Control Tutorials for MATLAB and Simulink

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Course Details

Description

Control Tutorials for MATLAB and Simulink is a set of modules consisting of control tutorials for MATLAB and Simulink, curriculum for a first course in systems dynamics and control and a set of homework problems and exams for a second course in controls.

- Control Tutorials for MATLAB and Simulink - Designed to help you learn how to use MATLAB and Simulink for the analysis and design of automatic control systems. They cover the basics of MATLAB and Simulink and introduce the most common classical and modern control design techniques.
- System Dynamics and Control - Modeling of electrical, mechanical and electromechanical systems. Analytic solution of open loop and feedback type systems. Root Locus methods in design of systems and evaluation of system performance. Time and frequency domain design of control systems.

Prerequisites:

- Module 1  
  - MATLAB Basics
Simulink Basics

- Module 2
  - Differential Equations

- Module 3
  - Laplace transforms, differential equations, transfer functions, root locus and Bode plot construction, MATLAB and Simulink

Original Course Documents

Source file URL  Control Tutorials for MATLAB and Simulink

Course Contents

MODULE 1: Control Tutorials for MATLAB and Simulink

System

Modeling

- Introduction
- Cruise Control
- Motor Speed
- Motor Position
- Suspension
- Inverted Pendulum
- Aircraft Pitch
- Ball & Beam

Analysis

- Introduction
- Cruise Control
- Motor Speed
- Motor Position
- Suspension
- Inverted Pendulum
- Aircraft Pitch
- Ball & Beam
Control

PID

- Introduction
- Cruise Control
- Motor Speed
- Motor Position
- Suspension
- Inverted Pendulum
- Aircraft Pitch
- Ball & Beam

Root Locus

- Introduction
- Cruise Control
- Motor Speed
- Motor Position
- Suspension
- Inverted Pendulum
- Aircraft Pitch
- Ball & Beam

Frequency

- Introduction
- Cruise Control
- Motor Speed
- Motor Position
- Suspension
- Inverted Pendulum
- Aircraft Pitch
- Ball & Beam

State–Space

- Introduction
- Cruise Control
• Motor Speed
• Motor Position
• Suspension
• Inverted Pendulum
• Aircraft Pitch
• Ball & Beam

Digital

• Introduction
• Cruise Control
• Motor Speed
• Motor Position
• Suspension
• Inverted Pendulum
• Aircraft Pitch
• Ball & Beam

Simulink

Modeling

• Introduction
• Cruise Control
• Motor Speed
• Motor Position
• Suspension
• Inverted Pendulum
• Aircraft Pitch
• Ball & Beam

Control

• Introduction
• Cruise Control
• Motor Speed
• Motor Position
• Suspension
• Inverted Pendulum
• Aircraft Pitch
MODULE 2: System Dynamics and Control

Lesson 1

- Lecture 1 - Introduction to modeling, control, differential equations
- Lecture 2 - Laplace transform definition and properties

Reading

- Chapter 1 and Section 2.1 of the book
- Sections 2.2 and 2.3 of the book

Problem Set

- Problem Set 1

Lesson 2

- Lecture 3 - Solving differential equations with Laplace
- Lecture 4 - Mechanical system models

Reading

- Sections 2.4 and 2.5 of the book
- Sections 3.1 to 3.3 of the book

Problem Set

- Problem Set 2

Lesson 3

- Lecture 5 - Transfer functions and block diagrams
- Lecture 6 - Time response

Reading
- Sections 4.1 and 4.2 of the book
- Sections 4.3 and 4.4 of the book

Problem Set

- Problem Set 3

Lesson 4

- Lecture 7 - State-space models
- Lecture 8 - Electrical system models

Reading

- Sections 5.1 to 5.3 and 5.5 in the book
- Sections 6.1 to 6.3 in the book

Problem Set

- Problem Set 4

Lesson 5

- Lecture 9 - Electromechanical systems
- Lecture 10 - DC Motors

Reading

- Section 6.5 in the book

Problem Set

- Problem Set 5

Lesson 6

- Lecture 11 - Linearization (Taylor Series expansion)
- Lecture 12 - First-order system response, stability

