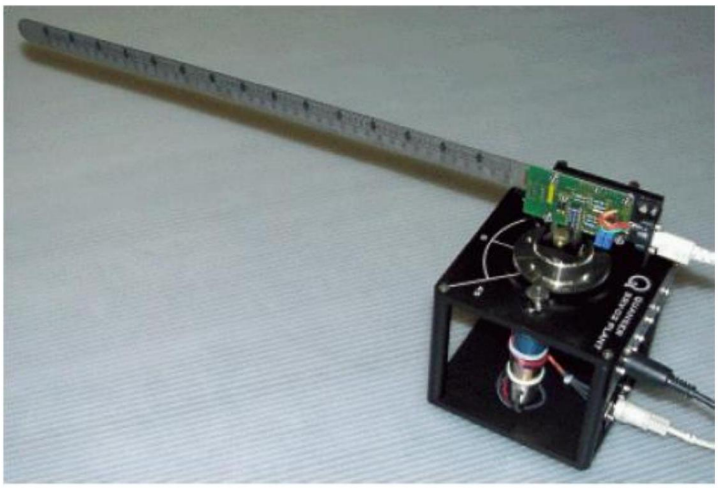
TÉCNICO LISBOA

Control of Cyber-physical Systems

LABORATORY WORK REPORT — PART I

Identification of a Flexible Robot Arm Joint



Shift X

Group XX:
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2024/2025 – 1st Quarter

Instituto Superior Técnico
Department of Electrical and Computer Engineering
Scientific Area of Systems, Decision, and Control

Important notice: Please note that you are allowed to add a maximum of 6 pages of content to the current template. The final compiled report, including all sections, shall not exceed 10 pages in total (after compilation into PDF format). Additional pages will not be considered for evaluation.

Contents

Introduction

1 Question 1 - Analyzing the problem (2.5 pts)

1.1 Why is achieving this control objective nontrivial? (2.5 pts)

(*Hints: Is it feasible to create a lookup table of electric voltages for the DC motor that ensures the bar tip remains at a fixed position? What would be the result if a constant voltage is applied to the motor? What would be the result if a constant voltage is applied to the motor? Reflect on the dynamics of the motor and the bar. What might the approximate open-loop pole distribution of the system look like?*)

2 Question 2 - Interfacing the plant with the computer (5 pts)

2.1 Comment on the motor operation. Explain in particular why their angular position never stabilizes when its command signal is constant in the open loop conditions described. (0.5 pts)

2.2 Explain the procedure carried out to perform sensor calibration. (4.5 pts)

(*Check the laboratory work guide to see what you should include in this answer.*)

3 Question 3 - Model identification and validation (9.5 pts)

3.1 Explanation on the tests performed on the plant to obtain the data used for identification. Discuss the results obtained with different types of excitation signals and the effect of very small amplitude and very large amplitude excitation signals. (2 pts)

3.2 Discussion of the sampling frequency. (1 pt)

3.3 Effect on identification of filtering the data. (1 pt)

3.4 Explanation on how the pole at the origin has been dwelt with. (0.5 pts)

3.5 Discussion on how the model orders have been decided. Take into consideration that the plant results from the interconnection of a DC motor and the flexible bar and discuss the models needed for each of them. (1 pt)

3.6 Description of the final ARMAX model. (0.5 pt)

3.7 Description of the final state-space model. (0.5 pts)

3.8 Characterization of the plant open loop pole-zero plot, frequency response and time response of the model. (1.5 pt)

3.9 Model validation. (1.5 pts)

Conclusions