شبکه‌های عصبی مصنوعی

درس ۲۷

مورد مطالعاتی ۵:

پیش‌بینی

Case Study 5: Prediction

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http://courses.fouladi.ir/nn

Prediction Case Study: Magnetic Levitation

شبکه‌های عصبی مصنوعی

مورد مطالعاتی ۵ : پیش‌بینی

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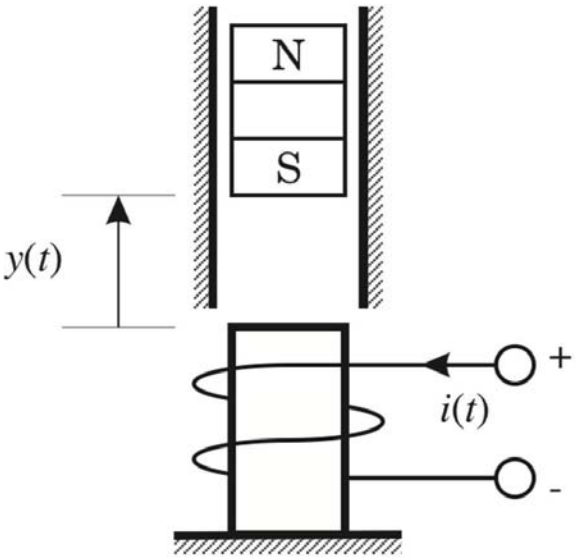
توصیف سیستم شناوری مغناطیسی

Magnetic Levitation System



$$\frac{d^2y(t)}{dt^2} = -g + \frac{\alpha}{M}\frac{i^2(t)\,\mathrm{sgn}(i(t))}{y(t)} - \frac{\beta}{M}\frac{dy(t)}{dt}$$

$$\beta = 12, \quad \alpha = 15, \quad g = 9.8, \quad M = 3$$

شبکه‌های عصبی مصنوعی

مورد مطالعاتی ۵ : پیش‌بینی

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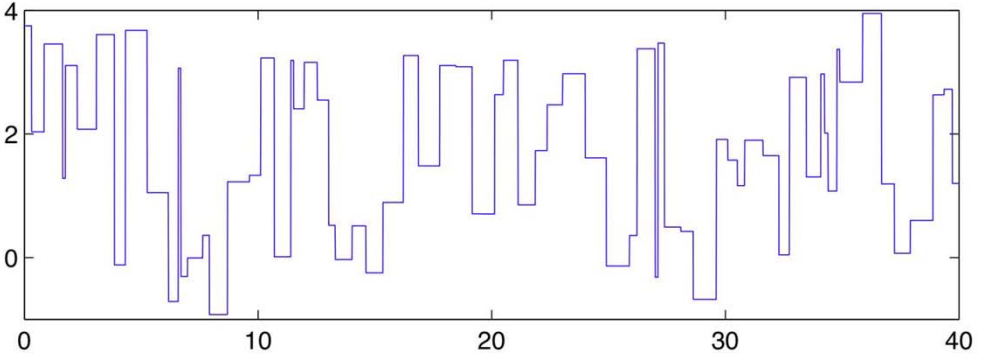
گردآوری داده‌ها و پیش‌پردازش

Training Data

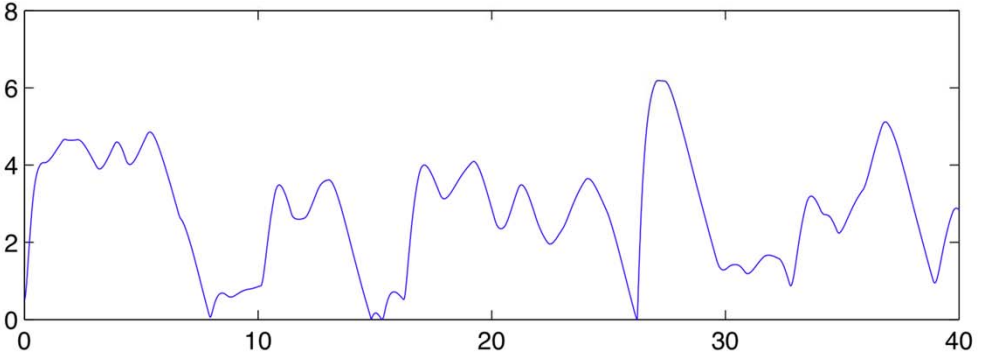
Skyline Function

Current (A)

