Abstract

The purpose of this task is to illustrate how Empirical modelling can be applied to find a black box model of an unknown dynamic linear system corrupted by noise. This task should be solved individually¹.

1 Introduction

A basic problem in system identification is to estimate discrete-time linear dynamic models from noise corrupted data. The key problem is to find a reliable model.

In this task, you will get data from an unknown system (some prior information will, however, be available) and the problem is to find a suitable model structure and model order. The results should be presented in a small written report.

2 The Task - Black box modelling

The goal is to calibrate and validate a discrete time black box model to a given data set. Data for this task is available on the course home page http://www.it.uu.se/edu/course/homepage/empmod/vt10 in the file blackbox.mat.

2.1 Data description

The data consists of two column vectors, the noise corrupted output signal \( y \) and the input signal \( u \). Use the command load in Matlab to get the data into the workspace. It is known that the system that generated the data is a discrete-time linear system of the form (12.10) in Ljung & Glad (2004). The system is of the form (12.11)-(12.12) and the noise is given by (12.14)-(12.15) (where, of course, some polynomials may be equal to 1). It is also known that none of the polynomials have a higher degree than 3, and also that the time delay \( nk \leq 3 \).

¹For information UU’s "cheating policy" see http://www.it.uu.se/edu/fusk.pdf
2.2 Task outline

The goal is to find a “validated” model for the data. The validation process should be documented and the chosen model structure and model order should be well motivated. Note that since the data has a significant noise level, you should not expect to get a fit very close to 100%.

Chapter 12 and 14 in the textbook describes the modelling process in details and are crucial for this task. Some guidelines are also given in “Empirical Modelling of Energy Processes - Project Description”.

3 Examination

In order to pass this task the following is required:

An individually written documentation (say two A4 pages) which satisfactorily motivates your choice of model (typically how the model validation was carried out). The document (Swedish or English) should start with an Abstract where your summarise your finding. Use the following outline (where a FIR model is used as an example):

XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

Sammanfattning

Från den undersökning som presenteras nedan anser jag att data kommer från följande FIR(1)system:

\[ y(t) = 2.718u(t - 3) + e(t) \]

XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

Be careful to use the right name and the right structure for the system!

The dead-line for sending the documentation is 2010-03-15 (24.00). On request you should also be prepared to send in your model.

Please send your documentation by email to Bengt: bc@it.uu.se

If you miss the dead-line, you will have to ask for a new data set in June 2010.

We will try (but do not promise) to select a few “winners” in this task. In any case, the true system will be presented during the project presentation (18 March 2010).