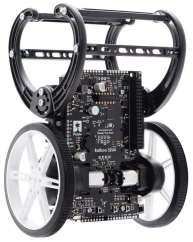
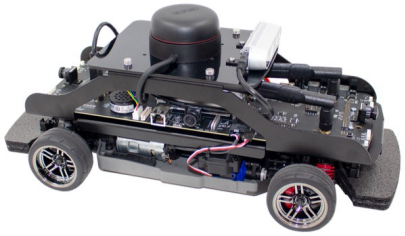
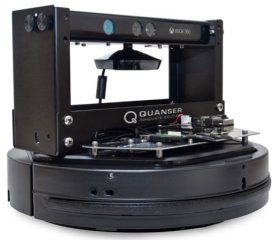
Control of mobile robots





Hugues GARNIER

hugues.garnier@univ-lorraine.fr

September 2026

Volumes horaires

- ***Contrôle de robots mobiles***
  - 1 séance de cours *de 2h* — 2h
  - 2 séances de TP *de 4h* — 8h
  - Mini-projets *(en binôme)* — 24h

- - - - - - - - - - - - - -

- Intervenants en cours/TP
  - Hugues Garnier
- Intervenants en mini-projets
  - Hugues Garnier
  - Théo Rutschke

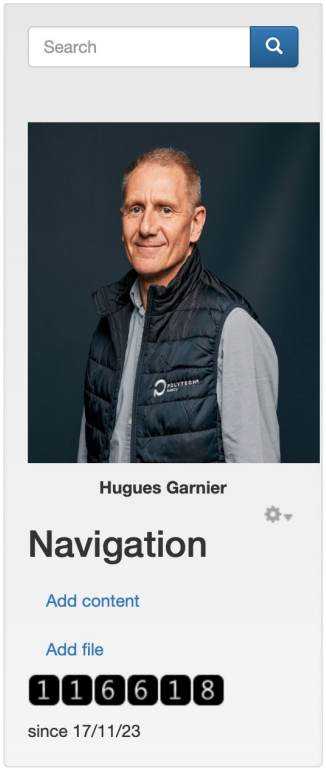
Contrôle des connaissances

- 1 rapport de mini-projet
  - A faire en binôme
- 1 présentation orale de mini-projet
  - A faire en binôme
- Calcul de la note finale

  Note EC = 0,25 rapport + 0,75 Oral

Website for the course : *Labs & mini-projects*

- **w3.cran.univ-lorraine.fr/hugues.garnier/?q=content/teaching**



Teaching

Basic page *Teaching* has been updated.

View Edit

Teaching activities

Since 2018, I have been teaching the following courses at Polytech Nancy:

Robotics S5 (3A IA2R FISE)

- Lab 1 - Sensors and actuators of the QUBE servo 2
  - QUBE-Servo 2 pdf guides

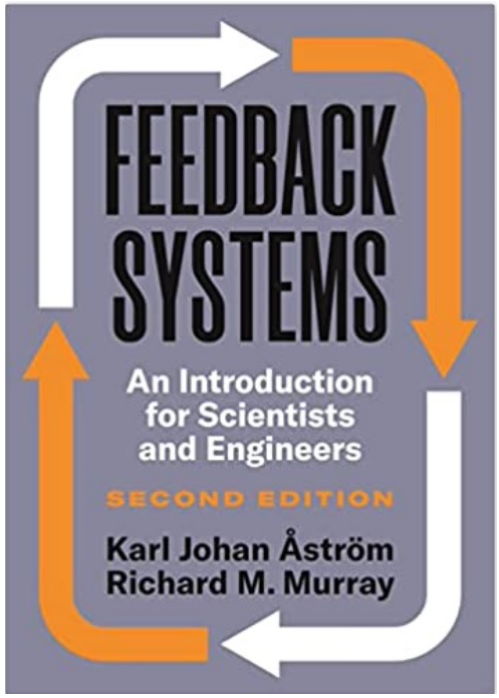
Control of Mobile Robots S9 (5A IA2R Parcours SIA)