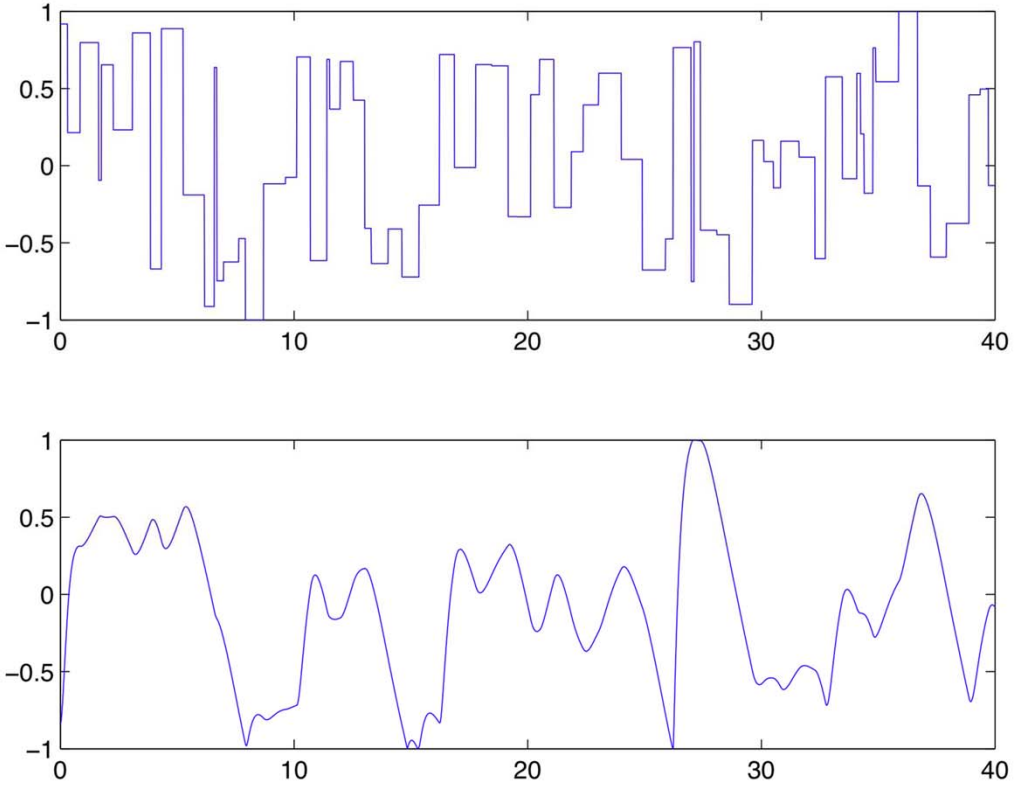


Sampling Rate = 0.01 sec

Position (m)



Scaled Training Data



شبکه‌های عصبی مصنوعی

مورد مطالعاتی ۵ : پیش‌بینی

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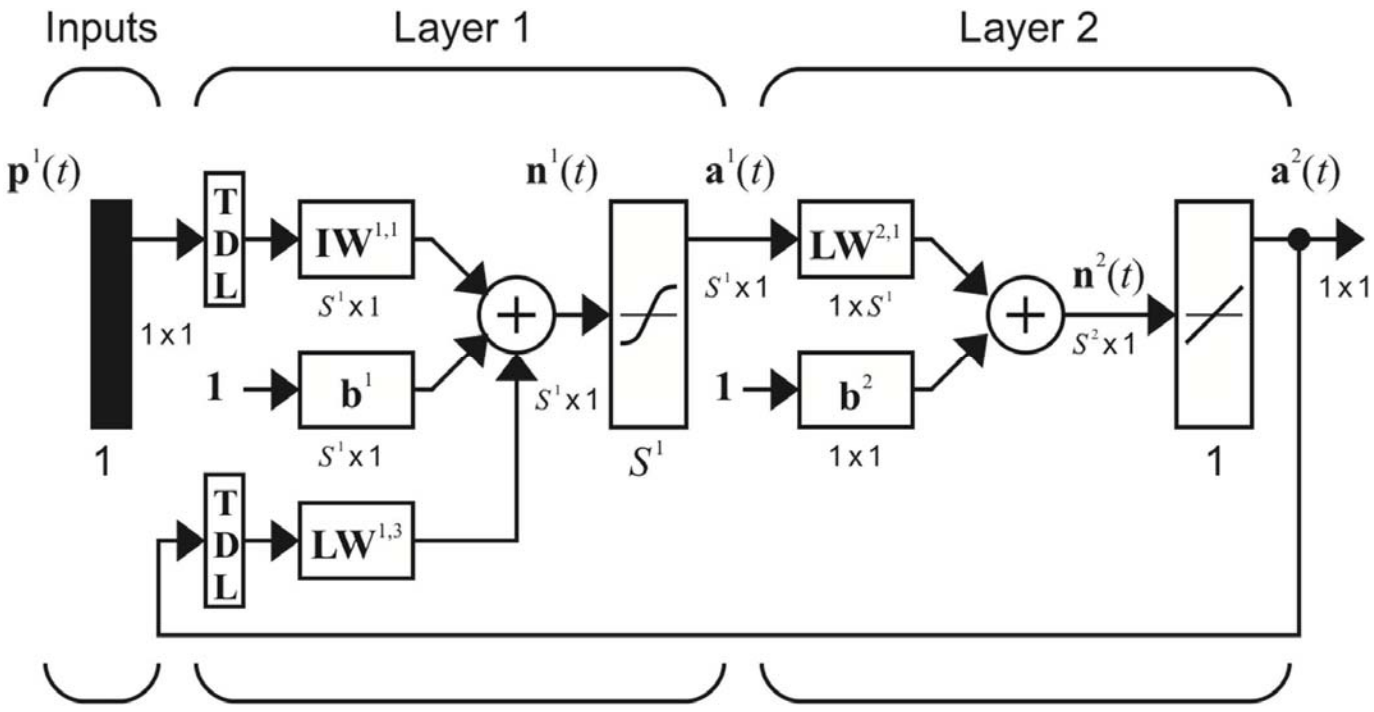
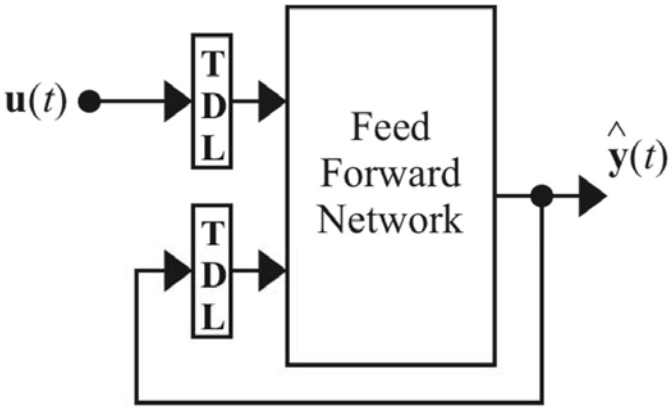
انتخاب معماری

