Discrete Models for Digital Control

APPENDIX F

The chemical processes considered in this book involve continuous variables and can be modelled using algebraic and differential equations. Also, the control calculations have been introduced as equations involving continuous variables, which can be implemented using electronic or pneumatic analog calculating equipment. When all elements in the feedback loop are continuous, the system can be described using transfer functions involving Laplace transforms; this allows powerful analysis tools to be applied in determining the stability and performance of control systems. However, most control calculations are now implemented using digital computers, which introduce discrete equations in the control system. If the digital calculations are executed rapidly compared with the process dynamics, the analysis of continuous systems provides an accurate approximation of the dynamic behavior.

Because the controller is implemented in digital form, it is important that the engineer understand the digital forms of the models and control calculations used in this book. The major applications of digital calculations are summarized below.

Chapter 3: numerical solutions of differential equations using Euler or Runge-Kutta methods
Chapter 6: least squares fitting of parameters in dynamic models
Chapter 11: digital formulation of the PID controller
Chapter 12: implementation issues for digital control
Chapter 15: lead/lag elements for feedforward control
Chapter 19: digital formulation of the model predictive controller
Chapter 21: decoupling of multiple PID controllers
Chapter 23: dynamic matrix control