Reading

- Section 7.4 in the book
Sections 8.1 and 8.2 in the book

Problem Set

- Problem Set 6

Lesson 7

- Lecture 13 - Second-order system response
- Lecture 14 - Higher-order system response, system identification

Reading

- Section 8.3 in the book
- Section 8.4 in the book

Problem Set

- Problem Set 7

Lesson 8

- Lecture 15 - Introduction to control, block diagram manipulation
- Lecture 16 - Control goals and specifications, PID control

Reading

- Sections 10.1 and 10.2 in the book
- Sections 10.3 to 10.5 in the book

Problem Set

- Problem Set 8

Lesson 9

- Lecture 17 - System type and steady-state error
- Lecture 18 - Root locus basics

Reading

- Section 10.6 in the book
Sections 10.8 and 10.9 in the book

Problem Set

  ○ Problem Set 9

Lesson 10

  • Lecture 19 - Root locus continued
  • Lecture 20 - Root Locus for Design

Reading

  ○ Sections 10.8 and 10.9 in the book

Problem Set

  ○ Problem Set 10

Lesson 11

  • Lecture 21 - Frequency response and Bode plots
  • Lecture 22 - Analysis with Bode plots

Reading

  ○ Sections 9.1, 9.2, 11.1 and 11.2 in the book
  ○ Sections 11.2 to 11.4 in the book

Problem Set

  ○ Problem Set 11

Lesson 12

  • Lecture 23 - Bode plots for controller design
  • Lecture 24 - More advanced control architectures

Reading

  ○ Section 11.6 in the book
Problem Set
  - Problem Set 12

Lesson 13
  - Lecture 25 - Controller implementation and advanced topics

Reading
  - Review

Problem Set
  - Problem Set 13

Project
  - Lab 1
  - Lab 2

Quizzes
  - Quiz 1
  - Quiz 2
  - Quiz 3
  - Quiz 4
  - Quiz 5
  - Quiz 6
  - Quiz 7

Exams
  - Mid-term Exam
  - Final Exam

Textbooks
Nise, Norman S., *Control Systems Engineering*. †

* Required Material
† Supplemental Material

MODULE 3: Controls II

Problem sets

- Problem Set 1
- Problem Set 2
- Problem Set 3
- Problem Set 4
- Problem Set 5
- Problem Set 6
- Problem Set 7
- Problem Set 8

Exams

- Mid-term Exam 1
- Mid-term Exam 2
- Final Exam

Textbooks

- Ogata, K., Modern Control Engineering. 5th Ed., Prentice Hall, 2010.*
- Franklin, G., Powell, J.D., and Emami-Naeini, A., *Feedback Control of Dynamic Systems*. †
- Nise, Norman S., *Control Systems Engineering*. †

* Required Material
† Supplemental Material

Links
YouTube Lecture Videos for a course similar to System Dynamics and Control.

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Learn more about MathWorks academic resources:
Introduction to MATLAB for engineering students. David Houcque Northwestern University. (version 1.2, August 2005). Contents. 1 Tutorial lessons 1.1 Introduction . . . 1.2 Basic features . . . 1.3 A minimum MATLAB session . . . When MATLAB is started for the first time, the screen looks like the one that shown in the Figure 1.1. This illustration also shows the default configuration of the MATLAB desktop.

You can customize the arrangement of tools and documents to suit your needs. This set of modules contains control tutorials for MATLAB and Simulink, as well as course curriculum for a first course in system dynamics and control and a second more advanced controls course. Control Tutorials for MATLAB and Simulink - Designed to help you learn how to use MATLAB and Simulink for the analysis and design of automatic control systems. They cover the basics of MATLAB and Simulink and introduce the most common classical and modern control design techniques. System Dynamics and Control - Modeling of electrical, mechanical, and electromechanical systems. Analytic solution of open...