Laboratory 2023/5 (24/05/2023): parameter convergence analysis in ARX identification; model identification using the Graphical User Interface of MATLAB Toolbox

Introduction to the first part (24/05/2021 videotape on Teaching Portal: 0:00 – 14:00):

Exercise 1 – parameter convergence in ARX model identification

First part (with your PC and MATLAB R2014a, 30 minutes):

- Definition of the ARX parameters
- System simulation:
  - Computation of the ARX output
  - Plot of the ARX output
- System identification:
  - Estimation of the ARX parameters using the Least Squares
  - Plot of the estimated parameters versus the actual ones

Comments on the first part (videotape: 14:00 – 28:00)

Introduction to the second part (videotape: 28:00 – 36:30):

Exercise 1 – parameter convergence in ARX model identification

Second part (with your PC and MATLAB R2014a, 20 minutes):

- System validation:
  - Computation of the prediction error using the final estimated parameters
  - Anderson's whiteness test using the xcorr function (hint: use the command `[r,lags] = xcorr(pred_error,'coeff')`)

Comments on the second part (videotape: 36:30 – 51:00)

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Introduction to the third part (24/05/2021 Teaching Portal videotape: 51:00 – 01:03:30):

Exercise 2 – hair dryer model identification using the MATLAB GUI

Third part (with your PC and MATLAB R2014a, 20 minutes):

0) Self guided tour on Matlab Graphical User Interface (GUI):
   type **`iddemo`** , then enter **`1`** , then select option **`1`** only
1) Open the System Identification Toolbox GUI typing **`ident`**
2) Import the dryer data from "Example" => Dryer window will appear
3) Remove the mean value form the data => Dryerd window will appear
4) Make the data without mean as current working dataset
5) Partition the whole dataset in two subsets:
   - the estimation dataset (ES: data from 1 to 500) => **`Dryerde`**
   - the validation dataset (VS: data from 501 to 1000) => **`Dryerdv`**

Introduction to the fourth part (videotape: 01:03:30 – 01:13:30)

Fourth part (with your PC and MATLAB R2014a, 25 minutes):

6) Set **`Dryerde`** as working dataset and **`Dryerdv`** as validation dataset
7) Perform the order selection for an ARX structure comparing AIC, MDL and Best Fit criteria
8) Identify several models of different orders and delays:
   - ARX(na,nb,nk), using na=nb=1,...,4 and nk=1,...,3
   - ARMAX(na,nb,nc,nk), using na=nb=nc=1,...,4 and nk=1,...,3
   - OE(nb,nf,nk), using nb=nf=1,...,4 and nk=1,...,3
9) Compare the identified models on the VS dataset considering residual analysis and Best Fit index
10) Select the “best” model

Comments on the fourth part (videotape: 01:13:30 – 01:21:00)