

Fig. 2. Experimental setup.

3. Experimental results

3.1. Experimental setup

The laboratory prototype consist of a servomotor from Moog, model C34-L80-W40 (Fig. 2) driven by a Copley Controls power servoamplifier, model 423, configured in current mode. A BEI optical encoder, model L15 with 2500 pulses per revolution, allows measuring the servomotor position. The algorithms are coded using the MacLab/Simulink software platform under the program Wincon from Quanser Consulting, and a Quanser Consulting Q8 board performs data acquisition. The data card electronics increases four times the optical encoder resolution up to $2500 \times 4 = 10\,000$ pulses per revolution. The control signal produced by the Q8 board passes through a galvanic isolation box. The software runs on a personal computer using an Intel Core 2 quad processor, and the Q8 board is allocated in a PCI slot inside this computer. The following transfer function, which is composed of a high-pass filter in cascade with a low-pass filter, allows obtaining velocity estimates from position measurements.

$$G(s) = \frac{400s}{s + 400} \frac{500}{s + 500}$$

The low pass filter attenuates the high frequency components of the position signal. The Simulink diagrams use a sampling period of 0.1 ms and the ODE5 solver. Fig. 2 depicts the experimental setup.

3.2. Experiments

3.2.1. Parameter identification

Two Duffing systems generate the signal used for exciting the servomechanism

$$\dot{x}_{11} = x_{21} \omega_1 \pi \quad (31)$$

$$\dot{x}_{21} = [-0.25 + x_{21} + x_{11} - 1.05x_{11}^2 + 0.3 \sin(\omega_1 \pi t)] \omega_1 \pi; \quad i = 1, 2$$

$$x_{1i} = 7x_{11} - 5x_{22}; \quad x_{21}(0) = 0; \quad x_{22}(0) = 0;$$

$$\omega_1 = 1 \text{ rad/s}; \omega_2 = 2 \text{ rad/s}.$$

This type of chaotic excitation was proposed in [24] for parameter identification of a speed controlled servomotor. Fig. 3 shows the time evolution of x_{11} . The gains for the PD controller are $k_p = 10$ and $k_v = 0.28$, and the update law gains are $\Gamma = \text{diag}\{12 \ 3000 \ 180 \ 90\}$.

Fig. 4 shows the time evolution of the parameter estimates obtained using the proposed approach. Fig. 5 depicts the input error e_u and the evaluation of the PE condition (30) with $v = \frac{1}{2} [1 \ 1 \ 1 \ 1]^T$; the values for the PE condition in Fig. 5(b) are

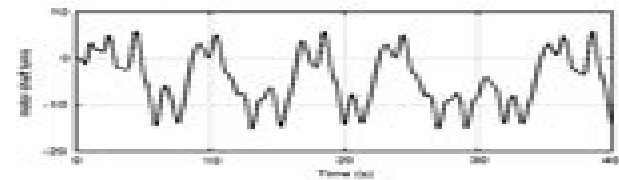
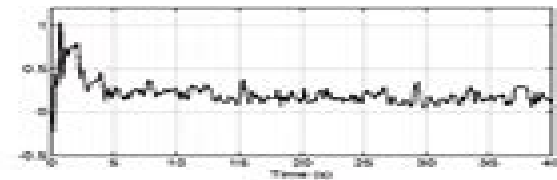
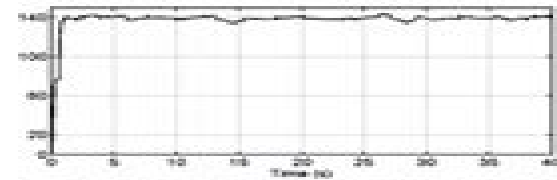
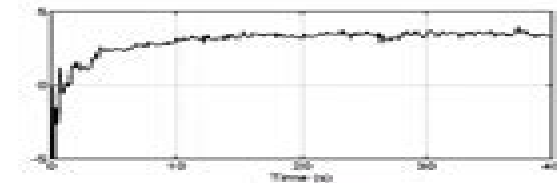
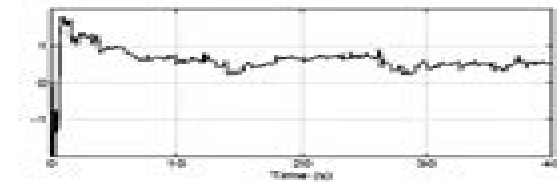


Fig. 3. Chaotic excitation signal.

Parameter estimate \hat{a} Parameter estimate \hat{b} Parameter estimate \hat{c} Parameter estimate \hat{d} Fig. 4. Parameter estimates obtained using the CLIE method: \hat{a} , \hat{b} , \hat{c} , and \hat{d} .

shown every five seconds, i.e. $\delta = 5$ s. Hence, the regressor vector fulfills the PE condition during the experiment. Table 1 shows the parameter estimates obtained from the experiment. They were

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This book delves into Servomechanism Analysis. Servomechanism Analysis is a crucial topic that needs to be grasped by everyone, from students and scholars to the general public. This book will furnish comprehensive and in-depth insights into Servomechanism Analysis, encompassing both the fundamentals and more intricate discussions.

1. The book is structured into several chapters, namely:

- Chapter 1: Introduction to Servomechanism Analysis
- Chapter 2: Essential Elements of Servomechanism Analysis
- Chapter 3: Servomechanism Analysis in Everyday Life
- Chapter 4: Servomechanism Analysis in Specific Contexts
- Chapter 5: Conclusion

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4. In chapter 3, this book will examine the practical applications of Servomechanism Analysis in daily life. The third chapter will showcase real-world examples of how Servomechanism Analysis can be effectively utilized in everyday scenarios.
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6. In chapter 5, the author will draw a conclusion about Servomechanism Analysis. This chapter will summarize the key points that have been discussed throughout the book.

This book is crafted in an easy-to-understand language and is complemented by engaging illustrations. It is highly recommended for anyone seeking to gain a comprehensive understanding of Servomechanism Analysis.

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