

1. Record Nr.	UNINA9910583046703321
Autore	Rohani Sohrab
Titolo	Coulson & Richardson's chemical engineering . Volume 3B Process control // Sohrab Rohani
Pubbl/distr/stampa	Oxford : , : Butterworth-Heinemann, , 2017
ISBN	9780081012246 0081012241 9780081010952 0081010958
Edizione	[4th edition.]
Descrizione fisica	1 online resource (630 pages) : illustrations
Disciplina	660
Soggetti	Chemical engineering Chemical process control
Lingua di pubblicazione	Inglese
Formato	Materiale a stampa
Livello bibliografico	Monografia
Nota di bibliografia	Includes bibliographical references and index.
Nota di contenuto	Front Cover -- Coulson and Richardson's Chemical Engineering: Volume 3B: Process Control -- Copyright -- Contents -- Contributors -- About Prof. Coulson -- About Prof. Richardson -- Preface -- Introduction -- Chapter 1: Introduction -- 1.1. Definition of a Chemical/Biochemical Process -- 1.1.1. A Single Continuous Process -- 1.1.1.1. A continuous chemical plant -- 1.1.1.2. A continuous biochemical process -- 1.1.1.3. A continuous green process -- 1.1.2. A Batch and a Semibatch or a Fed-Batch Process -- 1.2. Process Dynamics -- 1.2.1. Classification of Process Variables -- 1.2.2. Dynamic Modeling -- 1.3. Process Control -- 1.3.1. Types of Control Strategies -- 1.3.1.1. Feedback control -- 1.3.1.2. Feedforward control -- 1.4. Incentives for Process Control -- 1.5. Pictorial Representation of the Control Systems -- 1.6. Problems -- References -- Chapter 2: Hardware Requirements for the Implementation of Process Control Systems -- 2.1. Sensor/Transmitter -- 2.1.1. Temperature Transducers -- 2.1.2. Pressure Transducers -- 2.1.3. Liquid or Gas Flow Rate Transducers -- 2.1.4. Liquid Level Transducers -- 2.1.5. Chemical Composition Transducers -- 2.1.6. Instrument or Transducer Accuracy -- 2.1.7. Sources of Instrument Errors -- 2.1.8. Static and Dynamic

