Variable-Structure and Constraint Control

CHAPTER 22

22.1 ■ INTRODUCTION

To this point we have made the assumption that the multivariable process has the same number of manipulated and controlled variables. This situation is often referred to as a square or $n \times n$ system. Square systems are typical, because we consider dynamic behavior and control when designing plants and provide sufficient manipulated variables for at least the most important controlled variables. However, it is often the case that, due to process limitations and overriding control objectives, the number of manipulated and controlled variables are not always equal, and control approaches are needed to address these situations.

In this chapter, situations will be considered in which the number of manipulated variables is greater than or less than the number of controlled variables. When an excess of manipulated variables exists, the controlled variables can be returned to their set points at steady state by many combinations of the steady-state manipulated variables. Thus, the control system should operate the process in the most economical manner, in addition to providing good dynamic performance. When an excess of controlled variables exists, not all controlled variables can be maintained at their set points simultaneously. However, the control system can be designed to maintain the most important controlled variables at their set points.

The branch of process control that addresses these situations is known as *variable-structure* control. In this chapter, methods based on *single-loop control algorithms* are presented that provide the ability to change the input-output pairings of selected loops automatically. These methods are easy to design and simple to use and are therefore widely applied in practice. However, they are normally