

Project 1 Report - ME155C/ECE147C

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Abstract

1 Introduction

2 System Identification

2.1 Process to be controlled

The process we are controlling is a two cart system connected by a spring. The system is driven by a motor that applies a force F to the first cart with mass m_1 [kg], and the second cart with mass m_2 [kg] is connected to the first cart via a spring with spring constant k [N/m]. In this system, x_1 [m] is the position of the first cart, and x_2 [m] is the position of the second cart. The control input is the voltage $u := V$ [Volt] applied to the motor, and the measured output is the position $y := x_2$ [m] of the second cart.

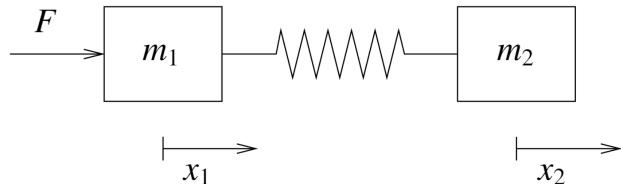


Figure 1: Two cart system

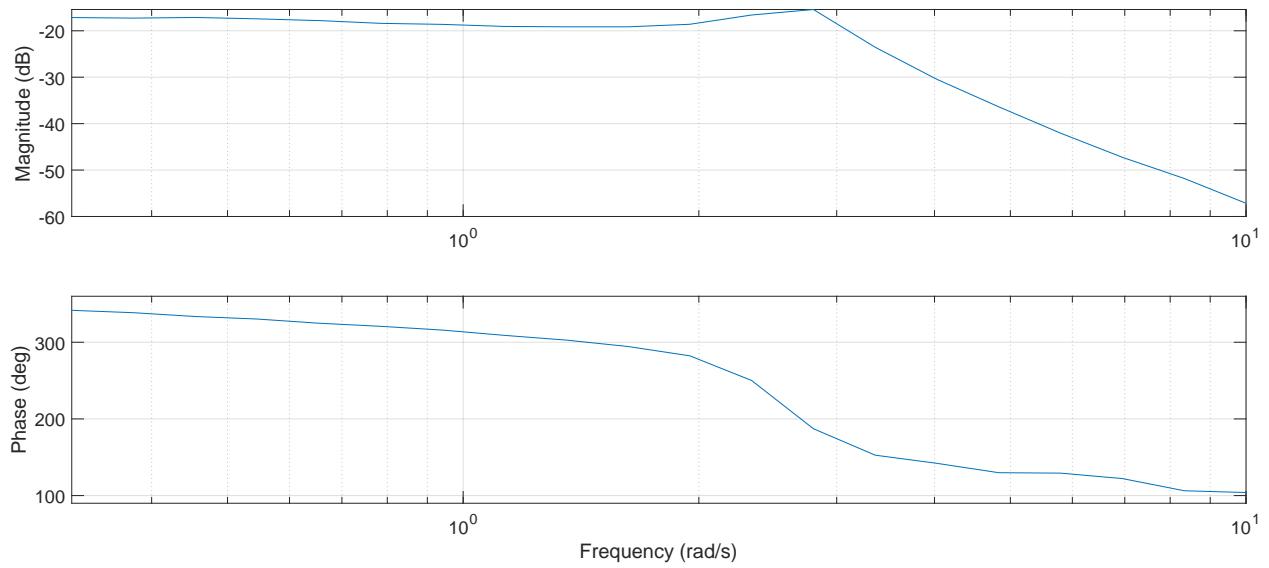


Figure 2: Bode plot of the identified system using non-parametric identification

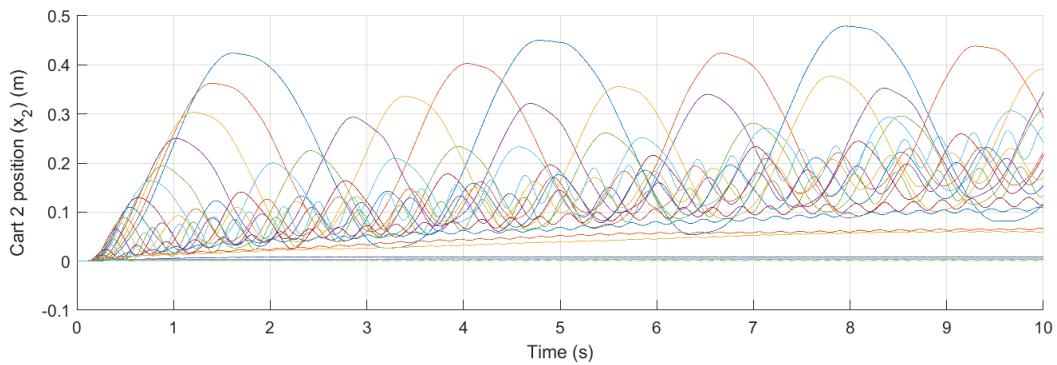


Figure 3: Output signals of all experiments for parametric identification

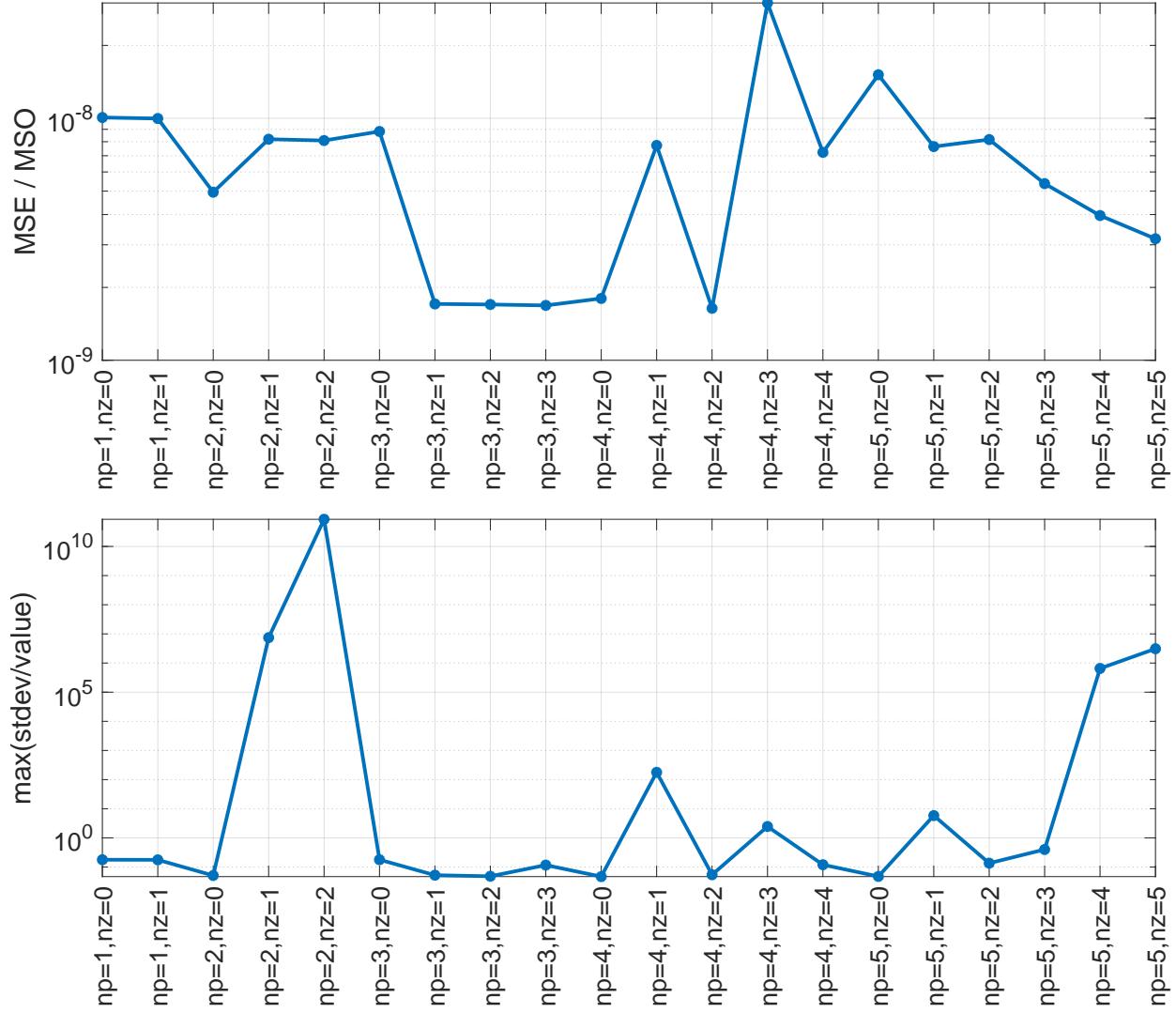


Figure 4: Normalized MSE and worst parameter standard deviation for different model orders

