Course Review

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Recap: control education and career

What are the control and robotics courses in typical engineering undergrad and grad level

Prerequisite courses for these controls and robotics courses

Career opportunities: industry, national labs, academia

Revised plan for the rest of this course

Today: an overview of course topics

Tomorrow: no lecture, only presentations: 9-11 am

Introduced the basic ideas in a control system

Open loop (feedforward) versus closed loop (feedback) control

Block diagrams: components (boxes) and channels (arrows)

Examples: identify boxes and arrows

Signals in a control system

Signals in continuous and discrete time

Dynamics in each component (box) of the block diagram $\rightsquigarrow$ signals

Examples: discrete time process dynamics

Stability and stabilization

Process dynamics could be stable or unstable

Different notions: stable (S), asymptotically stable (AS), globally asymptotically stable (GAS)

Engineering designs: deliberately unstable but closed loop stabilizable

Fixed points in discrete time dynamics and their stability

Process dynamics

Oscillations in discrete time dynamics

Linear versus nonlinear dynamics in discrete time

Fixed points and stability in numerical algorithms

State space: ideas and examples

Control objectives and synthesis

Controller is an algorithm

Regulation and tracking

Design/synthesis of linear feedback controller

MATLAB implementation

Controllability and standard state space form

Definition

Examples

Checking controllability of discrete time linear control systems in MATLAB

Modeling control systems in standard state space form

Uncertainties in control systems

Sources of uncertainties: initial conditions, parameters, process and measurement noise

Types of uncertainties

Deterministic uncertainties $\rightsquigarrow$ set-valued uncertainties

Probabilistic uncertainties $\rightsquigarrow$ probability distributions

Estimation problem

Estimate process states given noisy measurements + imperfects models

Filter = algorithm to solve the estimation problem (with optimality guarantees)

Many applications: tracking by radar

Many algorithms: Kalman filter, particle filter

Two steps: prediction (compute prior distribution), correction (compute posterior distribution)

Closing thoughts

Control education and career

Q&A

All the best!