
Contents

INTRODUCTION	vii
CHAPTER 1. MODELING	1
1.1. Linear systems	1
1.2. Mechanical systems	2
1.3. Servomotors	4
1.4. Exercises	4
1.5. Solutions	21
CHAPTER 2. SIMULATION	47
2.1. Concept of vector field	47
2.2. Graphical representation	49
2.2.1. Patterns	50
2.2.2. Rotation matrix	50
2.2.3. Homogeneous coordinates	52
2.3. Simulation	54
2.3.1. Euler's method	54
2.3.2. Runge–Kutta method	55
2.3.3. Taylor's method	56
2.4. Exercises	56
2.5. Solutions	67

CHAPTER 3. LINEAR SYSTEMS	85
3.1. Stability	85
3.2. Laplace transform	87
3.2.1. Laplace variable	87
3.2.2. Transfer function	88
3.2.3. Laplace transform	88
3.2.4. Input–output relation	90
3.3. Relationship between state and transfer representations	90
3.4. Exercises	92
3.5. Solutions	103
CHAPTER 4. LINEAR CONTROL	127
4.1. Controllability and observability	128
4.2. State feedback control	129
4.3. Output feedback control	130
4.4. Summary	133
4.5. Exercises	134
4.6. Solutions	150
CHAPTER 5. LINEARIZED CONTROL	185
5.1. Linearization	185
5.1.1. Linearization of a function	185
5.1.2. Linearization of a dynamic system	187
5.1.3. Linearization around an operating point	187
5.2. Stabilization of a nonlinear system	188
5.3. Exercises	191
5.4. Solutions	207
BIBLIOGRAPHY	235
INDEX	237