

Robust Control Workshop

AAS GN&C Conference

Breckenridge, CO

February 7th, 2023



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Robust Control Workshop - Agenda

- Part 1: Classic Control Design Basics

Lunch Break

- Part 2: Robust Control Analysis

Coffee Break

- Part 3: Robust Control Design

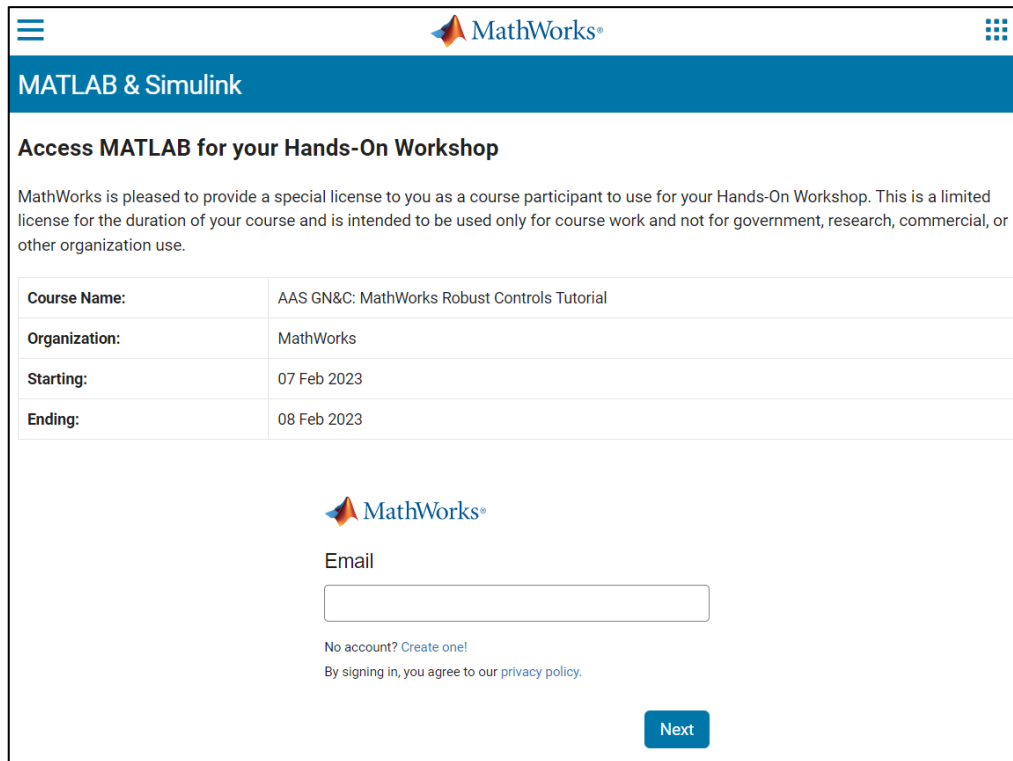
Appendix

- Exercise 1: Tuning of Gain Scheduled Controller for a Three-Loop Autopilot
- Exercise 2: MIMO Stability Margins for a Spinning Satellite
- Exercise 3: Robust Controller Design for a Spinning Satellite

Robust Control Workshop – Set-up Instructions

See the readme of this GitHub repository:

<https://github.com/juliaantoniou-ML/RobustControlsWorkshop>




MATLAB & Simulink

Access MATLAB for your Hands-On Workshop

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Course Name:	AAS GN&C: MathWorks Robust Controls Tutorial
Organization:	MathWorks
Starting:	07 Feb 2023
Ending:	08 Feb 2023



