

Lab 07: PLS Modelling

CHEN4011: Advanced modeling and Control

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1 Objectives

1. To develop PLS models using `plsregress` function.
2. To compare the PLS model predictive accuracies for different input shapes:
3. Uniform random numbers for sampling periods $T_s=0.5$ and $T_s=1.5$
4. Sequential step changes for sampling periods $T_s=0.5$ and $T_s=1.5$
5. To implement the PLS models as soft sensors for y_1 and y_2

2 Problem Statement

Figure 1 shows a distillation process that is represented using the [Simulink model](#). The outputs (responses) are the distillate product impurity y_1 and bottom product impurity y_2 . There are 3 measured state variables: x_1 and x_2 are tray temperatures while x_3 is column pressure. Also, there 3 measured inputs: u_1 is feed flow rate, u_2 reflux flow rate and u_3 steam flow rate to the distillation boiler. Note that both response variables y_1 and y_2 are difficult to measure but their values must be kept with acceptable ranges. Also note that, the values shown by the Simulink model simulation are based on the nominal operating values, not the absolute values. As a process control engineer in your company, you are responsible for the profitable operation of the distillation column. To enable tight control of the two response variables, you have decided to build two soft sensors for measuring the variables. The soft sensors are developed using the well-known PLS models.

3 Tasks

- i. Construct several PLS models using the `plsregress` function in Matlab for the different input shapes and sampling periods. Tabulate the regression coefficients and MSE values of all PLS models. [3 marks]
- ii. Compare the PLS modelling accuracies based on the MSE values. Comments on the impact of input shapes and sampling periods on the modelling accuracies. [3 marks]
- iii. Implement 2 of your best PLS models on the given Simulink model. Run the simulation for some input changes (you may mix both shapes, e.g., step tests for inputs 1 and 2, and random number for input 3). Plot the actual and predicted profiles of the response variables. Comments on the results. [4 marks]

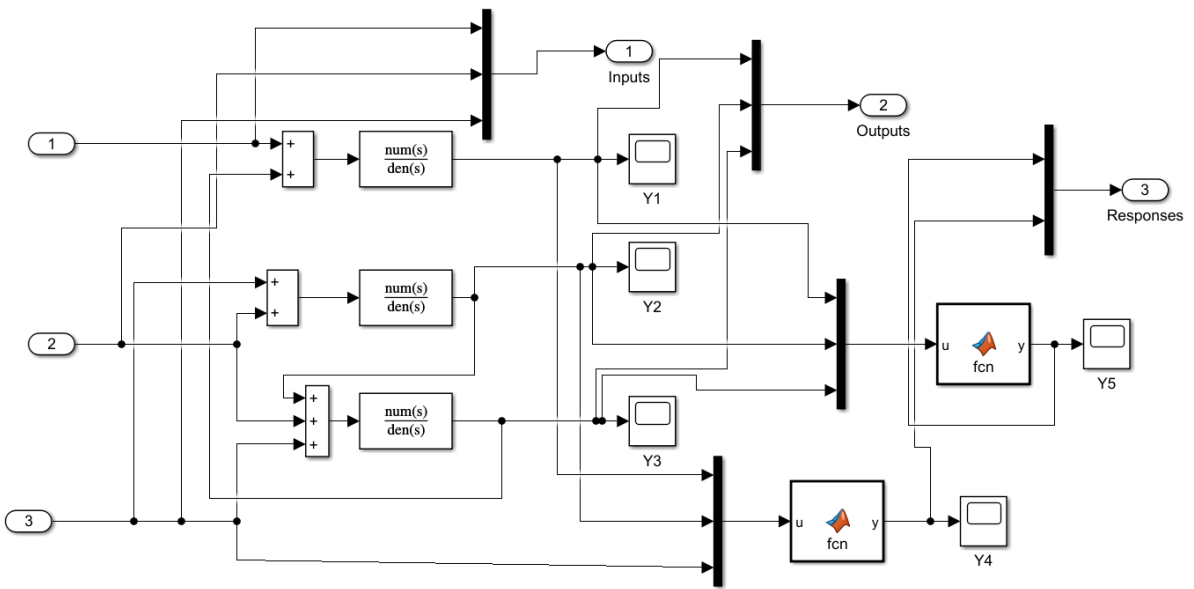


Figure 1: Distillation process: distillate impurity y_1 and bottom product y_2 .