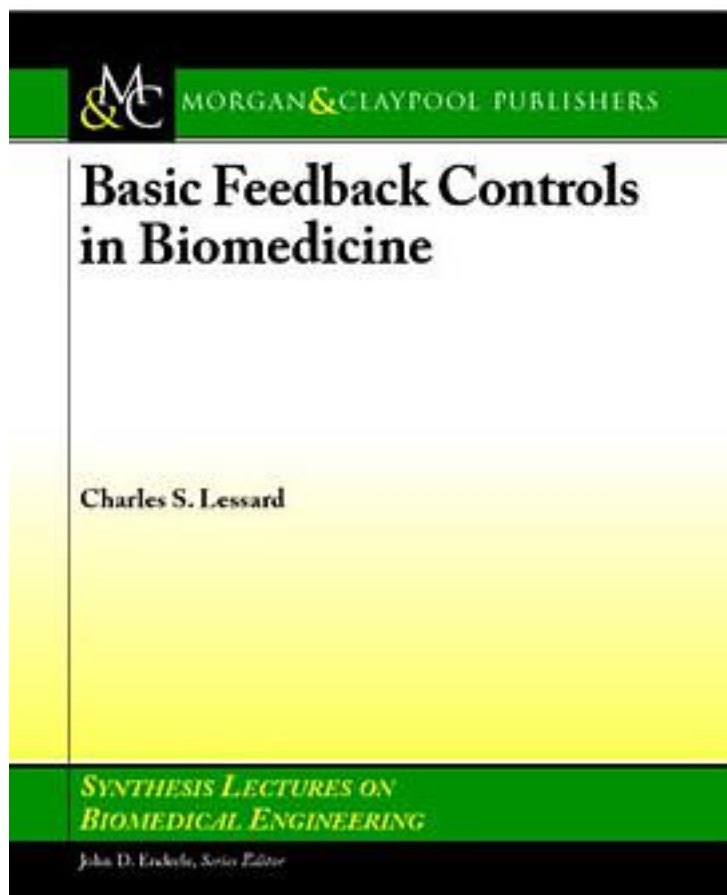


Basic Feedback Controls in Biomedicine



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This textbook is intended for undergraduate students (juniors or seniors) in Biomedical Engineering, with the main goal of helping these students learn about classical control theory and its application in physiological systems. In addition, students should be able to apply the Laboratory Virtual Instrumentation Engineering Workbench

(LabVIEW) Controls and Simulation Modules to mammalian physiology. The first four chapters review previous work on differential equations for electrical and mechanical systems. Chapters 5 through 8 present the general types and characteristics of feedback control systems and root locus, frequency response, and analysis of stability and margins. Chapters 9 through 12 cover basic LabVIEW programming, the control module with its pallets, and the simulation module with its pallets. Chapters 13 through 17 present various physiological models with several LabVIEW control analyses. These chapters cover control of the heart (heart rate, stroke volume, and cardiac output), the vestibular system and its role in governing equilibrium and perceived orientation, vestibulo-ocular reflex in stabilizing an image on the surface of the retina during head movement, mechanical control models of human gait (walking movement), and the respiratory control model. The latter chapters (Chapters 13-17) combine details from my class lecture notes in regard to the application of LabVIEW control programming by the class to produce the control virtual instruments and graphical displays (root locus, Bode plots, and Nyquist plot). This textbook was developed in cooperation with National Instruments personnel. Table of Contents: Electrical System Equations / Mechanical Translation Systems / Mechanical Rotational Systems / Thermal Systems and Systems Representation / Characteristics and Types of Feedback Control Systems / Root Locus / Frequency Response Analysis / Stability and Margins / Introduction to LabVIEW / Control Design in LabVIEW / Simulation in LabVIEW / LabVIEW Control Design and Simulation Exercise / Cardiac Control / Vestibular Control System / Vestibulo-Ocular Control System / Gait and Stance Control System / Respiratory Control System

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