Characteristics of Transducers -- 2.2. Signal Converters -- 2.3.
Transmission Lines -- 2.4. The Final Control Element -- 2.4.1. Control
Valves -- 2.4.1.1. Selection and design of a control valve -- 2.4.1.2.
Valve characteristic -- 2.4.1.3. The transfer function of a control valve
-- 2.5. Feedback Controllers -- 2.5.1. The PID (Proportional-Integral-
Derivative) Controllers -- 2.5.2. The PID Controller Law -- 2.5.3. The
Discrete Version of a PID Controller -- 2.5.4. Features of the PID
Controllers -- 2.5.4.1. The reset or integral windup -- 2.5.4.2. The
derivative and proportional kicks.
2.5.4.3. Caution in using the derivative action -- 2.5.4.4. Auto and
manual modes of the controller -- 2.5.4.5. The reverse or direct
controller action -- 2.6. A Demonstration Unit to Implement A Single-
Input, Single-Output PID Controller Using the National InstrumentR
Data A ... -- 2.7. Implementation of the Control Laws on the
Distributed Control Systems -- 2.8. Problems -- References -- Chapter
3: Theoretical Process Dynamic Modeling -- 3.1. Detailed Theoretical
Dynamic Modeling -- 3.2. Solving an ODE or a Set of ODEs -- 3.2.1.
Solving a Linear or a Nonlinear Differential Equation in MATLAB --
3.2.2. Solving a Linear or a Nonlinear Differential Equation on Simulink
-- 3.3. Examples of Lumped Parameter Systems -- 3.3.1. A Surge Tank
With Level Control -- 3.3.2. A Stirred Tank Heater With Level and
Temperature Control -- 3.3.3. A Nonisothermal Continuous Stirred
Tank Reactor -- 3.3.4. A CSTR With Liquid Phase Endothermic Chemical
Reactions -- 3.4. Examples of Stage-Wise Systems -- 3.4.1. A Binary
Tray Distillation Column -- 3.5. Examples of Distributed Parameter
Systems -- 3.5.1. A Plug Flow Reactor -- 3.6. Problems -- References
-- Chapter 4: Development of Linear State-Space Models and Transfer
Functions for Chemical Processes -- Part A-Theoretical Development of
Linear Models -- 4.1. Tools to Develop Continuous Linear State-Space
and Transfer Function Dynamic Models -- 4.1.1. Linearization of
Nonlinear Differential Equations -- 4.1.1.1. Linearization of nonlinear
terms involving more than one independent variable -- 4.1.2. The
Linear State-Space Models -- 4.1.3. Developing Transfer Function
Models (T.F.) -- 4.1.3.1. Review of Laplace transform (L.T.) -- 4.1.3.2.
Laplace transform of simple functions -- 4.1.3.3. Inverse Laplace
transform -- Case I: Roots of $P(s)$ are all real and distinct -- Case II:
Roots of $P(s)$ are complex conjugates.
Case III: $P(s)$ has multiple roots -- 4.1.3.4. Use of Laplace transform to
solve differential equations -- 4.1.3.5. Summary of Laplace transform
and inverse Laplace transform -- 4.1.3.6. MATLAB commands for the
calculation of Laplace transform and the inverse Laplace transform --
4.2. The Basic Procedure to Develop the Transfer Function of SISO and
MIMO Systems -- 4.3. Steps to Derive the Transfer Function (T.F.)
Models -- 4.4. Transfer Function of Linear Systems -- 4.4.1. Simple
Functional Forms of the Input Signals -- 4.4.2. First-Order Transfer
Function Models -- 4.4.2.1. The step response of a first-order system
-- 4.4.2.2. Impulse response of a first-order process -- 4.4.2.3.
MATLAB and Simulink commands -- 4.4.2.4. Examples of real
processes with first-order transfer functions -- 4.4.3. A Pure Capacitive
or An Integrating Process -- 4.4.4. Processes With Second-Order
Dynamics -- 4.4.4.1. Case I: An overdamped system, >1 , two distinct
real roots -- 4.4.4.2. Case II: A critically damped system, $=1$, multiple
real roots -- 4.4.4.3. Case III: An underdamped system, <1 , two
distinct complex conjugate roots with negative real parts -- 4.4.4.4.
Examples of real systems that have second-order dynamics (second-
order transfer functions) -- 4.4.5. Significance of the Transfer Function
Poles and Zeros -- 4.4.5.1. Summary of the significance of poles and
zeros of a transfer function -- 4.4.6. Transfer Functions of More

Complicated Processes-An Inverse Response (A Nonminimum Phase Process), A Higher Order ... -- 4.4.6.1. Physical processes with inverse response -- 4.4.7. Processes With Nth-Order Dynamics -- 4.4.8. Transfer Function of Distributed Parameter Systems -- 4.4.9. Processes With Significant Time Delays -- 4.4.9.1. Effect of time delay in more detail -- 4.4.9.2. Approximation of higher order transfer functions by a first order plus time delay.

