control of magnetorheological dampers in a vehicle suspension	108
7.1. Model of the system	108
7.2. Algorithms	111
7.3. Experimental setup	116
7.4. Experiments	119
7.5. Microcontroller based control system.....	129
7.5.1. Microcontroller architecture and integrated development environment	129
7.5.2. Implementation of a selected algorithm and results.....	130
8. Control of a magnetorheological damper attached to a cable	135
8.1. Model of the system	135
8.2. Algorithms	136
8.3. Experimental setup	138
8.4. Experiments	140
8.5. FPGA based control system	152
8.5.1. FPGA architecture and integrated development environment	152
8.5.2. Implementation of a selected algorithm and results.....	153
Summary	157
References	158