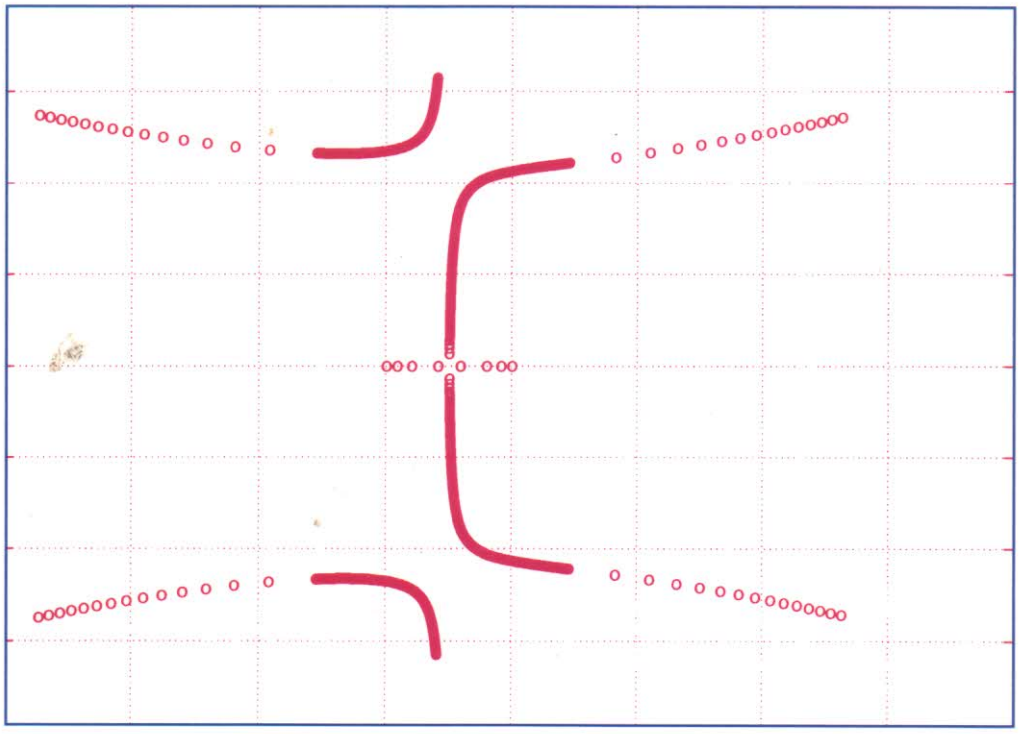
SOLVING CONTROL ENGINEERING PROBLEMS WITH MATLAB®



KATSUHIKO OGATA

MATLAB CURRICULUM SERIES

Contents

PREFACE *v*

CHAPTER 1 INTRODUCTORY MATERIALS *1*

1-1 Introduction 1
1-2 Commands and Matrix Functions Used in MATLAB 1
1-3 Outline of the Book 5

CHAPTER 2 BASIC BACKGROUND MATERIALS *7*

2-1 Introduction 7
2-2 Entering Matrices in MATLAB Programs 8
2-3 Vector Generation, Matrix Operations, Eigenvalues, and Related Subjects 21
2-4 Plotting Response Curves 30
2-5 Mathematical Models of Linear Systems 36

CHAPTER 3 TRANSIENT-RESPONSE ANALYSIS OF CONTINUOUS-TIME SYSTEMS *41*

3-1 Introduction 41
3-2 Step Response 42
3-3 Impulse Response 70
3-4 Ramp Response 80
3-5 Transformation of System Models 90

CHAPTER 4 TRANSIENT-RESPONSE ANALYSIS OF DISCRETE-TIME SYSTEMS *98*

4-1 Introduction 98
4-2 Digital Filters 102

4-3 Response to the Kronecker Delta Input 103
4-4 Step Response 115
4-5 Ramp Response 125
4-6 Case Studies 128
4-7 Transient Response of Discrete-Time Systems Defined in State Space 138

CHAPTER 5 ROOT-LOCUS PLOTS 145

5-1 Introduction 145
5-2 Obtaining Root-Locus Plots 147
5-3 Special Cases 172
5-4 Plotting Two or More Root-Locus Diagrams on One Graph 206
5-5 Root-Locus Plots in the *z* Plane 214

CHAPTER 6 FREQUENCY-RESPONSE PLOTS 228

6-1 Introduction 228
6-2 Background Materials 229
6-3 Plotting Bode Diagrams with MATLAB 246
6-4 Obtaining Nyquist Plots with MATLAB 274
6-5 Case Studies 301
6-6 Frequency Response of Discrete-Time Control Systems 326

REFERENCES 353

INDEX 355