UNIVERSITÄT DES SAARLANDES

Lehrstuhl für Intelligente Materialsysteme

Intelligent Materials Systems Lab

Aktorik und Sensorik mit intelligenten Materialsystemen 4

Computer Lecture: PID Position Control of a DE-Mass Actuator

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Computer Lecture Overview

- GOALS:
  - PID position control design for a DE-mass actuator
  - Model-free PID tuning via Ziegler-Nichols method
  - Model-based PID design
  - Introduction of harmonic compensator for sinusoidal tracking

Assignment

- Given the Simulink file representing the DE-mass model:

1) Design a PID control based on Ziegler-Nichols method. For generating the step, use Reference 1. Simulate the closed loop behavior of the DE in response to References 2 and 3.
2) Consider the following linear model, representing an approximation of the DE around equilibrium position corresponding to v = 1000 V

$$G(s) = \frac{0.0008757}{s^2 + 7.479s + 2293}$$

   Based on this model design a filtered PID controller, by imposing in closed loop a second order behavior with δ = 0.75, τ^* = 0.05 s. Simulate the closed loop response of both $G(s)$ and the DE to References 2 and 3.
3) Repeat design of point 2) by choosing instead δ = 0.75, τ^* = 0.01 s. Simulate both $G(s)$ and the DE in closed loop, and compare results with 2).
4) Test the performance of the filt. PID in tracking Reference 4, i.e., a 1 Hz sine.
5) Implement, in parallel with the previous filt. PID, an Harmonic compensator for tracking sinusoidal signals at 1 Hz (2π rad/s). Tune the gain of this harmonic compensator by hand. Test the performance of the PID + harmonic compensator in tracking References 4 and 5.

- NOTE: the input voltage of the DE must always range 0 V and 2500 V.