MECHATRONICS: AN INTEGRATED APPROACH

Clarence W. de Silva

Table of Contents

MECHATRONIC ENGINEERING
- Mechatronic Systems
- Study of Mechatronics
- References and Further Reading

DYNAMIC MODELS AND ANALOGIES
- Terminology
- Analogies
- State-Space Representation
- Model Linearization
- Linear Graphs
- State Models From Linear Graphs
- Electrical Systems
- Fluid Systems
- Thermal Systems
- Bond Graphs
- Transfer-Function Models
- Frequency Domain Models
- Response Analysis And Simulation

MECHANICAL COMPONENTS AND ROBOTIC MANIPULATORS
- Mechanical Components
- Transmission Components
- Robotic Manipulators
- Robotic Grippers

COMPONENT INTERCONNECTION AND SIGNAL CONDITIONING
- Component Interconnection
- Impedance Characteristics
- Amplifiers
- Analog Filters
- Modulators and Demodulators
- Analog-Digital Conversion
- Bridge Circuits
- Linearizing Devices
- Miscellaneous Signal Modification Circuitry
- Signal Analyzers And Display Devices

PERFORMANCE SPECIFICATION AND ANALYSIS

- Parameters For Performance Specification
- Linearity
- Instrument Ratings
- Bandwidth Design
- Instrument Error Analysis
- Statistical Process Control

ANALOG SENSORS AND TRANSDUCERS

- Terminology
- Motion Transducers
- Variable-Inductance Transducers
- Permanent-Magnet Transducers
- Variable-Capacitance Transducers
- Piezoelectric Sensors
- Effort Sensors
- Strain Gages
- Torque Sensors
- Tactile Sensing
- Gyroscopic Sensors
- Optical Sensors and Lasers
- Ultrasonic Sensors
- Thermo-Fluid Sensors
- Other Types of Sensors

DIGITAL TRANSDUCERS

- Advantages Of Digital Transducers
- Shaft Encoders
- Incremental Optical Encoders
- Absolute Optical Encoders
- Encoder Error
- Miscellaneous Digital Transducers

STEPPER MOTORS

- Principle of Operation
- Stepper Motor Classification
- Driver And Controller
- Torque Motion Characteristics
- Damping of Stepper Motors
- Stepping Motor Models
- Control of Stepper Motors
- Stepper Motor Selection and Applications

CONTINUOUS-DRIVE ACTUATORS

- DC Motors
- DC Motor Equations
- Control of DC Motors
- Motor Driver

- DC Motor Selection
- Induction Motors
- Induction Motor Control
- Synchronous Motors
- Linear Actuators
- Hydraulic Actuators
- Hydraulic Control Systems
- Fluidics

DIGITAL LOGIC AND HARDWARE

- Number Systems and Codes
- Logic and Boolean Algebra
- Combinational Logic Circuits
- Sequential Logic Devices

MICROPROCESSORS AND PLCS

- Digital Computer
- Programmable Logic Controllers
- Data Acquisition And Control

CONTROL SYSTEMS

- Control Engineering
- Control System Performance
- Control Schemes
- Stability and Routh-Hurwitz Criterion
- Root Locus Method
- Frequency Domain Analysis
- Controller Design and Tuning
- Compensator Design in the Frequency Domain
- Controller Tuning
- Design Using Root Locus
- Digital Control

CASE STUDIES IN MECHATRONICS

- Design of a Mechatronic System
- Robotics Case Study
- Iron Butcher Case Study
- Projects

Appendix A. Transform Techniques

- Laplace Transform
- Response Analysis
- Transfer Function
- Fourier Transform
- The S-Plane

Appendix B. Software Tools

- SIMULINKÒ
- STATEFLOW
- MATLABÒ
- Control Systems Toolbox
- LabVIEWÒ

Index