Control System Engineering (EE31009)

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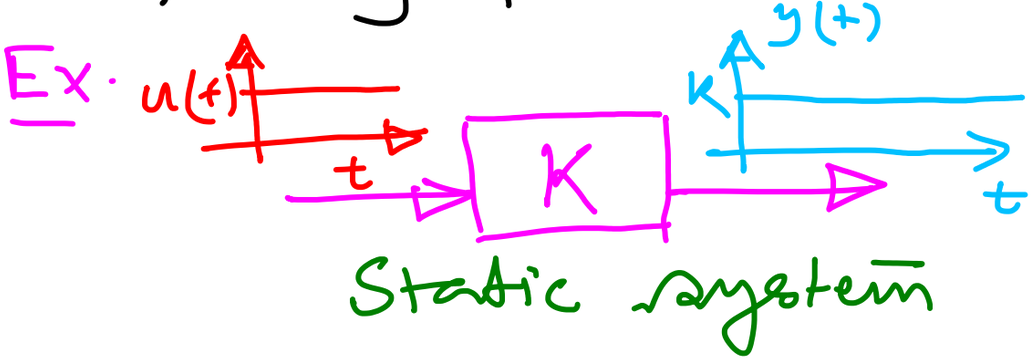
Reference books:

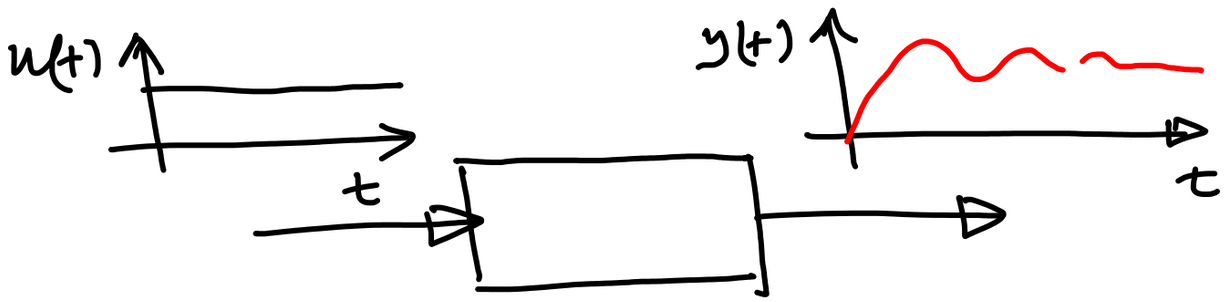
1. K. Ogata, Modern Control Engg., PHI
2. R.C. Dorf and R.H. Bishop, Modern Control Systems, Pearson
3. B.C. Kuo, Automatic Control System, PHI
4. N.S. Nise, Control System Engg. Wiely

CSE deals with dynamical systems.

- A system is said to be dynamical system if its behavior changes over time, often in response to external stimulation or forcing function.