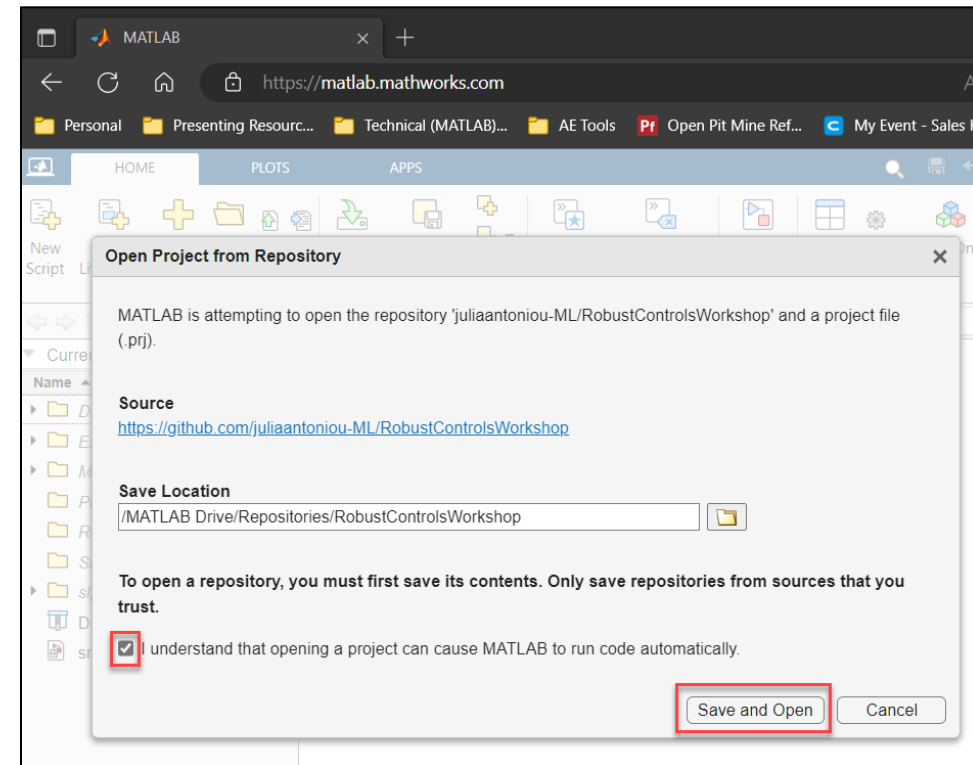
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Step 1



Step 5

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Mission accomplished, now it's time to crash?

Posted by [Lisa Harvey](#), September 29, 2016

19 views (last 30 days) | 0 Likes | 0 comment


Imagine travelling twelve years in pursuit of a comet that is streaking along at 24,600 miles per hour only to crash into the comet. Twelve years. 4.9 billion miles. Untold hours of science and engineering manpower invested in this project and it's going to crash?

Yet that is exactly what's about to happen to the Rosetta comet chaser. That is, as long as everything goes according to plan. And *BBC* will be [covering it live](#).

Tomorrow, the twelve-year-long [European Space Agency \(ESA\)](#) mission's probe is going to intentionally crash land, albeit slowly, into the comet it has been trailing.

The mission

ESA's Rosetta probe was launched on 2 March 2004 in order to rendezvous with comet [67P](#). Rosetta's prime objective is to help understand the origin and evolution of the Solar System. According to ESA, "The comet's composition reflects the composition of the pre-solar nebula out of which the Sun and the planets of the Solar System formed, more than 4.6 billion years ago. Therefore, an in-depth analysis of comet 67P by Rosetta and its lander will provide essential information to understand how the Solar System formed."



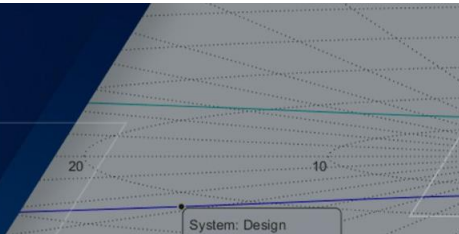
Artist's impression of the Rosetta orbiter deploying the Philae lander to comet 67P/Churyumov-Gerasimenko. Image credit: ESA-C. Carreau/ATG medialab

[Link to the article](#)