2.2 Non-Parametric Identification

2.3 Parametric Identification

3 Controller Design

3.1 Design Methodology

3.2 Simulation Results

4 Closed-loop Testing

4.1 Step Response Experiments

4.2 Closed-loop Frequency Response

5 Conclusions and Future Work

References

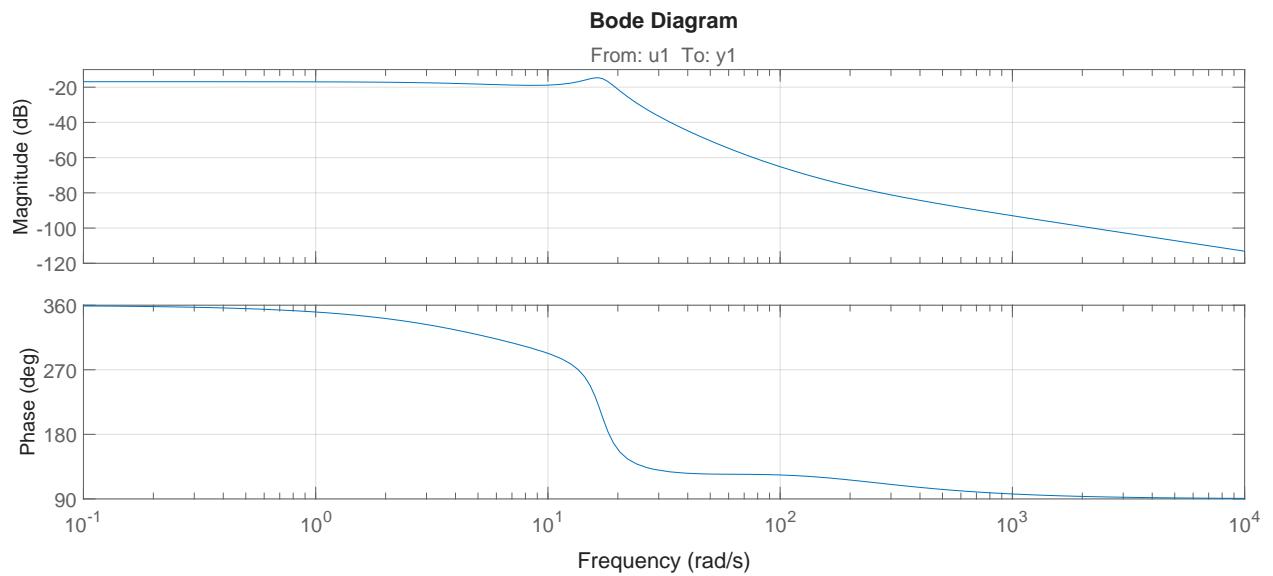


Figure 5: Bode plot of the identified system using parametric identification