NARX Network

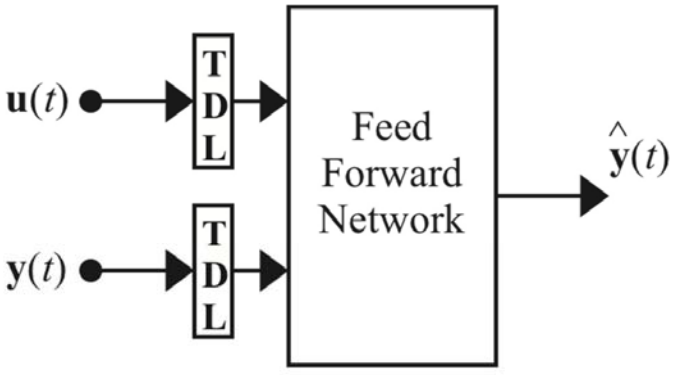


$$y(t) = f\left(y(t-1), y(t-2), \mathrm{K}\ , y\left(t-n_y\right), u(t-1), u(t-2), \mathrm{K}\ u\left(t-n_u\right)\right)$$

Parallel and Series-Parallel Forms



Parallel Architecture



Series-Parallel Architecture

$$\mathbf{p} = \begin{bmatrix} u(t-1) \\ u(t-2) \\ y(t-1) \\ y(t-2) \end{bmatrix} \qquad \mathbf{t} = \begin{bmatrix} y(t) \end{bmatrix}$$