Control Systems Product Suite

Control System Toolbox

Design and analyze control systems



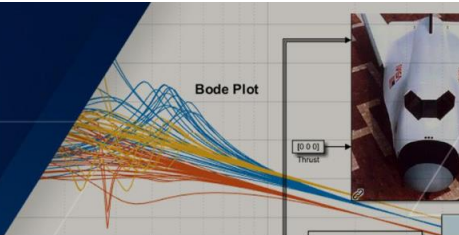
Model Predictive Control Toolbox

Design and simulate model predictive controllers



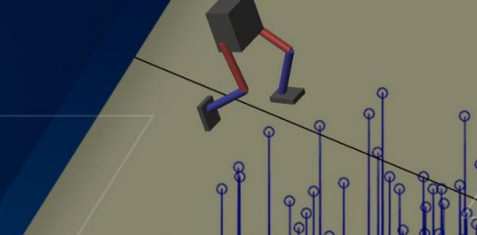
Simulink Control Design

Linearize models and design control systems



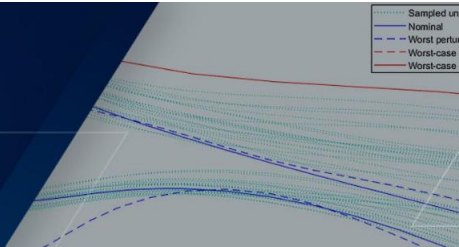
Reinforcement Learning Toolbox

Design and train policies using reinforcement learning



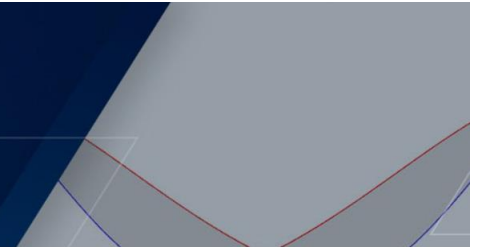
Robust Control Toolbox

Design robust controllers for uncertain plants



Fuzzy Logic Toolbox

Design and simulate fuzzy logic systems



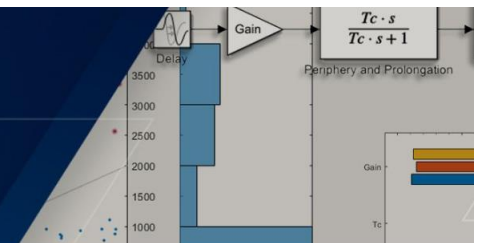
System Identification Toolbox

Create linear and nonlinear dynamic system models from input-output data















Simulink Design Optimization

Analyze model sensitivity and tune model parameters


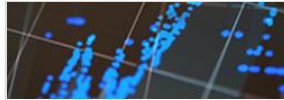






Online Courses

Getting Started

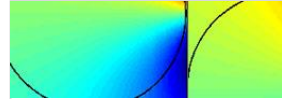
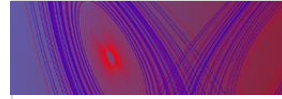
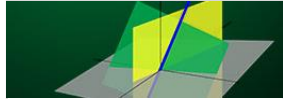


 FREE	 FREE	 FREE	 FREE	 FREE	 FREE	 FREE
MATLAB Onramp	Deep Learning Onramp	Reinforcement Learning Onramp	Machine Learning Onramp	Image Processing Onramp	Signal Processing Onramp	Optimization Onramp
 FREE	 FREE	 FREE	 FREE	 NEW FREE		
Simulink Onramp	Control Design Onramp with Simulink	Stateflow Onramp	Simscape Onramp	Circuit Simulation Onramp		

MATLAB

		
MATLAB Fundamentals	MATLAB for Data Processing and Visualization	MATLAB Programming Techniques
		 NEW
Deep Learning with MATLAB	Machine Learning with MATLAB	Image Processing with MATLAB