Part B-The Empirical Approach to Develop Approximate Transfer Functions for Existing Processes -- 4.5. The Graphical Methods for Process Identification -- 4.5.1. Approximation of the Unknown Process Dynamics by a First-Order Transfer Function With or Without a Time Delay -- 4.5.1.1. The Sundaresan and Krishnaswamy method1 -- 4.5.2. Approximation by a Second-Order Transfer Function With a Time Delay -- 4.5.2.1. The Smith's method2 -- 4.5.2.2. Fitting to an underdamped second-order model -- 4.6. Process Identification Using Numerical Methods -- 4.6.1. The Least Squares Method -- 4.6.2. Using the "Solver" Function of Excel for the Estimation of the Parameter Vector in System Identification -- 4.6.3. A MATLAB Program for Parameter Estimation -- 4.6.4. Using System Identification Toolbox of MATLAB -- 4.7. Problems -- References -- Chapter 5: Dynamic Behavior and Stability of Closed-Loop Control Systems-Controller Design in the Laplace Domain -- 5.1. The Closed-Loop Transfer Function of a Single-Input, Single-Output (SISO) Feedback Control System -- 5.2. Analysis of a Feedback Control System -- 5.2.1. A Proportional Controller -- 5.2.2. A Proportional-Integral (PI) Controller -- 5.3. The Block Diagram Algebra -- 5.4. The Stability of the Closed-Loop Control Systems -- 5.5. Stability Tests -- 5.5.1. Routh Test -- 5.5.2. Direct Substitution Method -- 5.5.3. The Root Locus Diagram -- 5.5.3.1. The numerical method -- 5.5.3.2. The graphical method -- Graphical rules for the construction of the approximate root locus diagram -- 5.5.3.3. Application of the root locus diagram to unstable processes -- 5.6. Design and Tuning of the PID Controllers -- 5.6.1. Controller Design Objectives -- 5.6.2. Choosing the Appropriate Control Law -- 5.6.3. Controller Tuning -- 5.6.4. The Use of Model-Based Controllers to Tune a PID Controller (Theoretical Method). 5.6.4.1. The direct synthesis method -- 5.6.4.2. The internal model control (IMC) -- 5.6.5. Empirical Approaches to Tune a PID Controller -- 5.6.5.1. The open-loop controller tuning or the process reaction curve approach -- 5.6.5.2. Closed-loop controller tuning (field tuning), the continuous cycling, or the Ziegler-Nichols (Z-N) method -- 5.7. Enhanced Feedback and Feedforward Controllers -- 5.7.1. Cascade Control -- 5.7.1.1. The closed-loop transfer function of a cascade control algorithm -- 5.7.2. Override Control -- 5.7.3. Selective Control -- 5.7.4. Control of Processes With Large Time Delays -- 5.7.5. Control of Nonlinear Processes -- 5.8. The Feedforward Controller (FFC) -- 5.8.1. The Implementation of a Feedforward Controller -- 5.8.2. The Ratio Control -- 5.9. Control of Multiinput, Multioutput (MIMO) Processes -- 5.9.1. The Bristol Relative Gain Array (RGA) Matrix -- 5.9.2. Control of MIMO Processes in the Presence of Interaction Using Decouplers -- 5.9.2.1. Design of decouplers -- 5.10. Problems -- References -- Chapter 6: Digital Sampling, Filtering, and Digital Control -- 6.1. Implementation of Digital Control Systems -- 6.2. Mathematical Representation of a Sampled Signal -- 6.3. z-Transform of a Few Simple Functions -- 6.3.1. A Discrete Unit Step Function (Fig. 6.3) -- 6.3.2. A Unit Impulse Function -- 6.3.3. A Discrete Exponential Function (Fig. 6.4) -- 6.3.4. A Discrete Delayed Function Where Is the Delay Time -- 6.4. Some Useful Properties of the z-Transform -- 6.5. Inverse z-Transform -- 6.6. Conversion of an Equation From the z-

Domain to a Discrete Equation in the Time Domain -- 6.7. Derivation of the Closed-Loop Transfer Function (CLTF) of a Digital Control System -- 6.8. The Closed-Loop Pulse Transfer Function of a Digital Control System -- 6.9. Selection of the Sampling Interval -- 6.10. Filtering. 6.11. Mapping Between the s-Plane and the z-Plane.

Sommario/riassunto

Coulson and Richardson's Chemical Engineering: Volume 3B: Process Control, Fourth Edition, covers reactor design, flow modeling, and gas-liquid and gas-solid reactions and reactors.- Converted from textbooks into fully revised reference material- Content ranges from foundational through to technical- Added emerging applications, numerical methods and computational tools