- Introduction to the course
- Tutorials - Correction_tutorials
- Labs
  - Lab 1 - PID control of the QUBE-Servo 2
    - QUBE-Servo 2 pdf guides
    - Files for the PID control
  - Lab 2 - State-feedback control of QUBE rotary inverted pendulum
    - Files for the State-feedback control
  - Mini-projects
    1. Control design for the self-driving Qcar
    2. Control design for the Qbot
    3. Control design for the self-balancing Balboa robot
    4. MPC control design for the rotary inverted pendulum
    5. Control design for the Tello mini-drone
    6. Control design for the AERO system
- Feedback about the course from the students
  - Feedback from students 2024-2025

Recommended book in Control

Feedback Systems

An Introduction for Scientists and Engineers, *K.J. Astrom & R. Murray 2021*



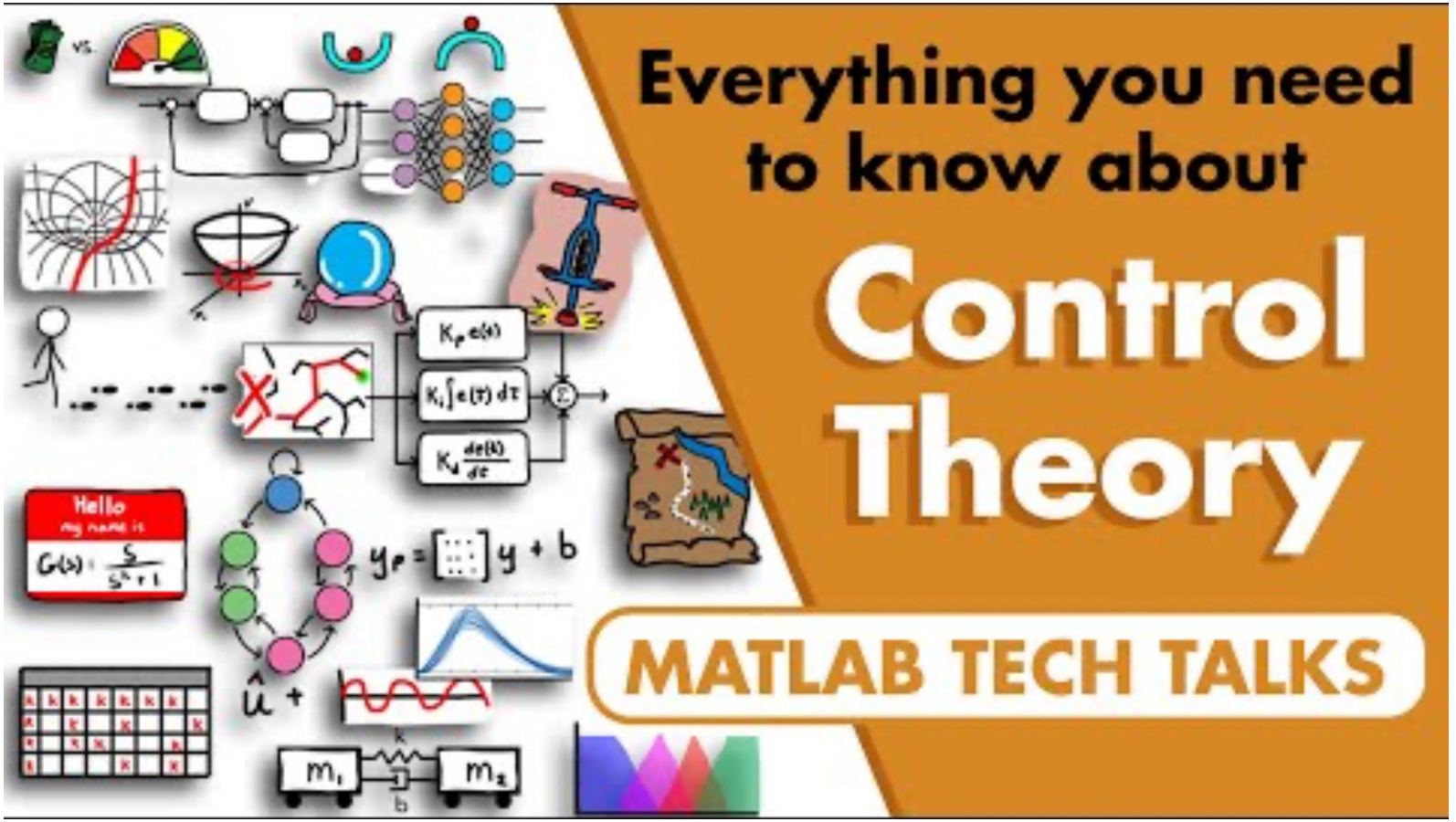