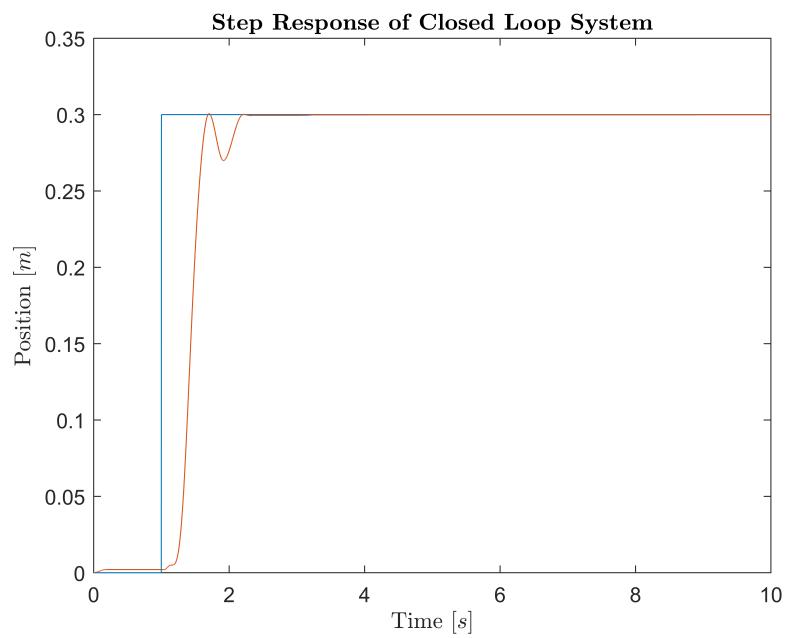


Figure 6: Closed-loop step response

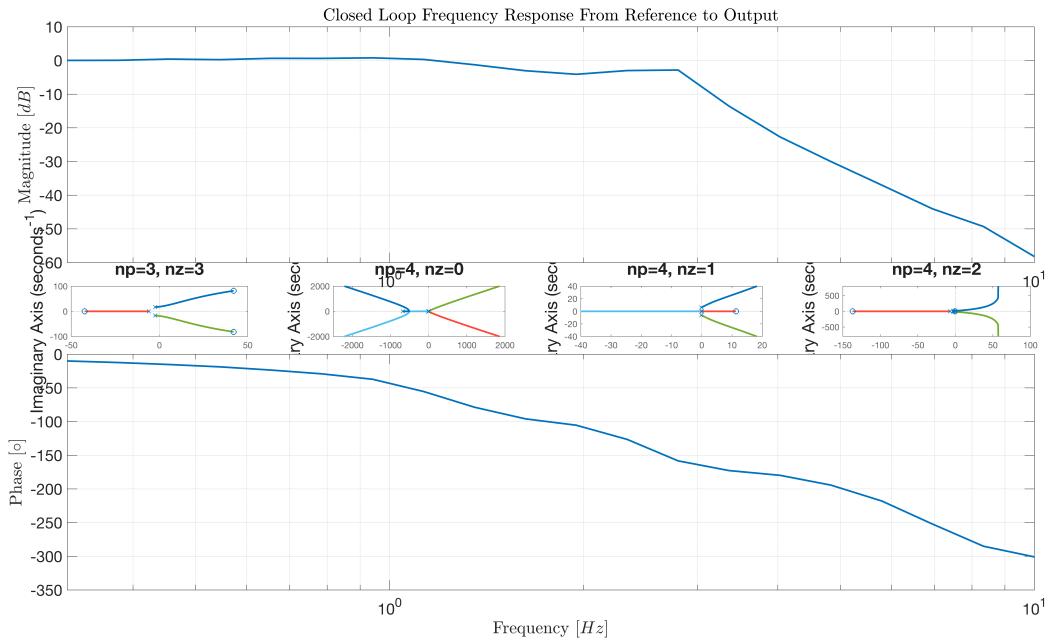


Figure 7: Closed-loop frequency response of the transfer function from reference to output

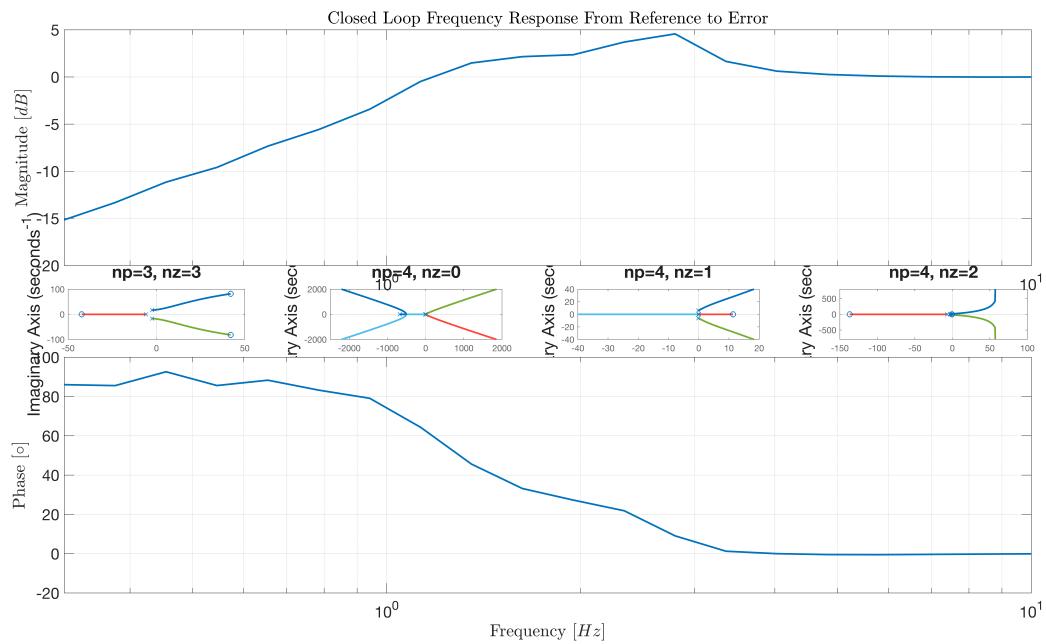


Figure 8: Closed-loop frequency response of the transfer function from reference to error