UNIVERSITÄT DES SAARLANDES

Lehrstuhl für Intelligente Material Systeme

Intelligent Material Systems Lab

Aktorik und Sensorik mit intelligenten Materialsystemen 4

Computer Lecture: Digital control of a SMA-spring actuator

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Computer Lecture Overview

- GOALS:
  - Digital PI position control for a SMA-spring actuator
  - Simulation for different sampling times
  - Simulation for different discretization methods
  - Implementation of anti-windup architecture

Assignment

- Given the Simulink file representing the SMA-spring model:

1) Design and implement a PI controller for the SMA actuator, based on the following linearized model,

$$G(s) = -\frac{0.2891}{s + 14.93}$$

in such a way that the closed loop system is a first order transfer function with time constant τ^* = 0.015 s.

2) Implement the controller as a digital PI, by choosing a preferred discretization method for the integral. Choose the sampling time as

$$T_s = \frac{\tau}{N}$$

where τ is the time constant of the SMA model transfer function $G(s)$. Simulate the closed loop performance for N = 20, 10, 5, 2, for a test of the duration of 1 second in which a step reference starts at 0.104 m and switches to 0.103 m at t = 0.5 s.

3) For the case with N = 2, simulate the closed loop performance obtained by using the other two discretization methods

4) Choose N = 10 and a preferred discretization method. Simulate the closed loop performance for a test of the duration of 1 second in which a step reference starts at 0.104 m and switches to 0.102 m at t = 0.5 s. Implement an arbitrary anti-windup architecture. Compare the performance obtained with and without the anti-windup scheme, considering J limited within 0 W and 0.25 W.