
Summary

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What was this course about?
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We want to control dynamical systems in a good way
Control dynamical systems in a good way
Control dynamical systems in a good way

**Systems**: Linear time-invariant system models

\[
\frac{d^n}{dt^n} y + \cdots = \frac{d^m}{dt^m} u + \cdots \\
Y(s) = G(s)U(s) \\
\dot{x} = Ax + Bu \\
y = Cx + Du
\]
Control dynamical systems in a good way

Systems: Linear time-invariant system models

Complex-valued transfer function is compact (assumes initial values 0)
Control dynamical systems in a good way

**Systems:** Linear time-invariant system models

\[ u \rightarrow (sI - A)^{-1}B \rightarrow x \rightarrow C \rightarrow y \]

*State-space description* with matrices and arbitrary initial values
Control dynamical systems in a good way

Systems: Linear time-invariant system models

Interpretations in time- and frequency domain

![Graph showing time-domain and frequency-domain interpretations](image-url)
Control dynamical systems in a good way

Control: Feedback controllers to achieve \( y(t) \approx r(t) \)

- PID-controller
- P-control with frequency-based compensation
- State-feedback controller (with observer)

Closed-loop systems from \( r(t) \) to \( y(t) \)
Control dynamical systems in a good way

Control: Feedback controllers to achieve $y(t) \approx r(t)$

Structure of general linear feedback (See F5+F10)
Control dynamical systems in a good way

**Control:** Feedback controllers to achieve \( y(t) \approx r(t) \)

Discrete-time models for digital implementation

\[
\begin{align*}
F_d & \rightarrow y(k) = y_c(kT) \\
& \rightarrow G \\
& \rightarrow y_c(t)
\end{align*}
\]
Control dynamical systems in a good way

Good: Control criteria for closed-loop system

Stability

Methods: i) compute poles, ii) Routh’s algorithm. iii) root locus, special case iv) Nyquist curve $G_0(i\omega)$
Control dynamical systems in a good way

Good: Control criteria for closed-loop system

> Quickness
> Damping
> Accuracy
Control dynamical systems in a good way

**Good:** Control criteria for closed-loop system

- Sensitivity towards disturbances and noise
- Robustness towards model errors
Written exam

Individual estimate of attained knowledge goals

Each problem solution evaluated using three criteria:

1. submitted solution
2. demonstrates understanding of problem
3. provides a reasonable and reproducible solution

Formula sheet: Key formulae handed out with exam. BETA and Pocket calculator allowed.

Bonus points from assignments can eliminate half or the entire first problem.

[Board: problems from exam]

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Written exam
Individual estimate of attained knowledge goals

Each problem solution evaluated using three criteria:

1. **submitted** solution
2. **demonstrates** understanding of problem
3. provides a reasonable and **reproducible** solution

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[Board: problems from exam]
The future

Related courses:

- Empirisk modellering
- Automatic Control II: MIMO systems and optimal controllers
- Automatic Control III: nonlinear systems, limitations and trade-offs

Good luck!

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The future

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Good luck!