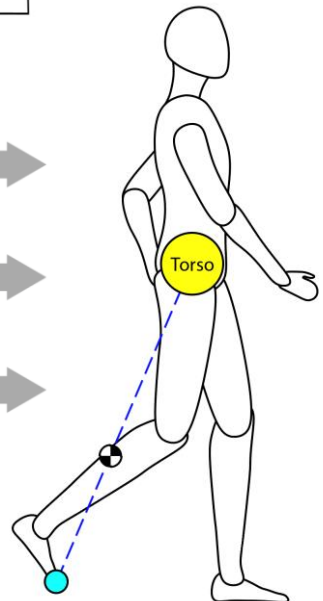
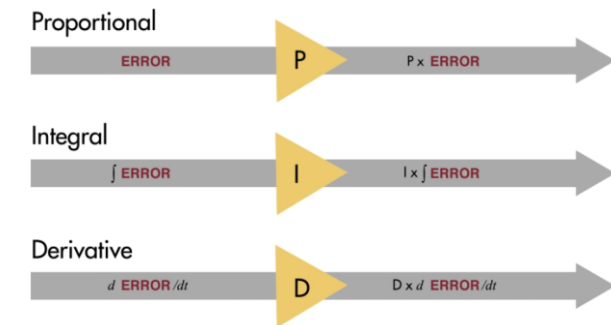
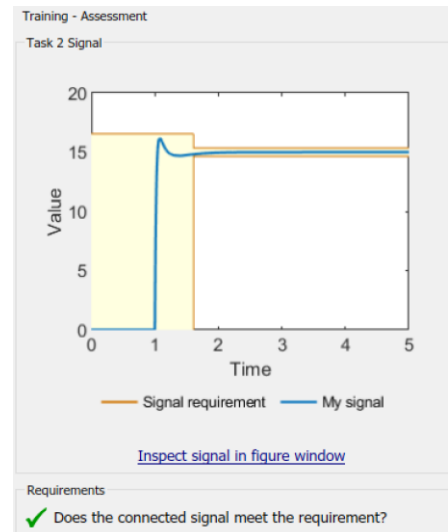
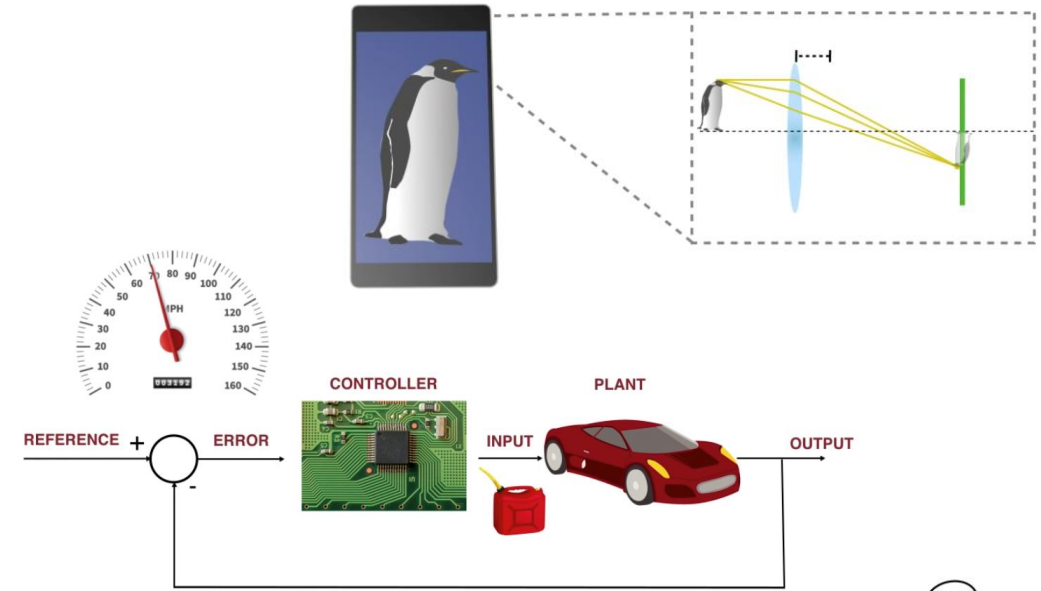
Computational Mathematics

* Available exclusively for users with Online Training Suite

		
Solving Nonlinear Equations with MATLAB	Solving Ordinary Differential Equations with MATLAB	Introduction to Linear Algebra with MATLAB
		
Introduction to Statistical Methods with MATLAB	Introduction to Symbolic Math with MATLAB	

Control Design Onramp with Simulink

- Free, short course on the basics of linear analysis and feedback control design in Simulink
- Interactive exercises
- Automated assessments & immediate feedback
- Access from Simulink (from R2020b on)
- Topics include:
 - Linearize nonlinear plants
 - Common linear analysis
 - Feedback control
 - Automatic PID controller tuning

