

Basic
DYNAMICS and CONTROL

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Preface

This book is about on automatic control using the industry-standard PID controller, and control structures based on the PID controller.¹

This book is based on a mathematical description – mathematical models – of the processes to be controlled. Models are very useful for several reasons:

- To represent processes, and other components of control systems, in a clear, conceptual way.
- To create simulators. Simulation is very convenient for design and testing of processes and control systems.
- To characterize the dynamic properties of processes.
- To tune a PID feedback controller from the process model, as with Skogestad's tuning method.
- To design a feedforward controller.

Despite the use of models as mentioned above, this book does not contain theoretical analysis of stability and dynamics of control systems. Also, frequency response analysis is omitted. After many years of teaching basic dynamics and control, I have found that omitting these topics releases valuable time which can be used on practical control topics, as experimental methods for controller tuning and control structures. Furthermore, the practical control tasks that I have been working with have taught me some lessons about what knowledge is needed to solve a control problem. In more advanced courses about control, theoretical analysis of stability and dynamics, including frequency response analysis, is relevant, of course. (A reference for these topics is [2].)

¹PID = proportional + integral + derivative, expressing the mathematical functions of the controller.

The theoretical parts of the book assumes basic knowledge about differential equations. A minimal introduction to the Laplace transform, which is the basis of transfer function models which are used in several sections of the book, is given in a separate chapter of the book.

Supplementary material is available from <http://techteach.no>:

- **Tutorials** for LabVIEW, MATLAB/SIMULINK, Octave, and Scilab/Scicos.
- **SimView** which is a collection of ready-to-run simulators.
- **TechVids** which is a collection of instructional streaming videos, together with the simulators that are played and explained in the videos.
- **An English-Norwegian glossary** of a number of terms used in the book is available at the home page of the book at <http://techteach.no>.

This book is available for sale only via <http://techteach.no>.

It is not allowed to make copies of the book.

About my background: I graduated from the Norwegian Institute of Technology in 1986. Since then I have been teaching control courses in the bachelor and the master studies and for industry in Norway. I have developed simulators for educational purposes, and video lectures, and I have been writing text-books for a couple of decades. I have been engaged in industrial projects about modeling, simulation and control. (More information is on <http://techteach.no/adm/fh>.)

What motivates me mostly is a fascination about using computers to model, simulate and control physical systems, and to bring theoretical solutions into actions using numerical algorithms programmed in a computer. National Instruments LabVIEW has become my favourite software tool for implementing this

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