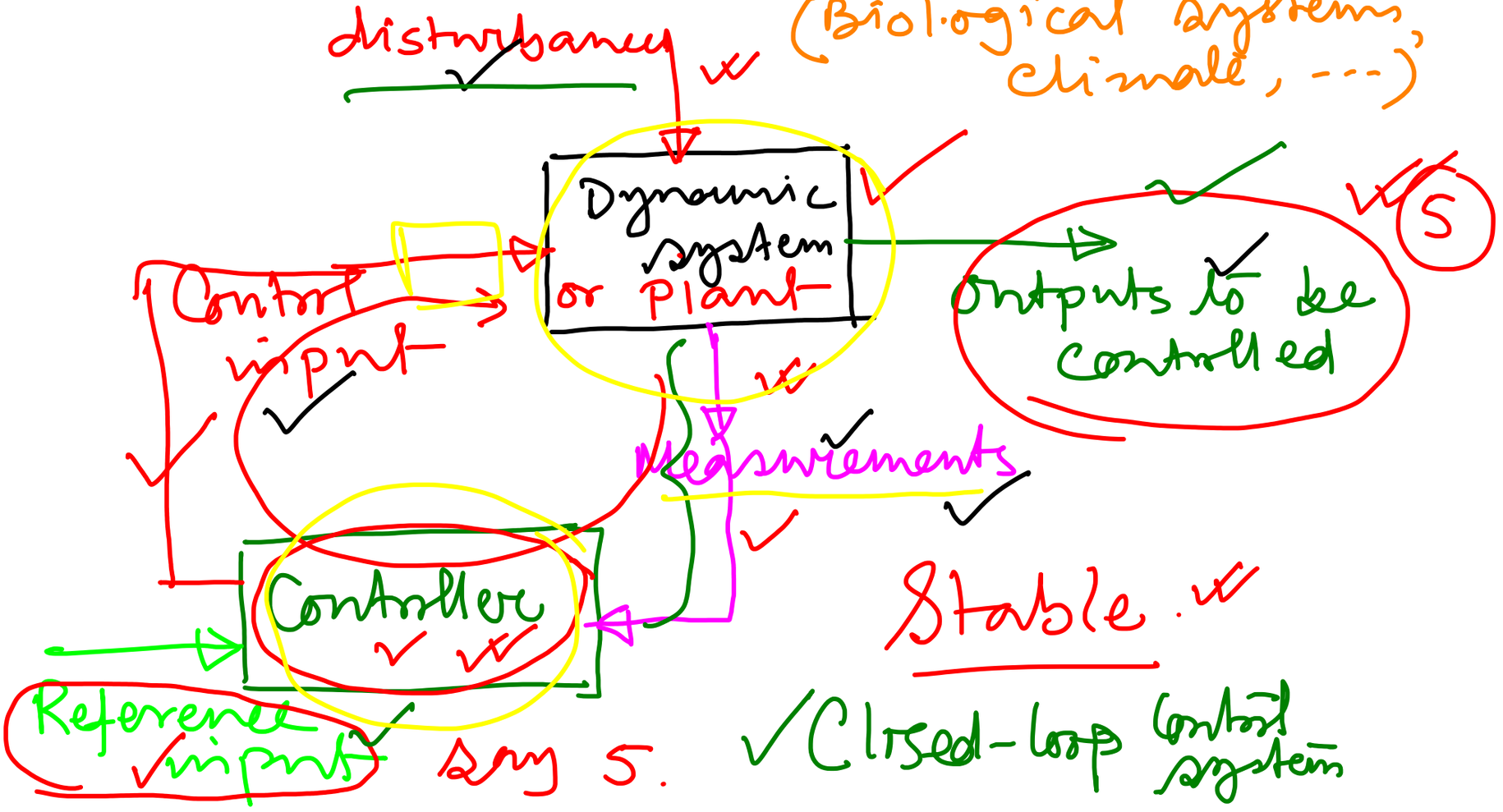
Static system



Dynamic System

Two types of system

- Engineered systems (that we make)
- Natural systems (Biological systems, climate, ...)



Stable.

Closed-loop control system

Day 5.

Types of dynamical systems:

- with respect to the method of analysis and design
  - linear
  - nonlinear
    - Time-invariant
    - Time varying
- with respect to the types of signal used
  - Continuous-time
  - Discrete-time

Examples:

$\dot{x}(t) = a\,x(t)$ [linear time-invariant]

$\dot{x}(t) = a\,x^2(t)$ [nonlinear time-invariant]

$\dot{x}(t) = \sin(t)\,x(t)$ [linear time varying]

$\dot{x}(t) = \sin(t)\,x^2(t)$ [nonlinear time-varying system]

$\dot{x}(t) = a\,x(t)$ [Continuous-time]

$x(k+1) = a\,x(k)$ [discrete-time]

- Control is exercised by feedback.
- The control design problem is to determine the characteristics of the controller so that the controlled outputs can be
  - set to prescribed values called reference
  - maintain at the reference values despite the unknown disturbances.
  - above two are met despite the inherent uncertainties and changes in the plant dynamics.

Robustness

Present scenario:

Critical societal challanges

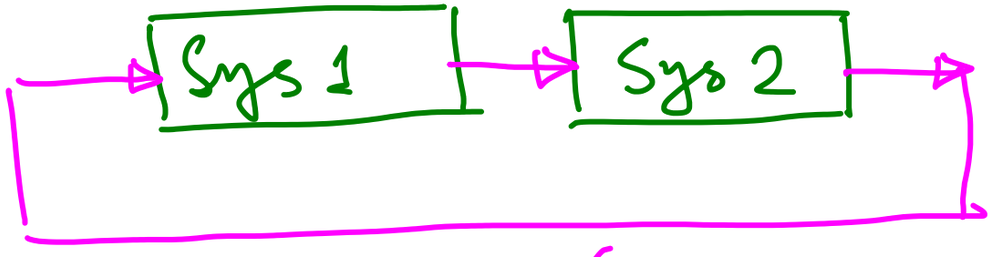
Transportation Energy Water Healthcare Manufacturing

- Distributed networked control system
- Data driven dynamic modeling & Control
- Complexity and Control
- Critical infrastructure systems
- Cyber-physical systems
- Autonomy, Cognition and Control

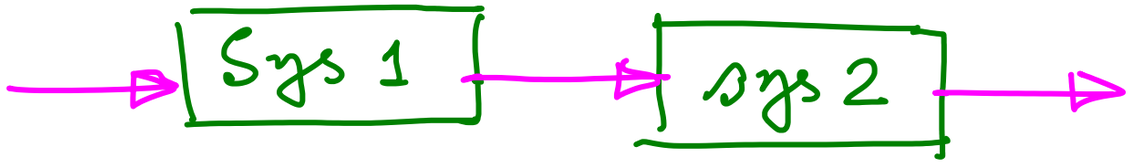
Toward 2030

What is feedback?

— The term feedback refers to a situation in which two (or more) dynamical systems are connected together such that each system influences the other and their dynamics are thus strongly coupled.



Closed-loop (feedback system)



open-loop
(non-feedback system)