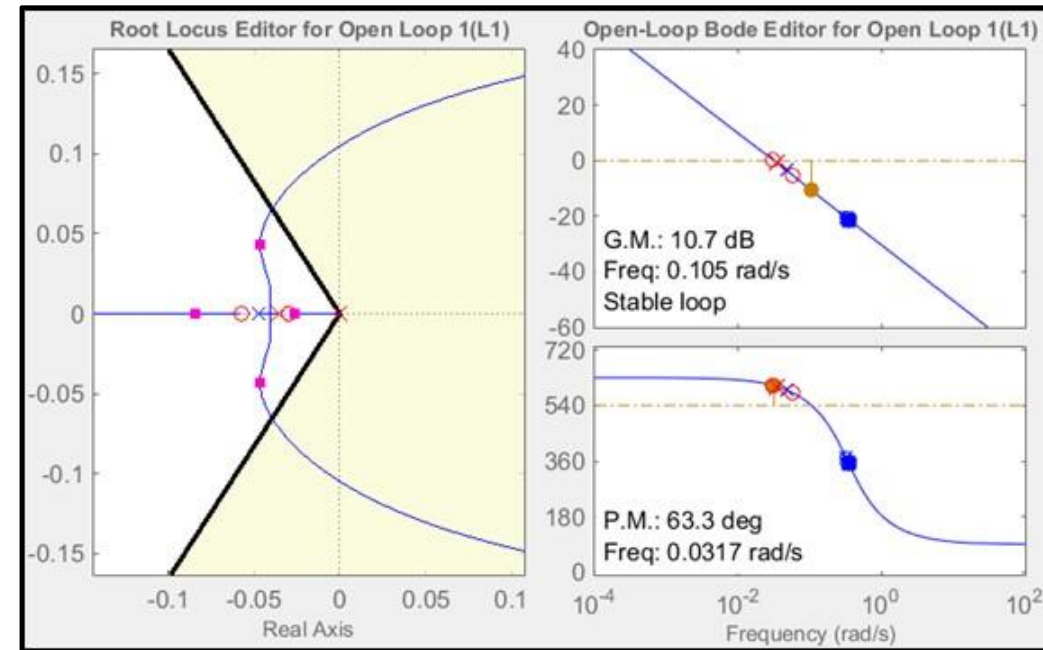


Control System Design with MATLAB and Simulink

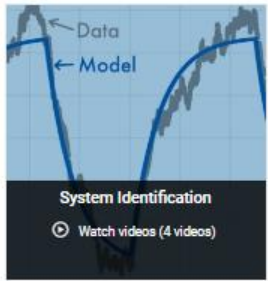


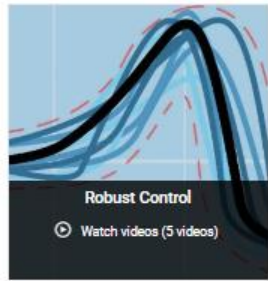
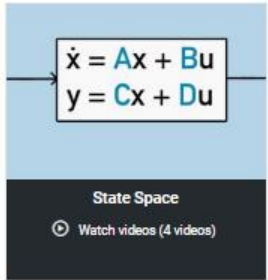
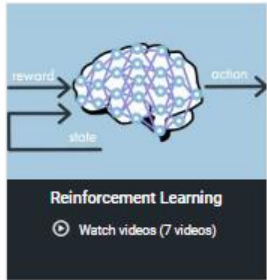
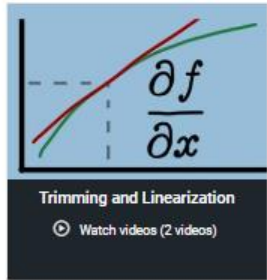

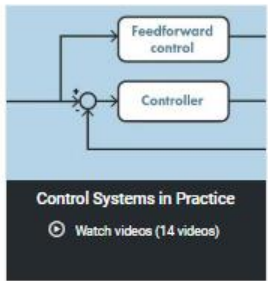
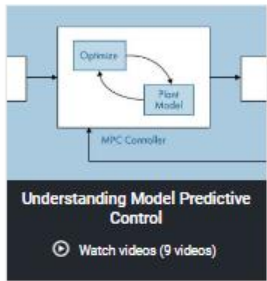
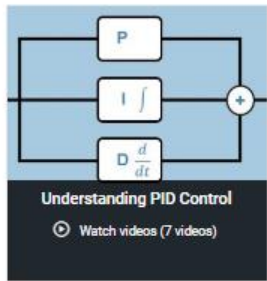

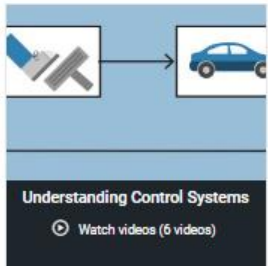
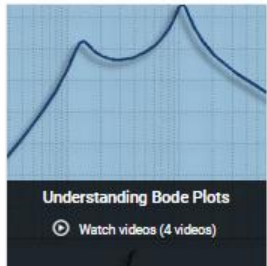

Topics included in this 2-day course:

- Control system design, modeling and analysis
- System identification
- Parameter estimation
- Response optimization
- Linearization
- Controller implementation

[See detailed course outline](#)



MATLAB Tech Talks - Controls

 <p>System Identification Watch videos (4 videos)</p>	 <p>Fuzzy Logic Watch videos (4 videos)</p>	 <p>Learning-Based Control Watch videos (3 videos)</p>	 <p>Robust Control Watch videos (5 videos)</p>
 <p>State Space Watch videos (4 videos)</p>	 <p>Reinforcement Learning Watch videos (7 videos)</p>	 <p>Trimming and Linearization Watch videos (2 videos)</p>	 <p>Drone Simulation and Control Watch videos (5 videos)</p>
 <p>Control Systems in Practice Watch videos (14 videos)</p>	 <p>Understanding Model Predictive Control Watch videos (9 videos)</p>	 <p>Understanding PID Control Watch videos (7 videos)</p>	 <p>Understanding Kalman Filters Watch videos (7 videos)</p>
 <p>Understanding Control Systems Watch videos (6 videos)</p>	 <p>Understanding Bode Plots Watch videos (4 videos)</p>	 <p>Using Bode Plots Watch videos (5 videos)</p>	

<https://www.mathworks.com/videos/tech-talks/controls.html>