SSY 230, System Identification
Project 3: Identification of a Real System

Yuxuan Xia
yuxuan.xia@chalmers.se
Emil Staf
emil.staf@chalmers.se

May 11, 2018

1 Flexible Robot Arm

The system we have chosen to identify is a mechanical system, where a flexible robot arm have been installed on an electrcal motor. It is a SISO system where the input $u(t)$ is measured reaction torque and the output $y(t)$ is the acceleration of the flexible robot arm. The experimental set-up was performed using a periodic sinusodial sweep.

1.1 Data

As mentioned previously the input data is a periodic sinusodial sweep (see top plot of Figure 1). Due to the fact that the data was obtained using a periodic sinusodial sweep we split the data in half and use the first part as training data and the second part as validation data.

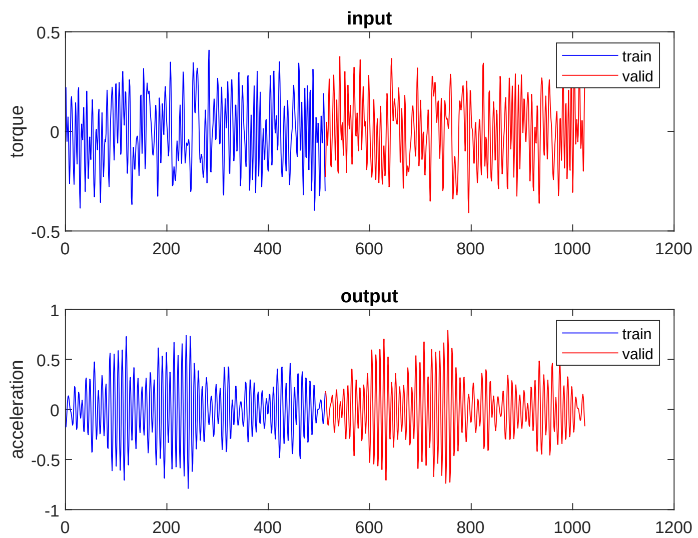
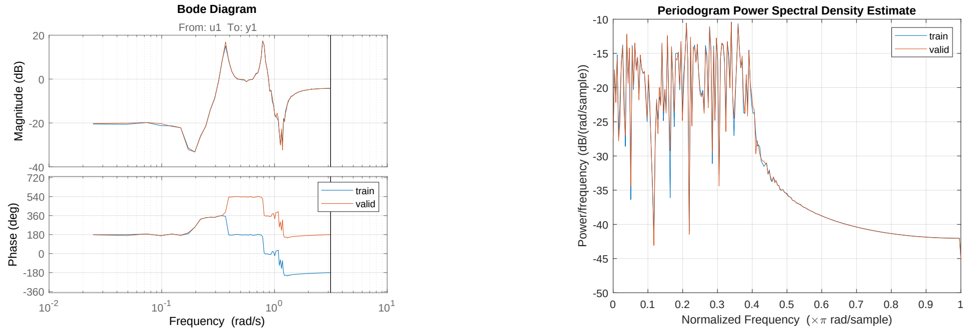


Figure 1: System data, input $u(t)$ (top) and output $y(t)$ (bottom).

To make sure that the frequency content in both the training and validation data are similar we use the *etfe* in MATLAB to find the Empirical Transfer Function Estimate of training- and validation data. The resulting bode-plot is shown in Figure 2a.



(a) Bode-plot of training and validation data. (b) Periodogram of training and validation data.

Figure 2: Analyzing training/validation split.

From analysing Figure 2a it is clear that the amplitude of the frequency content in both training- and validation data is very similar, while there is a phase shift for frequencies > 0.35 rad/s. Using the MATLAB build-in function *periodogram* it is clear that the frequency content of the training- and validation data is very similar and we conclude that the chosen way to construct training/validation data is a good choice.

It can be interesting to analyse the autocorrelations of and cross-correlation between the input $u(t)$ and the output $y(t)$. The correlations can be seen in Figure 3. From Figure 3 it is clear that the

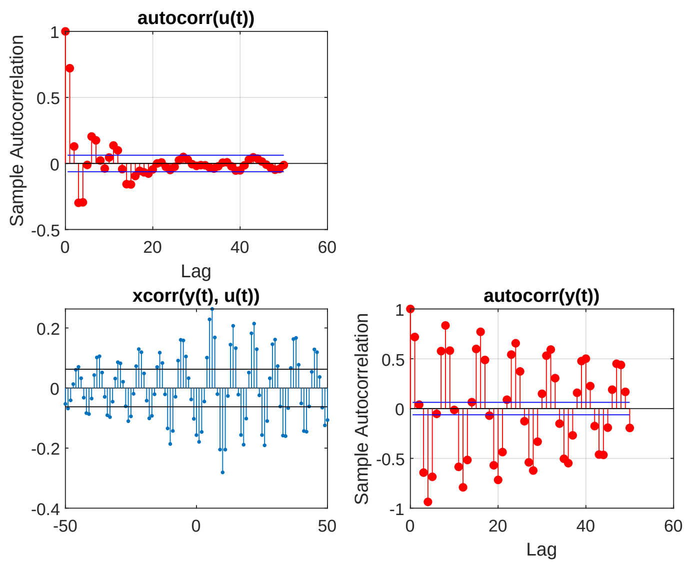


Figure 3: Autocorrelations of and cross-correlation between the input $u(t)$ and the output $y(t)$

output depends on previous values of itself as well as previous values of the input.

NOTE: We should return to cross-correlation analysis after having a trained model of the system to make sure there are no cross-correlations remaining, since that could mean that a too simple model would have been used.

1.2 Pre-Processing