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.
- Controls II - Advanced study of root locus analysis. Frequency response analysis. Design and compensation techniques. Control system analysis and design using state-space methods.

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

- Ball & Beam

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

Ogata, K., *System Dynamics*. 4th Ed., Pearson Prentice Hall, 2004.*

Franklin, G., Powell, J.D., and Emami-Naeini, A., *Feedback Control of Dynamic Systems*. ∓

Nise, Norman S., *Control Systems Engineering*. Ŧ

* *Required Material*

Ŧ *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*. Ŧ

Nise, Norman S., *Control Systems Engineering*. Ŧ

* *Required Material*

Ŧ *Supplemental Material*

Links

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

Learn more about MathWorks academic resources:

MATLAB Courseware Hardware Resources Classroom Resources MATLAB Examples Books Tutorials Webinars Technical Articles

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 ... MATLAB & Simulink Tutorial. 16.06 Principles of Automatic Control & 16.07 Dynamics. Violeta Ivanova, Ph.D. Educational Technology Consultant MIT Academic Computing. violeta@mit.edu. This Tutorial. Â„ Class materials. web.mit.edu/acmath/matlab/course16/. Â„ Topics. { MATLAB Review { Exercise 1: Matrices & ODEs { Introduction to Simulink { Exercise 2: Simulink Model. Simulink Â MATLAB Basics Tutorial The plot contains approximately one period of a sine wave. Basic plotting is very easy in MATLAB, and the plot command has extensive addon capabilities. I would recommend you visit the plotting page to learn more about it. Polynomials as Vectors In MATLAB, a polynomial is represented by a vector.Â For example, (2) would be represented in MATLAB as: y = [1 0 0 0 1] y = 1 0 0 0 1 3/9 1/19/2017 Control Tutorials for MATLAB and Simulink Â MATLAB Basics Tutorial You can find the value of a polynomial using the polyval function. For example, to find the value of the above polynomial at s = 2, z = polyval([1 0 0 0 1],2) z = 17 You can also extract the roots of a polynomial.