Master of science degree in Computer Engineering
Academic Year 2021-2022, Second Semester

01UDSOV - Modeling and control of cyberphysical systems

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Part II, Homework n. 2

1. Formulate the problem of identifying the mathematical model of the plant in the set-membership framework, on the basis of the following information:
   (a) the plant can be modeled by a discrete-time linear time-invariant system described by the following transfer function
   $$G(z) = \frac{\beta_1 z^2 + \beta_2 z + \beta_3}{z^2 + \alpha_1 z + \alpha_2}$$
   (b) A set of 50 input-output data pair (available in the data file *data_exam_1A*) has been collected to describe the input-output behavior of the plant.
   (c) The input sequence is assumed to be exactly known, while the output data are known to be corrupted by an additive noise $\eta(t)$ having absolute value of amplitude bounded by $\Delta\eta = 1$.
2. Provide a mathematical formulation of the optimization problems to be solved for the computation of the PUIs.
3. Provide an accurate description of the data structure to be built in order to solve the problem with the sparsePOP software.
4. Write a MATLAB script for the computation of the PUIs.
5. Discuss how to force stability constraints in the identification of the system parameters. Provide the new EFCPS and additional sparsePOP data structures required.
6. Let's call p_1 and p_2 the plant poles. Discuss how to force that $p_1 = p_2$. Provide the new EFCPS and additional sparsePOP data structures required.

Remark 1: Use the *'active-set'* POP solver.