4-10-1 Network

شبکه‌های عصبی مصنوعی

مورد مطالعاتی ۵ : پیش‌بینی

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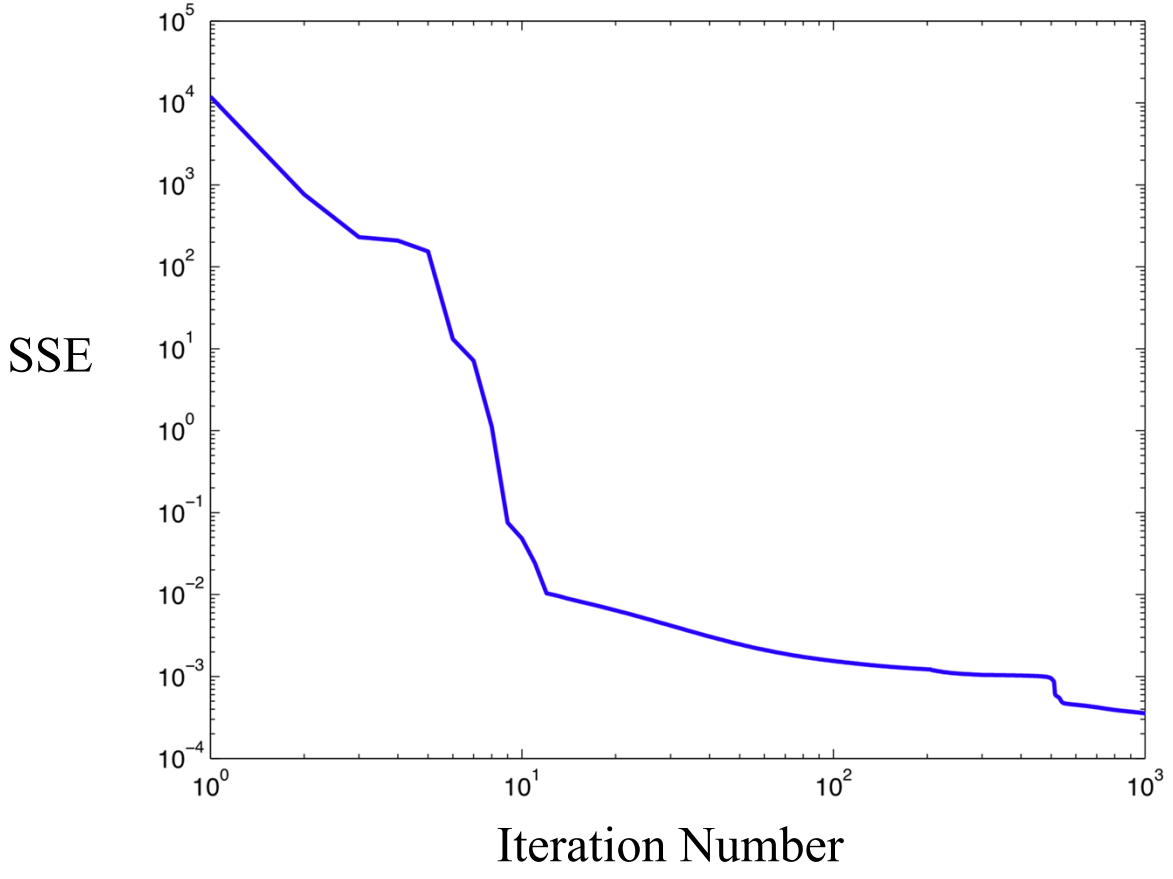
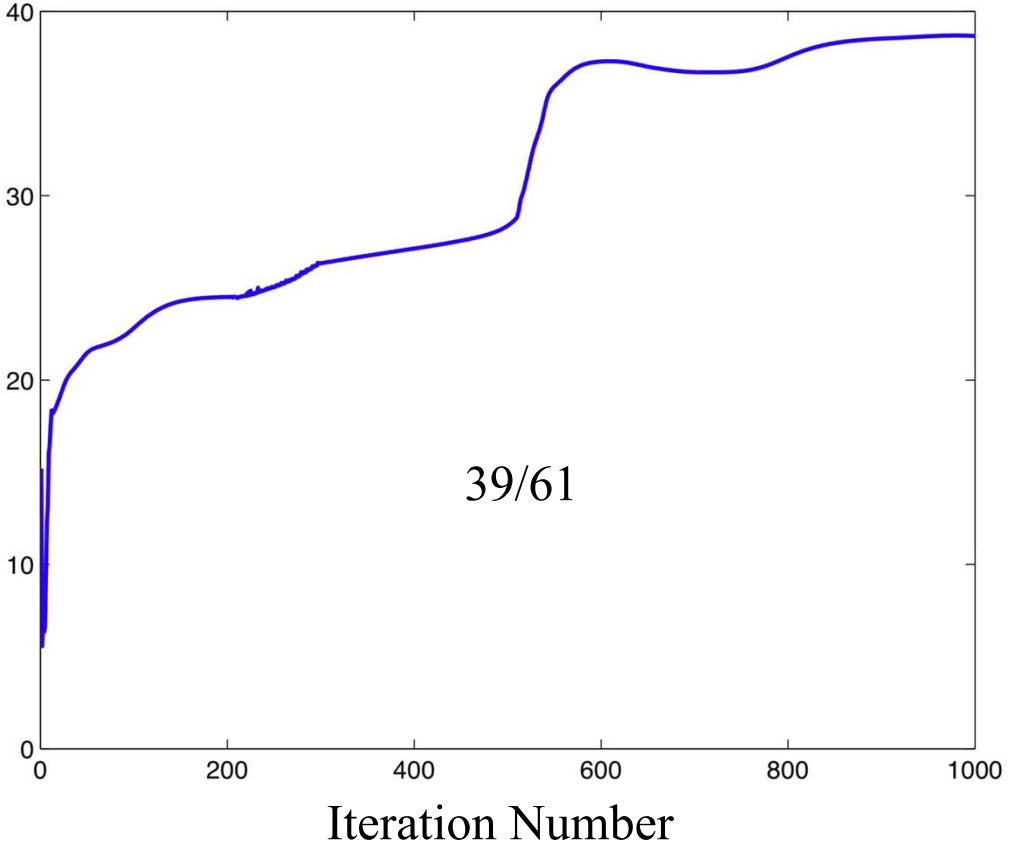
آموزش شبکه

