ASSIGNEMENT 3

LSE, PCA and PCR model identification method

In folder you will find the mat file with the measured data from the ammonia oxidation process. In the mat file you will find the following measurements: air flow for cooling (A\_FLOW), water temperature (T\_H2O), acid concentration (C\_ACID) and inverse value of efficiency (I\_EFF). The goal is to get the equation based on which one can estimate the inverse value of efficiency. But during the assignment you will also test different properties of the PCA method.

1. **EFFECT OF DATA STANDARDIZATION ON MODEL**:

Test and check how different data standardization approaches affect the model. Note that when using “PCA” for getting the parameters of the model you will get the model in an implicit form (p’\*(x-v)=0). Repeat the same test for LSE method. You need to transform that implicit equation into explicit one. Test the following standardizations:

1. Standardization of data to interval [0 1]: X = (X-min(X))/(max(X)-min(X))
2. Z-score standardization:

X = (X-mean(X))/std(X)

1. Raw data without standardization.

For all three cases calculate the model using eigen vectors (PCA – implicit model) and LSE model. Note that for case a) and b) you have to de-normalize the parameters in order to compare them.

Present the results in the report and comment them. Also present and analyze the distribution of the model error. Does the data standardization have any influence on the results? How do obtained parameters with “PCA” compare to parameters obtained with LSE (compare them). Estimate theoretical variance of parameters for LSE method.

1. **COLINEARITY PROBLEM**:

Add a collinear variable to the existing measurements. Make the variable dependent on the temperature:

x = 2\*T\_H20 +6+0.1\*randn(length(T\_H2O,1)).

Calculate the model with the PCR method (PCA and LSE combination) and LSE method. With the PCR method you first transform data into different space then use LSE method and transform parameters back to original space. Run the identification several times and check what is happening with the model parameters. Compare the parameters obtained with PCR and LSE.

Estimate theoretical variance of parameters for LSE method. Estimate variance of parameters for LSE and PCR from experiments.

Write a report in which you give the basic theory background of the used methodology. Present and comment the obtained results.