
Preface

Intended Audience

This book is intended for people with many different backgrounds and objectives.

Category 1

Experienced individuals with a technical background: Engineers and senior technicians from varied engineering disciplines such as mechanical, chemical, electrical, *etc.*, possessing a limited experience of automated systems. Such people would be seeking background information rather than an in-depth analysis in model-based predictive control techniques.

Category 2

Individuals educated in automation: People who have been exposed to the concepts of a process, transfer function, stability, *etc.*, but have not had the opportunity to put this theory into practice. Also, it is intended for those who wish to be kept informed of developments in industrial automation without going into the practical implementation details.

Category 3

Automation industry practitioners: PID specialists, instrumentation personnel and those familiar with the issues surrounding instrumentation, actuators and sensors, which are required to implement continuous controllers. It is also intended for people with a long-term requirement for a more effective form of control and who are seeking a guide for potential controllers.

Category 4

Individuals who have attended seminars or graduate courses in “advanced control”: Those who possess a good theoretical and practical background in automatic control and make use of controllers other than PID.

The use of mathematical tools is kept to a minimum in order to retain the emphasis on the concepts. The level of mathematics used is equivalent to that of a junior engineer.

However, a basic understanding of systems theory would be beneficial. This would include a basic understanding of fundamental concepts such as:

- block-diagram algebra;
- the Laplace and z-transforms for the continuous and discrete time domains (although, this is not crucial);
- elementary knowledge of PID.

Reading Guide

Chapters 1, 2 and 3 present the basic principles and fundamental concepts of the predictive control methodology in an intuitive manner.

Chapter 4 presents a mathematical derivation of the predictive regulator in its most basic form. Extensions to the basic regulator are then proposed for controlling integrating, time-delayed and unstable systems. A basic knowledge of the mathematical tools mentioned in Category 4 above would be useful.

Chapter 5 discusses the factors that influence the tuning of the predictive regulator. The chapter concludes by presenting a tuning aid that suggests how the regulator parameters should be altered when particular results are obtained.

Chapter 6 describes how the presence of the system constraints may be dealt with by imposing limits on the range of various parameters of the predictive regulator and through the use of logical supervisors.

Chapter 7 puts the concepts described in the previous chapters into practice. Many control structures are discussed, some of which may be used in conjunction with a PID regulator. This chapter demonstrates techniques of practical benefit in industrial applications and *should be read by everyone*, if for no other reason than to become familiar with the specific control structures involved.

Chapter 8 is aimed specifically at thermal process control specialists. The previously unpublished material contained within this chapter is of great practical benefit.

Chapter 9 deals with unstable and non-minimum phase (inverse unstable) systems, which are difficult to control and fortunately rare. Consequently, this chapter does not constitute essential reading for all.

Chapter 10 describes several industrial applications. These examples are provided to demonstrate that predictive control is far more than just an academic concept. It is felt that the examples chosen are of interest generally, rather than confining the discussion to specialist areas – although such discussions do contain merit.

Chapter 11 discusses important precautions to be taken when using the predictive control technique and describes the associated risks.

Some chapters, such as Chapters 8 and 9, contain original material that, although having been applied in practice, has not been presented previously. By its nature, the novel content of these chapters is more demanding than that of the initial introductory and final assessment chapters.

The following guide indicates the suggested reading path for each category of reader.

Chapter		Category			
		1	2	3	4
1	Why Predictive Control?	*	*	*	*
2	Internal Model	*	*	*	*
3	Reference Trajectory	*	*	*	*
4	Control Computation	-	-	*	*
5	Tuning	-	-	*	*
6	Constraints	-	-	*	*
7	Industrial Implementation	-	*	*	*
8	Parametric Control	~	~	*	*
9	Unstable Poles and Zeros	-	-	-	~
10	Industrial Examples	*	*	*	*
11	Conclusions	*	*	*	*

* To read

- May be omitted during first reading

~ Personal choice

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Peugeot PSA (F), ESA (Eu), SanofiAventis (F), EDF (F), SNCF (F), Mitsui-chem (JP), JGC (JP), CSEE (F), Lactalis (F), Tour Eiffel (F), Schneider Electric (F), Nodon (F), Veolia (F), Sepro (F), SFIM (F), Marine Nationale, Armée de l'air (F).



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