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
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
Syllabus

- 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


Franklin, G., Powell, J.D., and Emami-Naeini, A., Feedback Control of Dynamic Systems.
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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MATLAB Courseware  Hardware Resources  Classroom Resources  MATLAB Examples  Books
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 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 Welcome to the Control Tutorials for MATLAB and Simulink (CTMS): They are 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. Navigation: There are several items listed down the left column of the main page. These represent the various steps or approaches in the controller design process: System modeling and analysis - PID, root locus, frequency domain, state-space, and digital controller design - and Simulink modeling and ...
To start Simulink, you must first start MATLAB. Consult your MATLAB documentation for more information. You can then start Simulink in two ways: • Click on the Simulink icon on the MATLAB toolbar. • Enter the simulink command at the MATLAB prompt. On Microsoft Windows platforms, starting Simulink displays the Simulink Library Browser. The Library Browser displays a tree-structured view of the Simulink block libraries installed on your system. MATLAB is an interactive program for numerical computation and data visualization; it is used extensively by control engineers for analysis and design. There are many different toolboxes available which extend the basic functions of MATLAB into different application areas; in these tutorials, we will make extensive use of the Control Systems Toolbox. MATLAB is supported on Unix, Macintosh, and Windows environments; a student version of MATLAB is available for personal computers. For more information on MATLAB, please visit the MathWorks home. You should be able to re-do all of the plots and calculations in the tutorials by cutting and pasting text from the tutorials into the MATLAB Command Window or an m-file.

Let's start off by creating something simple, like a vector. 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 I remember when I started to study matlab I was searching for matlab control design step by step tutorials but I have not seen any. Self studying is not easy, it took me sometimes to learn and get what I want. However, we will not having the same experience. In this tutorial I use R2011a version of matlab. Higher version of matlab has different appearance or interface but the command/syntax are all the same. You may just need a little exploration but do not worry this software is user friendly. These are our objectives in this tutorial: To create an equivalent Simulink diagram, on the Tool menu of SISO Design for SISO Design Task window, select “Draw Simulink Diagram”. This is only possible if both the compensator and plant are already exported to MATLAB workspace. Modelling a Dynamic Control System. Simulink is used to analyze various real-time-based complex systems related to friction, air resistance, gear slippage etc. These system are very complex, and to design a Model for that is out of the scope the article. But to learn how to model dynamic control system, MATLAB itself provided a nice documentation. You can access that in Getting Started tutorial of the MATLAB. Go to “Model a Dynamic System™” after selecting Getting Started. You will be redirected to the help browser of the MATLAB, as shown in below image.