pdf version of the book available

http://www.cds.caltech.edu/~murray/books/AM08/pdf/fbs-public_24Jul2020.pdf

Other ressource recommended in Control

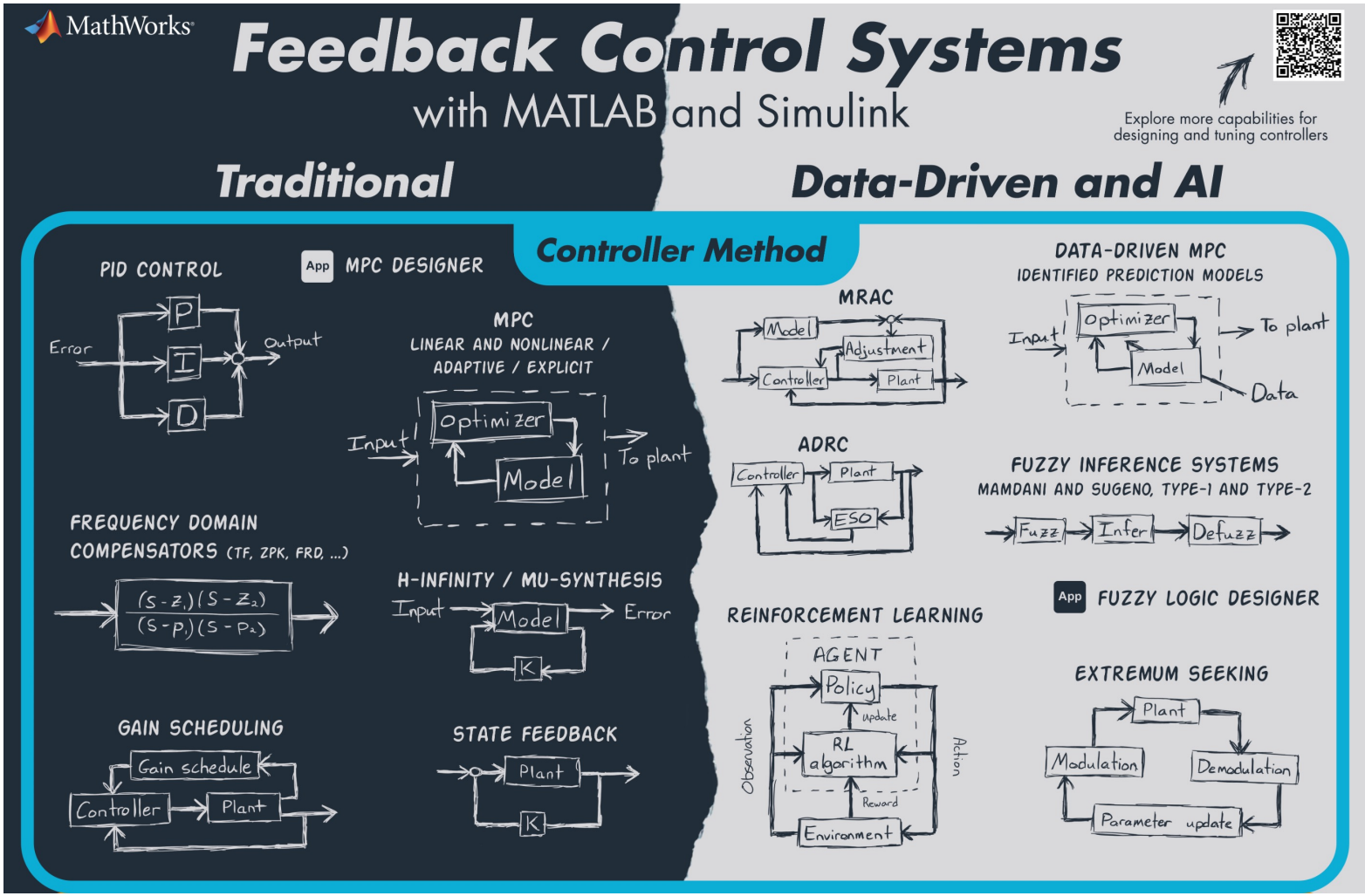
Matlab Tech Talks with *Brian Douglas*

Everything you need to know about control theory



www.youtube.com/watch?v=lBC1nEq0_nk

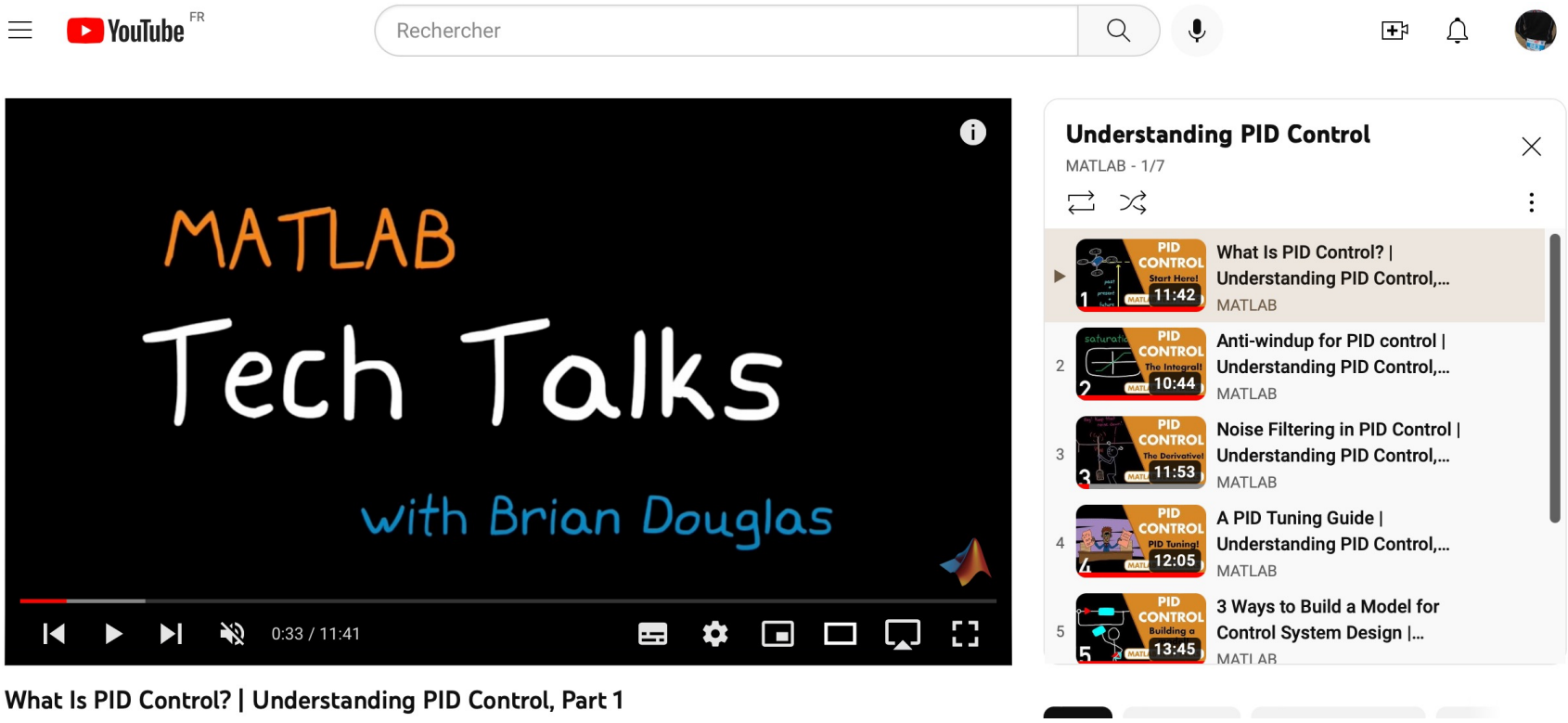
Traditional model-driven methods *versus* data-driven/AI control methods



