Master of science degree in Mechatronic Engineering
Academic Year 2016-2017, First Semester

Laboratory of Robust Identification and Control (01PDXOV-01PDXQW-01PDXND)

Diego Regruto

Exam simulation

Surname	**Name**
Student ID	

The student is required to solve the following two exercises:

Exercise 1

(A) **4 Points** — Formulate the problem of identifying the mathematical model of the plant in the set-membership framework, on the basis of the following information:

- the plant can be modeled by a discrete-time linear time-invariant systems described by the following transfer function

$$G(z) = \frac{\beta_1 z + \beta_2}{z^2 + \alpha_1 z + \alpha_2}.$$

- 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.
- 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 $\Delta_\eta = 1$.

(B) **3 Points** — Provide a mathematical formulation of the optimization problems to be solved for the computation of the PUIs.

(C) **5 Points** — Provide a accurate description of the data structure to be built in order to solve the problem with the sparsePOP software.

(D) **6 Points** — Write a MATLAB script for the computation of the PUIs.

Exercise 2

(A) **4 Points** — Formulate the problem of identifying the mathematical model of the plant in the set-membership framework, on the basis of the following information:

- the plant can be modeled by discrete-time linear time-invariant subsystem described by the following transfer function

$$G(z) = \frac{\beta_1 z + \beta_2}{z + \alpha_1}$$

- The steady-state gain of the plant is know to belong to the range $[5, 9]$

- The plant is known to have a zero belonging to the range $[0.1, 0.5]$
- A set of 30 input-output data pair (available in the data file *S:\LRIC\data_exam_2A_dg*) has been collected to describe the input-output behavior of the plant.
- Input and the output data sequences are known to be corrupted by additive noise signals $\epsilon(t)$ and $\eta(t)$ respectively, having absolute value of amplitude bounded by $\Delta_\epsilon = \Delta_\eta = 0.07$.

(B) **3 Points** — Provide a mathematical formulation of the optimization problems to be solved for the computation of the PUIs.

(C) **5 Points** — Provide a accurate description of the data structure to be built in order to solve the problem with the sparsePOP software.

(D) **6 Points** — Write a MATLAB script for the computation of the PUIs.

All the details of student's solution must be reported on the written examination papers. Each step of the proposed solution must be properly discussed.