

Control System Design

Lecture 11

Associate Prof. Dr. Klaus Schmidt

Department of Mechatronics Engineering – Çankaya University

Elective Course in Mechatronics Engineering
Credits (2/2/3)

Webpage: <http://ece441.cankaya.edu.tr>

Actuators: Maximum Movement

Actuator Constraint Examples

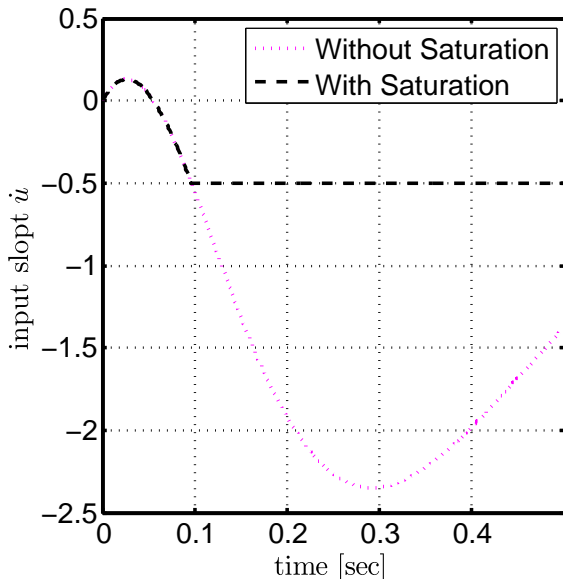
- Limited maximum output value provided by actuator
⇒ Engine momentum, input voltage/power, temperature
- Limited slope (rate of change) of the actuator movement

Remedies

- Use higher quality actuator
⇒ Might be too expensive
- Accept deterioration of control loop performance
⇒ Might be unacceptable
- Perform controller design such that actuator meets the constraints
⇒ Decrease closed-loop bandwidth
⇒ Simulate closed loop including actuator constraint

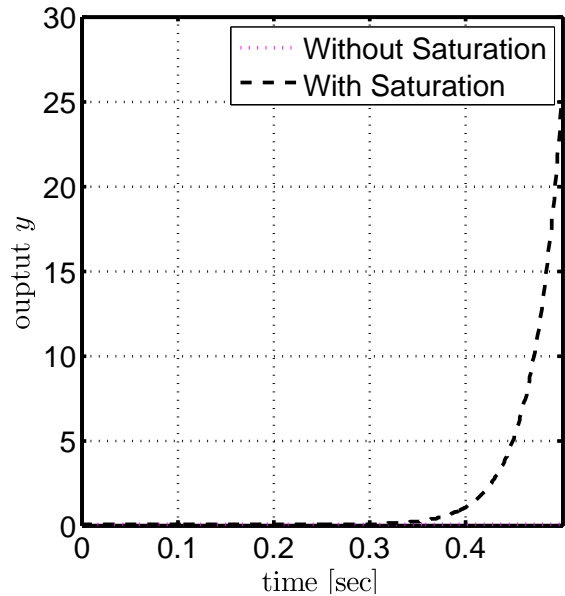
Actuators: Input Slope Saturation for Magnetic Suspension

Input Slope for Reference Step



⇒ Input slope bounded by maximum movement of actuator

Output for Reference Step

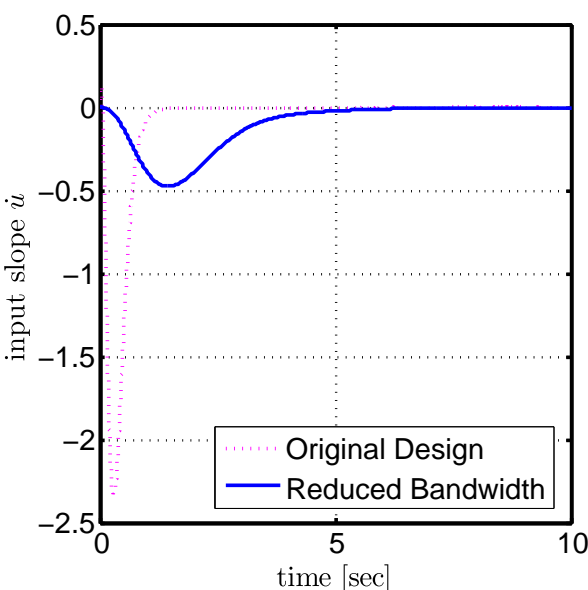


⇒ Instability due to inappropriate design

Actuators: Input Slope Saturation for Magnetic Suspension

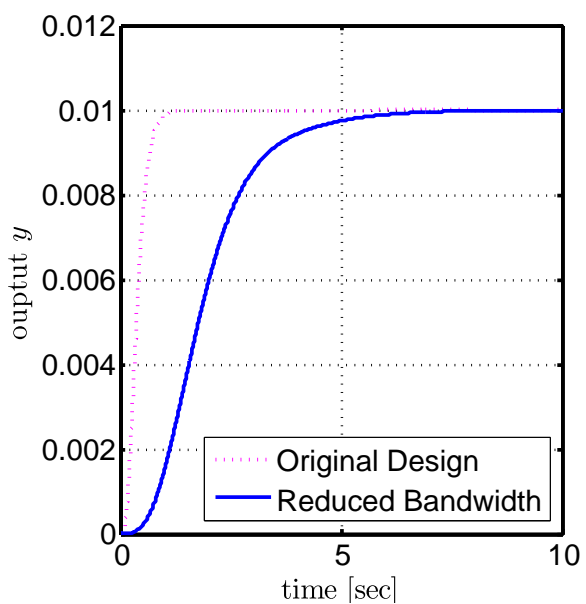
⇒ Redesign with limited closed-loop bandwidth of 2 rad/sec

Input Slope for Reference Step



⇒ Input slope is reduced

Output for Reference Step



⇒ Stable but slower closed loop