Other ressource recommended in Control

Matlab Tech Talks with *Brian Douglas*

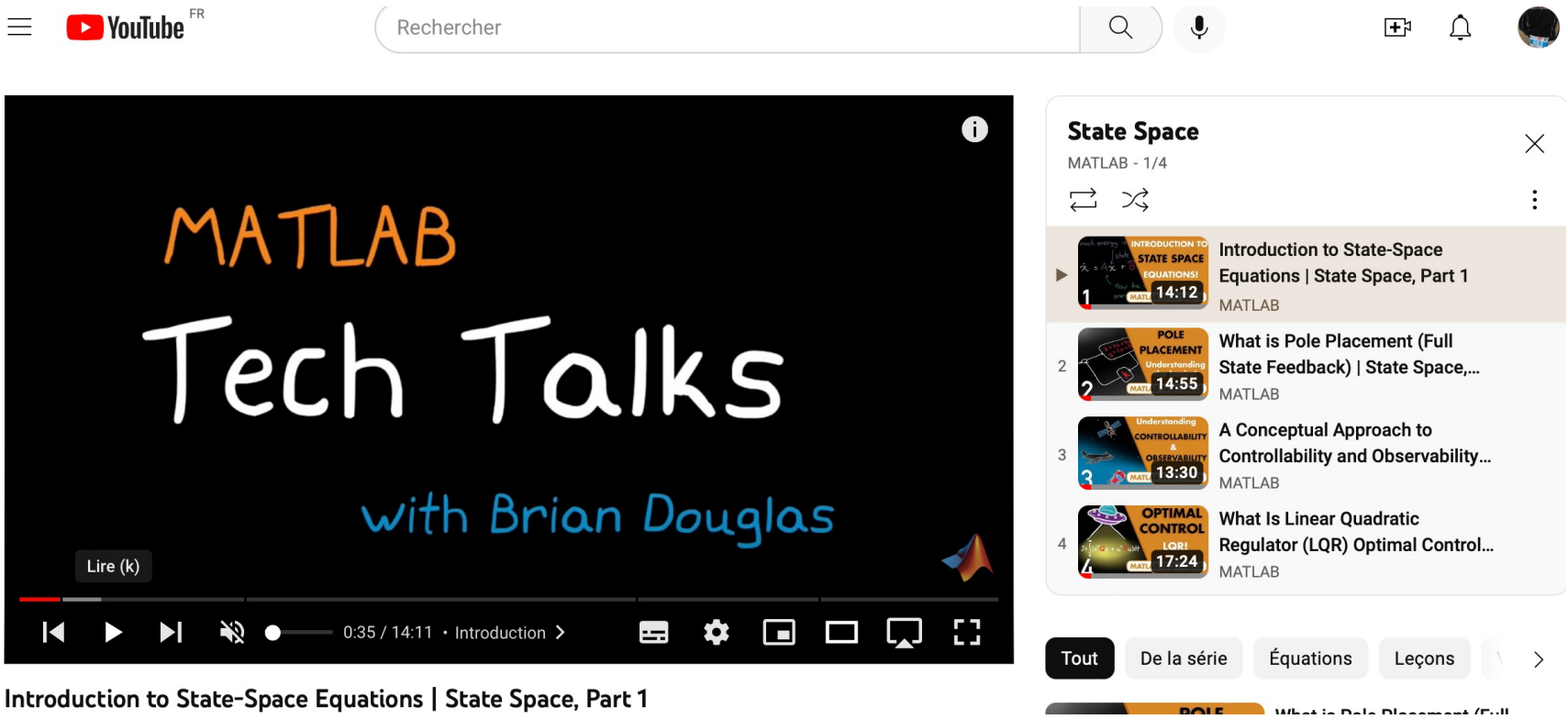
Understanding PID control



Other ressource recommended in Control

Matlab Tech Talks with *Brian Douglas*

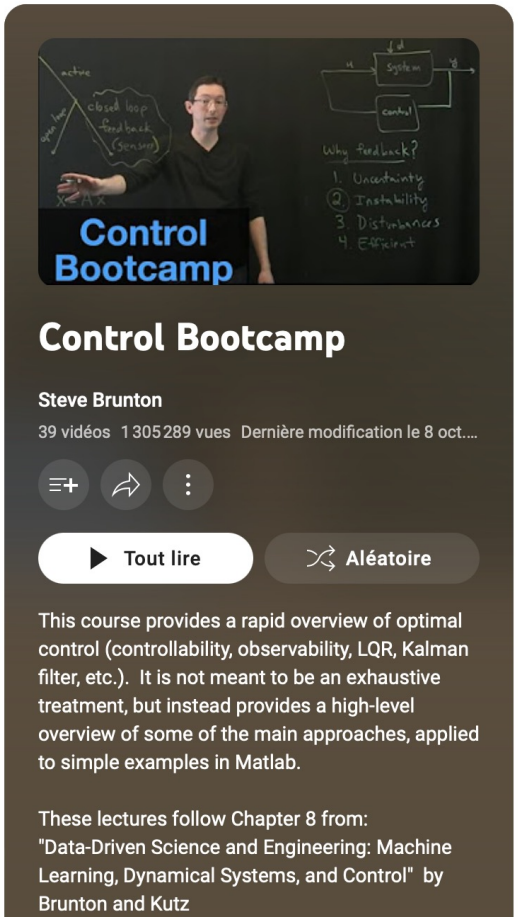
State-space model and control

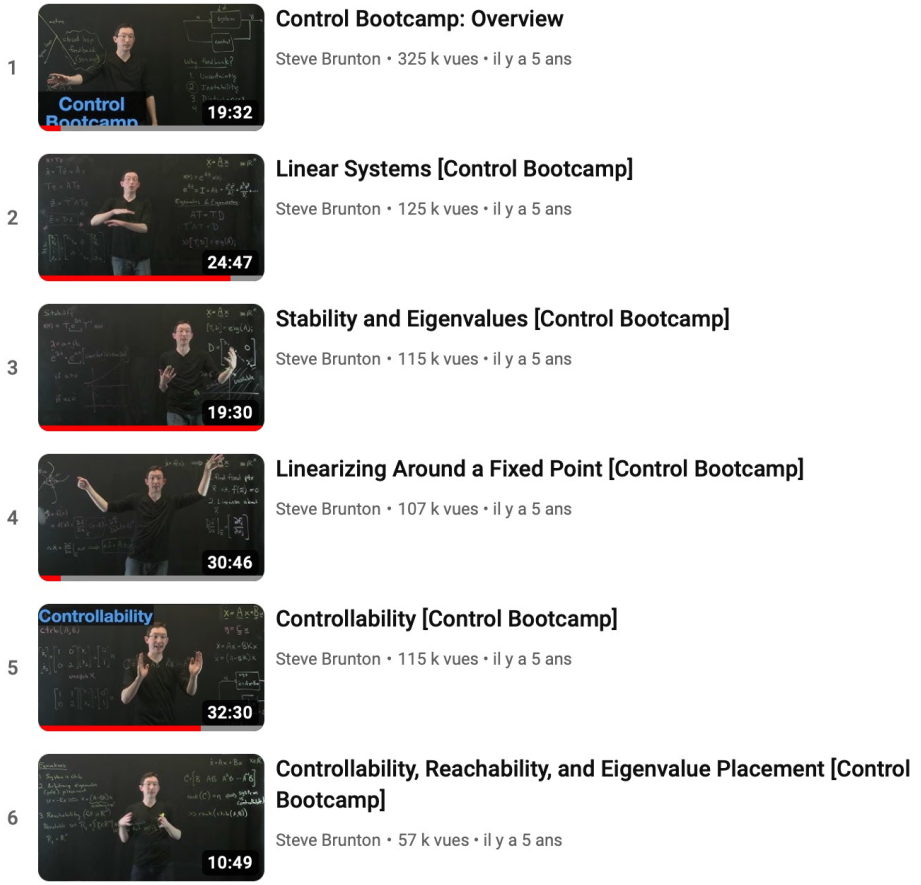


Other ressource recommended in Control

Control Bootcamp by *Steve Brunton*

- https://www.youtube.com/playlist?list=PLMrJAkhIeNNR20Mz-VpzgfQs5zrYi085m

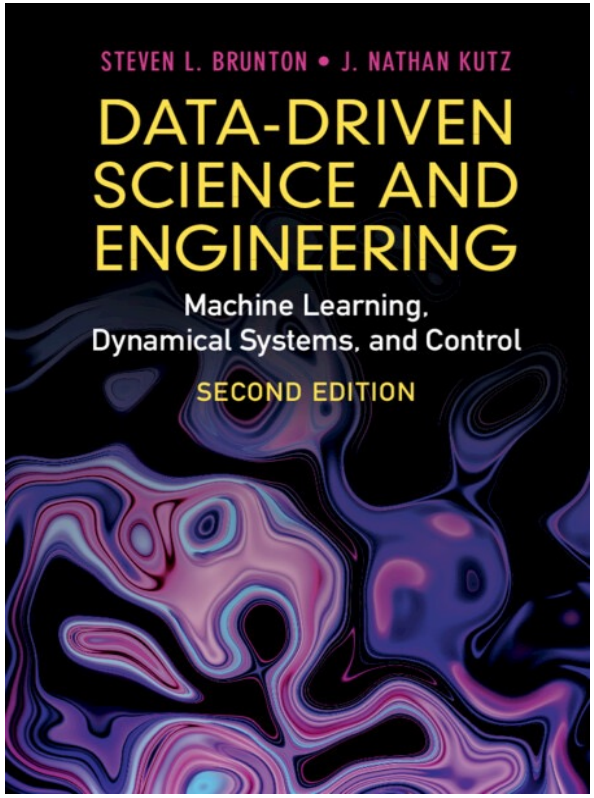




Other book recommended

Data-Driven Science and Engineering

Machine Learning, Dynamical Systems, and Control *S. Brunton & N. Kutz 2022*



Part I. Dimensionality Reduction and Transforms:
1. Singular Value Decomposition
2. Fourier and Wavelet Transforms
3. Sparsity and Compressed Sensing

Part II. Machine Learning and Data Analysis:
4. Regression and Model Selection
5. Clustering and Classification
6. Neural Networks and Deep Learning

Part III. Dynamics and Control
7. Data-Driven Dynamical Systems
8. Linear Control Theory
9. Balanced Models for Control

Part IV. Advanced Data-Driven Modeling and Control:
10. Data-Driven Control
11. Reinforcement Learning
12. Reduced Order Models (ROMs)
13. Interpolation for Parametric ROMs
14. Physics-Informed Machine Learning

Other ressource recommended in Control:
Textbook available from ***Quanser***

Experience Controls by Quanser

Experience Controls is a free mobile textbook designed to give you real design intuition and relevant skills in a hands-on way in the control systems engineering space.