Network Training

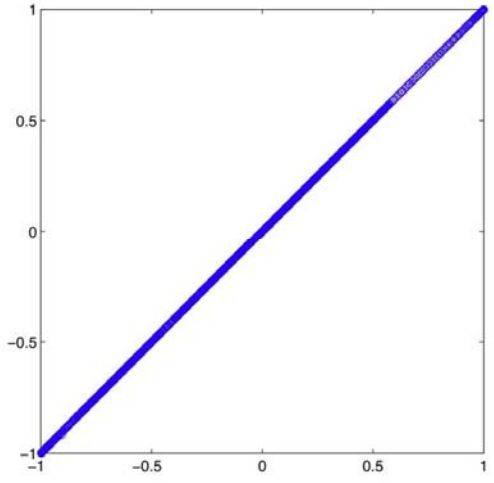


Effective Number of Parameters

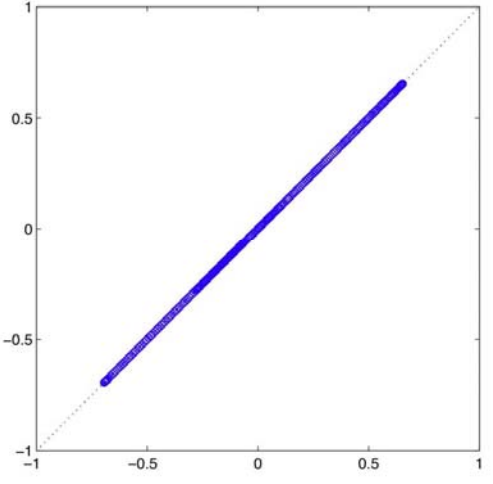


Scatter Plots

Training



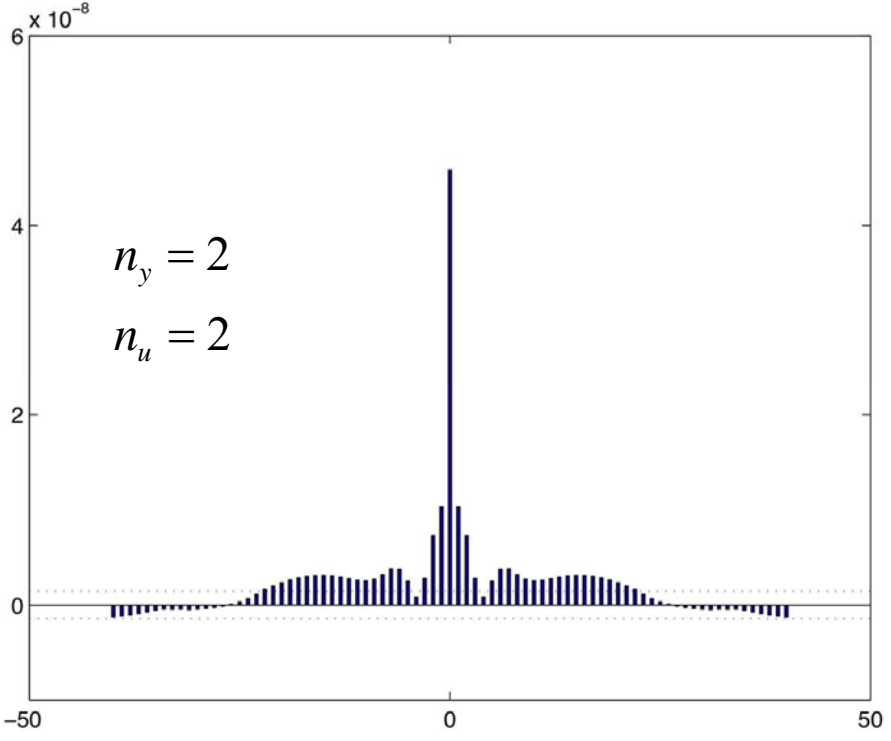
Testing



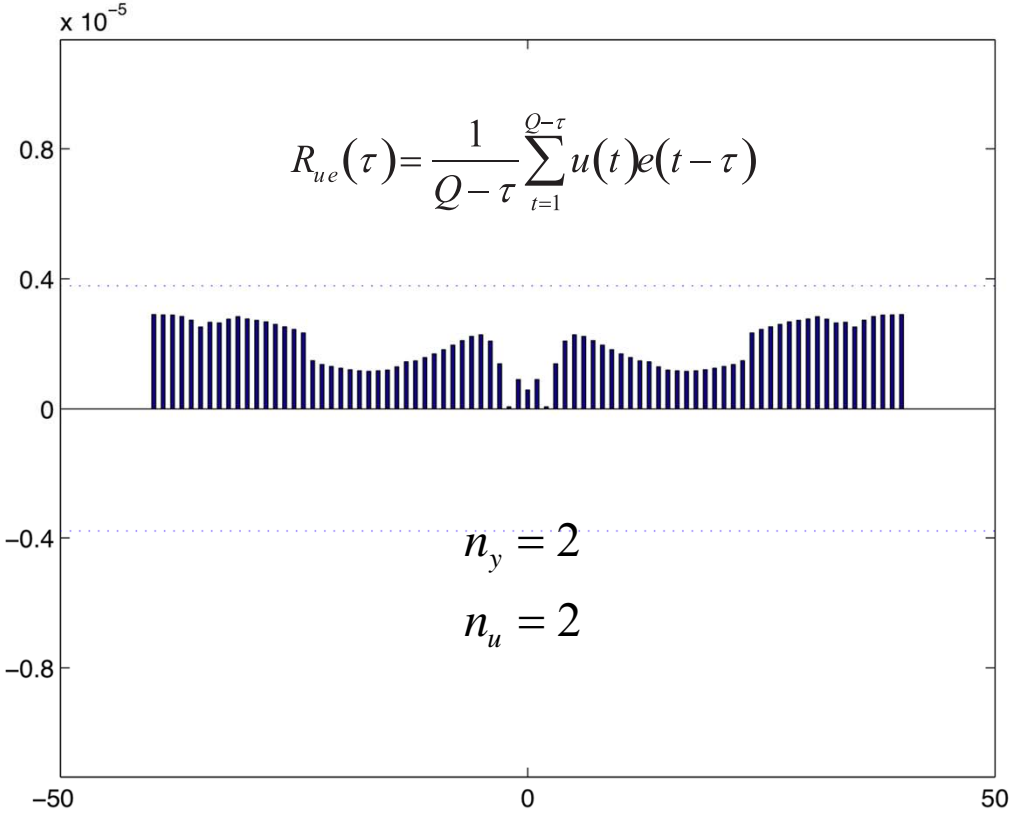
Scatter Plots of Network Outputs vs. Targets - Training and Testing Sets

