Performance of Feedback Control Systems

13.1 ■ INTRODUCTION

As we have learned, feedback control has some very good features and can be applied to many processes using control algorithms like the PID controller. We certainly anticipate that a process with feedback control will perform better than one without feedback control, but how well do feedback systems perform? There are both theoretical and practical reasons for investigating control performance at this point in the book. First, engineers should be able to predict the performance of control systems to ensure that all essential objectives, especially safety but also product quality and profitability, are satisfied. Second, performance estimates can be used to evaluate potential investments associated with control. Only those control strategies or process changes that provide sufficient benefits beyond their costs, as predicted by quantitative calculations, should be implemented. Third, an engineer should have a clear understanding of how key aspects of process design and control algorithms contribute to good (or poor) performance. This understanding will be helpful in designing process equipment, selecting operating conditions, and choosing control algorithms. Finally, after understanding the strengths and weaknesses of feedback control, it will be possible to enhance the control approaches introduced to this point in the book to achieve even better performance. In fact, Part IV of this book presents enhancements that overcome some of the limitations covered in this chapter.

Two quantitative methods for evaluating closed-loop control performance are presented in this chapter. The first is frequency response, which determines the