Contents

List of Figures xi

List of Tables xvii

List of Algorithms xix

List of Symbols xxi

Introduction 1
Objectives 1
Organization of the Book 5

1 Reliability, Robustness and Structural Control 9
1.1 Preliminary Concepts 9
1.2 Definitions 13
1.3 System Representation 16
1.4 A Comparison of Passive, Active and Semiactive Control Strategies 22

2 Collocated and Non-collocated Systems 27
2.1 Introduction 27
2.2 Definition of Collocated System 27
2.3 Centralized and Non-centralized Systems 29
2.4 Linear and Non-linear Systems 30
2.5 The Problem of Spillover 34

2.6 Advantages and Disadvantages of Collocated and Non-collocated Systems 41
2.7 A Numerical Comparison 46

3 Semiactive Devices 57
3.1 The Basic Idea and a Brief History 57
3.2 Variable Viscous Devices 59
3.3 Variable Stiffness Devices 61
3.4 Magnetorheological Devices 62
3.5 Friction Devices 66
3.6 Tuned Liquid Dampers 71
3.7 Electro-inductive Device 75
3.8 Air-jet Actuators 76
3.9 SMA Actuators 78

4 Semiactive Control Laws 79
4.1 Control Strategies and Algorithms for Semiactive Damping 79
4.2 Implementation Schemes 95

5 Implementation of Semiactive Control Strategies 113
5.1 Introduction 113
5.2 Hardware Control Implementation 114
5.3 Real-time Software 123
5.4 Non-centralized Control Versus Collocated Systems 132

6 Experimental Verification 143
6.1 Introduction 143
6.2 The Challenges of Performance-based Design in Structural Testing 145
6.3 Base-isolated Buildings and Bridges 148
6.4 Supplemental Damping Devices 155

6.5 Experimental Methods in Structural Dynamics 159
6.6 Assessment of Structural Control Devices 187

7 Stability and Foreseen Developments 199
7.1 Preliminary Concepts 199
7.2 Semiactive Features 206
7.3 Conclusions 215

Appendix A Damping 219
A.1 Types of Damping 219
A.2 Why Have a Damping Matrix? 223
A.3 Rayleigh Damping 224

Bibliography 225

Index 243