Prediction Error Autocorrelation

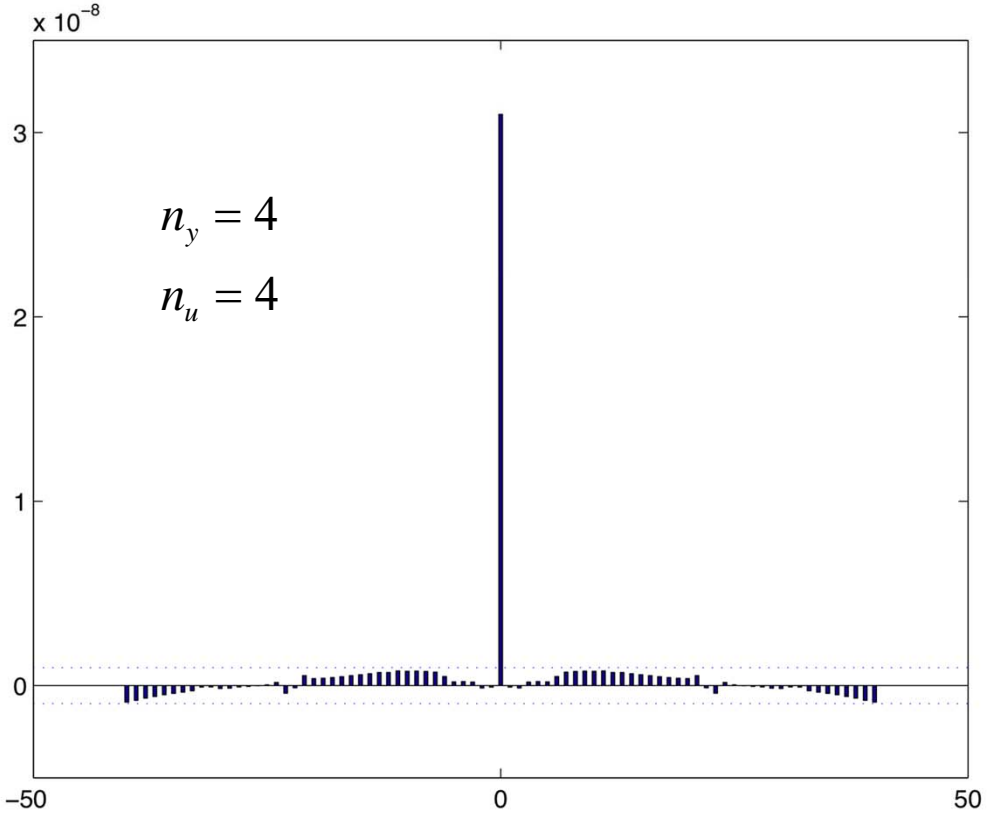
$$R_e(\tau) = \frac{1}{Q-\tau}\sum_{t=1}^{Q-\tau} e(t)e(t-\tau)$$



