1

Model Estimation from Process Reaction Curves

In this project you will experiment with different process reaction curve models obtained from the reaction curve of a process.

1.1 System description

Here is what we know about the system that we are trying to find the model for,

- The process is linear, but may have time delay.
- The process is not oscillatory.
- The process is open-loop stable.
- The process output measurement is corrupted with a normally (Gaussian) distributed random noise.

We would like to estimate a model for this process using different approaches. Using the process response data, identify the following types of models for this process,

(a). 3-Parameter 1^{st} order model using area methods.
(b). 3-Parameter 2^{nd} order model using area methods.
(c). 3-Parameter 1^{st} order model using method of moments.
(d). 3-Parameter 2^{nd} order model using method of moments.
(e). 4-Parameter 2^{nd} order model using method of moments.

	IAE	ISE	Maximum Error
3-P 1^{st} O (Area)			
3-P 2^{nd} O (Area)			
3-P 1^{st} O (Moment)			
3-P 2^{nd} O (Moment)			
4-P 2^{nd} O (Moment)			

Table 1.1 *Table of comparison of modeling errors - Step input*

	IAE	ISE	StdV of Error
3-P 1^{st} O (Area)			
3-P 2^{nd} O (Area)			
3-P 1^{st} O (Moment)			
3-P 2^{nd} O (Moment)			
4-P 2^{nd} O (Moment)			

Table 1.2 *Table of comparison of modeling errors - Random input*

1.2 Problem sets

The problem tasks are as follows (to be submitted by **Wednesday 25th of Tir 1399**). Please note the following:

- You need to present your results in a report. The report should include all your results. **Marks will only be awarded to results which are present in your report**.
- Your report should be typed, **no longer than 30 pages AND 3000 words**.
- All your m-files should also be submitted.
- Please check that your files run correctly and are **compatible with 64-bit MATLAB 2013b**, prior to submission. If your file do not run correctly no marks will be awarded at all.
- You should have **one main m-file from which all other m-files may be run**. Your main m-file should produce figures and results in exactly the same order in which they appear in your report. Failure to do so will result in a loss of marks

Q1). Compute a model for the system using each of the techniques listed. For each case you need to clearly state the following:

(a). For each case, you need to calculate the model using at least ***two different inputs on two different time intervals***. Clearly discuss why you have chosen each of the two inputs. Pay attention to the issues you need to follow for each technique.

(b). If the model you obtain for each input is different, explain why the difference exists. Select what you believe to be the better model of the two and explain why you made the choice?

Q2). Complete Tables 1.1 to 1.2. The modeling error indices in Tables 1.1 to 1.2 need to be computed over the ***same time interval*** for all models. In each table, the ***same*** input should be used to calculate all columns. In Table 1.1 you should use a suitable step input. For Table 1.2 use random signal as the input. In your answer to this part you need to discuss the following points:

(a). How are the ISE and the IAE calculated and what is the difference between the two?

(b). What is a suitable time interval to calculate the errors for and why?

Q3). Compare Tables 1.1 to 1.2. Discuss the result and explain if they match with your expectations. Based on these date select determine what you believe to be the best model. State the reasons for your choice.

Q4). Compare the Nichols diagram of the system and the model you have selected as your model of choice. What does this tell you? Comment on the results and whether it matches the results predicted by tables 1.1 and 1.2.