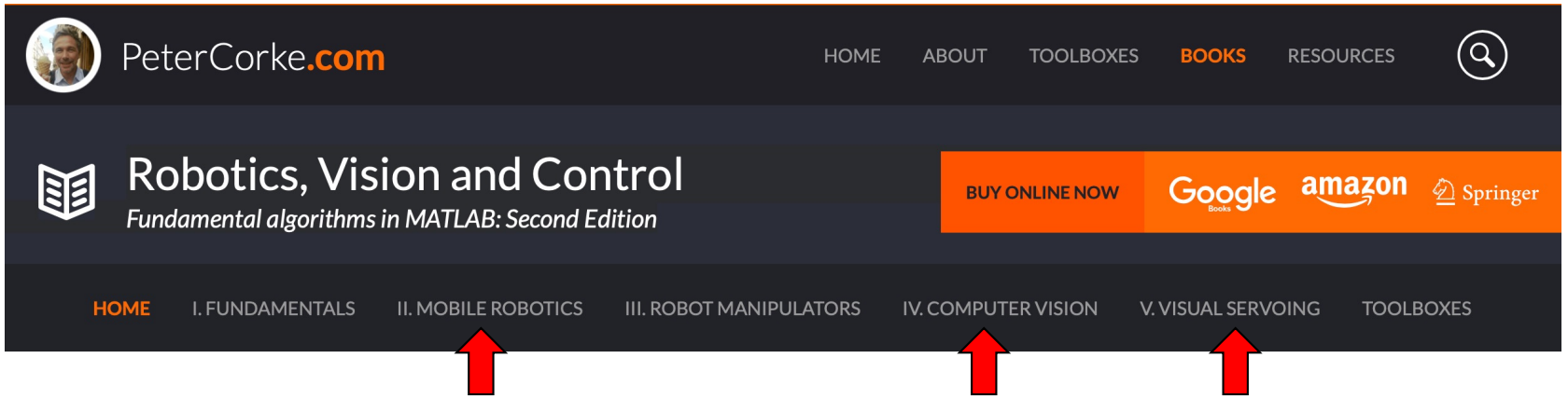
The textbook app includes:

- 50+ lesson modules covering introductory to advanced concepts
- Interactive simulations of industrial-level controls problems
- Mini-lecture podcasts that summarize key takeaways for each chapter, available in-app or in your preferred podcast player
- End-of-chapter review questions to check your understanding

Download on the App Store

GET IT ON Google Play

Recommended book in mobile robots



Home

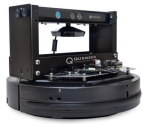
This book makes the fundamental algorithms of robotics, vision and control accessible to all. It weaves together theory, algorithms and examples in a narrative that covers robotics and computer vision separately and together. The author shows how complex problems can be decomposed and solved using just a few simple lines of code, supported by two MATLAB® Toolboxes. The topics covered are guided by real problems observed by the author over many years as a practitioner of both robotics and computer vision.

It is written in a light but informative style, it is easy to read and absorb, and includes over 1000 MATLAB® and Simulink® examples and figures. The book is a walk through the fundamentals of mobile robots, navigation, localization, arm-robot kinematics, dynamics and joint level control, then camera models, image processing, feature

Proposed mini-projects

1. Model-based trajectory tracking control for the autonomous QCar

2. Model-based trajectory tracking control for the differential-drive mobile Qbot



3. Model-based stabilization andcontrol for the self-balancing Balboa robot

4. Model Predictive Control (MPC) for the rotary inverted pendulum

5. Model-based flight control design for the Tello mini-drone

6. Model-based flight control for the Quanser AERO Helicopter