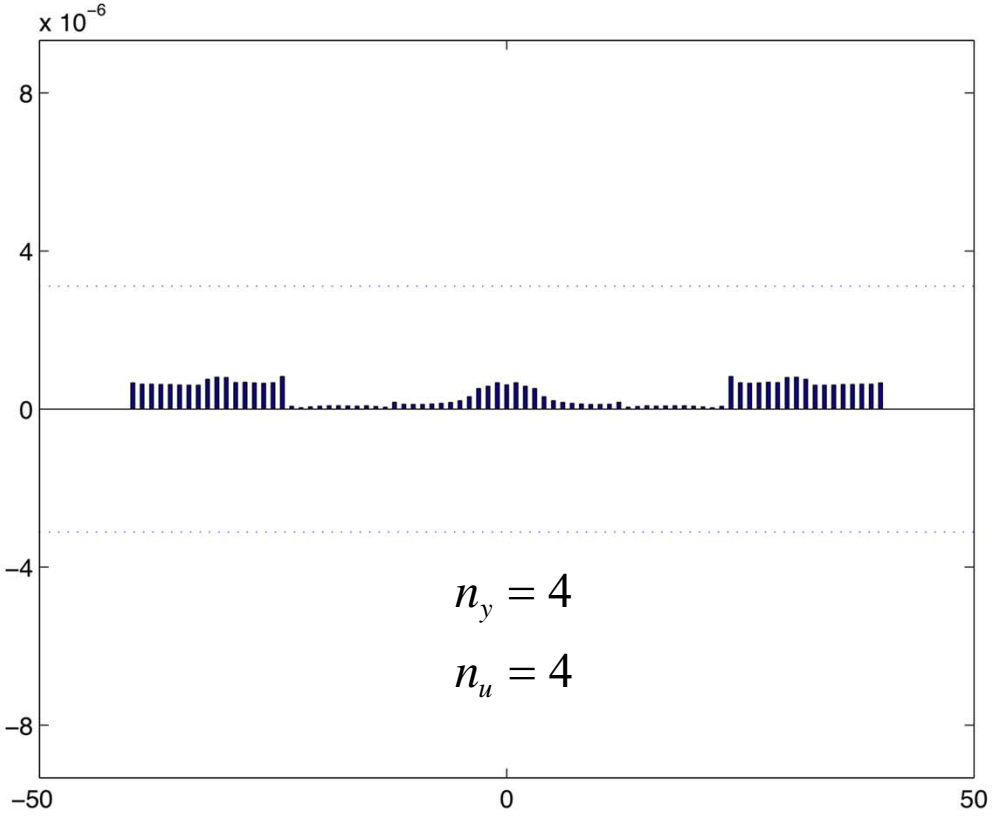
Error/Input Crosscorrelation



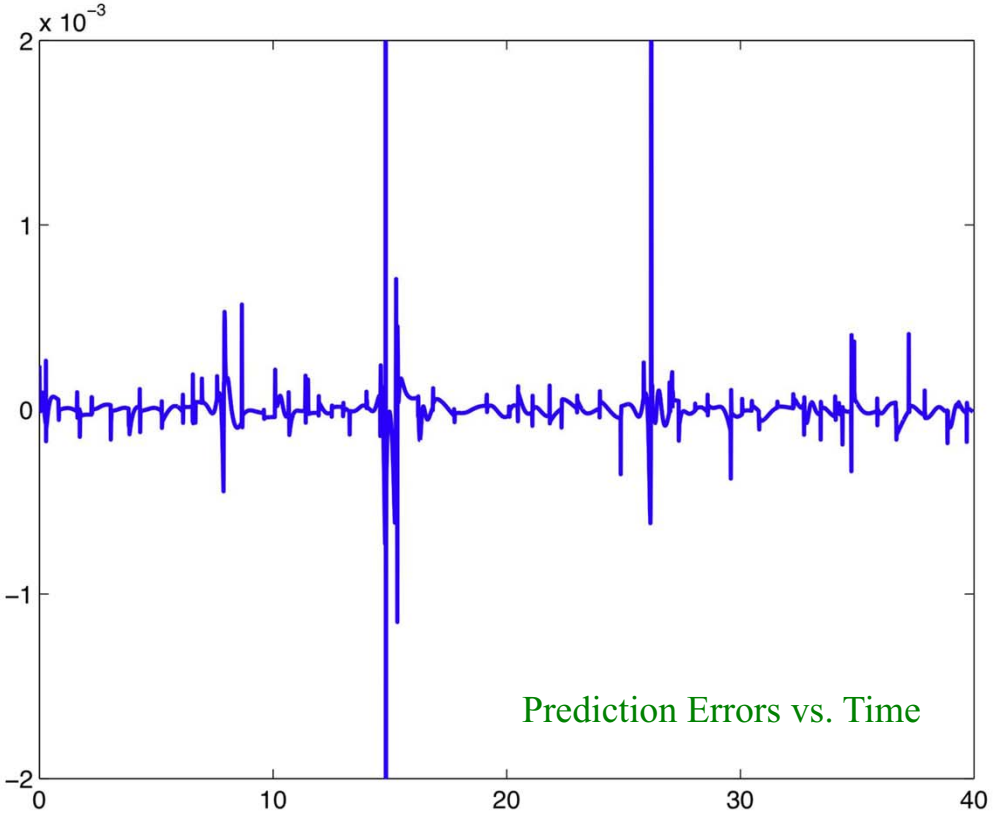
Prediction Error Autocorrelation



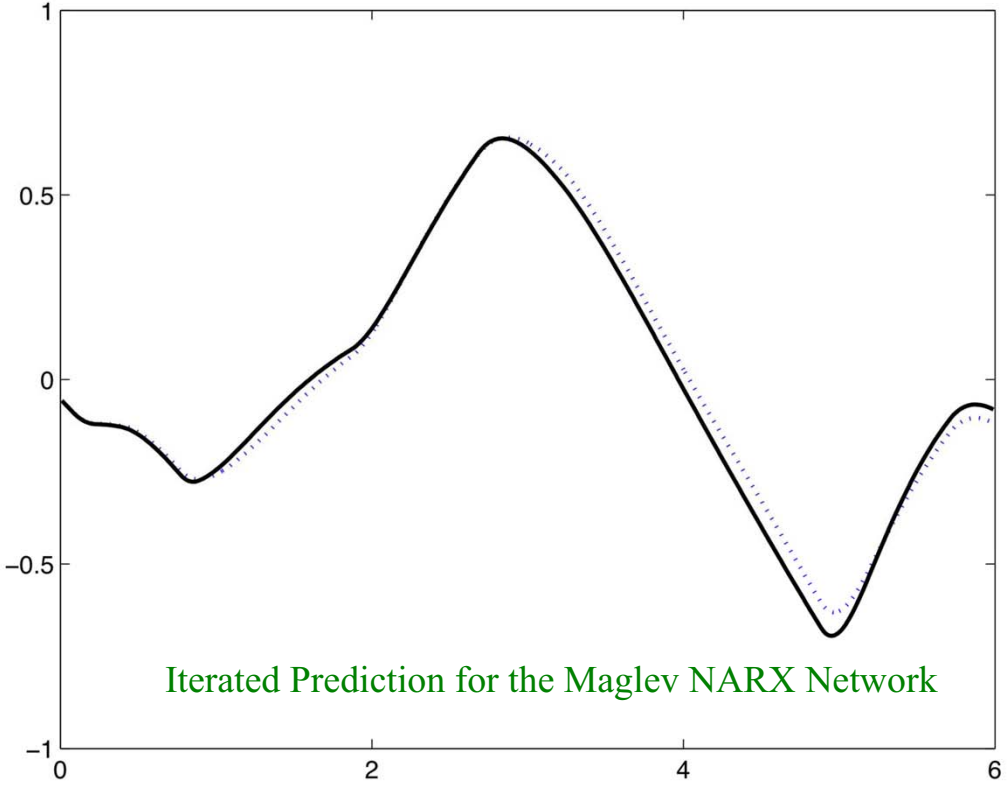
Error/Input Crosscorrelation



Prediction Errors



Iterated Prediction



Iterated Prediction for the Maglev NARX Network

مورد مطالعاتی ۵ : پیش‌بینی

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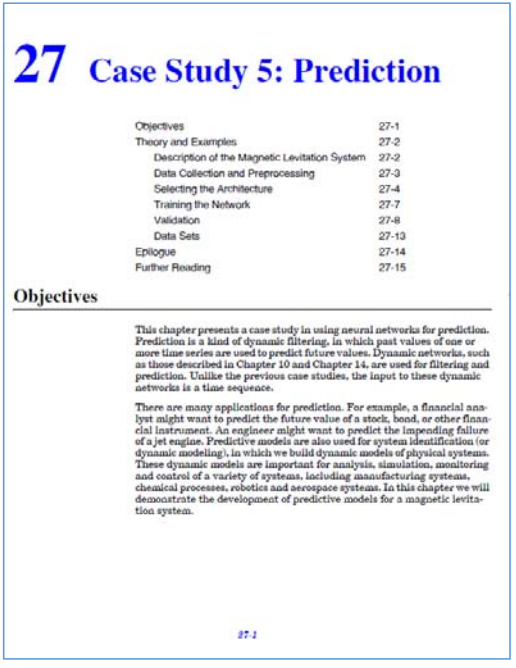
منابع

منبع اصلی



27 Case Study 5: Prediction

Objectives

This chapter presents a case study in using neural networks for prediction. Prediction is a kind of dynamic filtering, in which past values of one or more time series are used to predict future values. Dynamic networks, such as those described in Chapter 10 and Chapter 14, are used for filtering and prediction. Unlike the previous case studies, the input to these dynamic networks is a time sequence.

There are many applications for prediction. For example, a financial analyst might want to predict the future value of a stock, bond, or other financial instrument. An engineer might want to predict the impending failure of a jet engine. Predictive models are also used for system identification (or dynamic modeling), in which we build dynamic models of physical systems. These dynamic models are important for analysis, simulation, monitoring and control of a variety of systems, including manufacturing systems, chemical processes, robotics and aerospace systems. In this chapter we will demonstrate the development of predictive models for a magnetic levitation system.

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Martin T. Hagan, Howard B. Demuth, Mark H. Beale, Orlando De Jesus,
Neural Network Design,
2nd Edition, Martin Hagan, 2014.
Chapter 27

Online version can be downloaded from: http://hagan.okstate.edu/nnd.html