ELEC-E8103 - Modelling, Estimation and Dynamic Systems

Assignment 4

Mario Tilocca 914934

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1 Exercise 1

1.1 part a

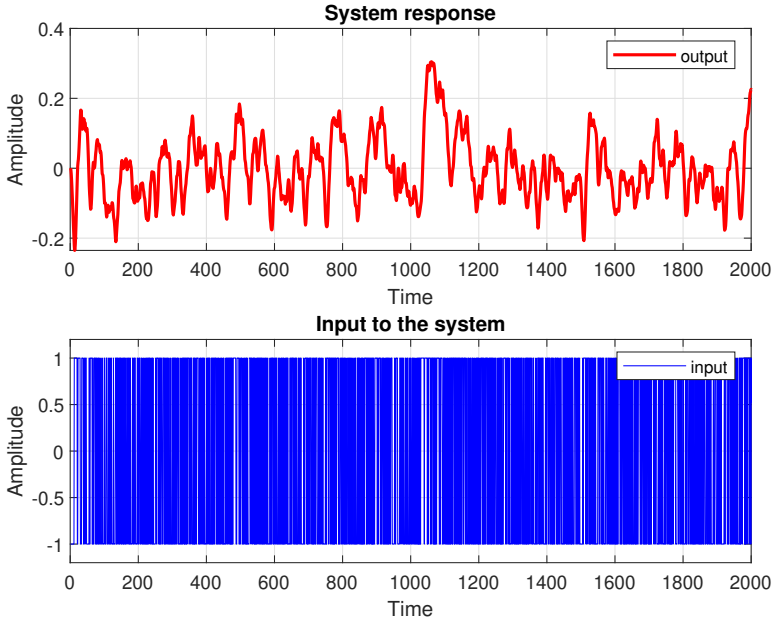

Figure 1: Pseudorandom binary signal input and signal output

1.2 part b

1.3 part c

As it can be observed in Fig. 3 the estimation of the impulse response manages to represent the behavior of the actual impulse response accurately until 7 seconds, afterwards the estimation drops to negative values therefore not following accurately the trend of the actual impulse response.

1.4 part d

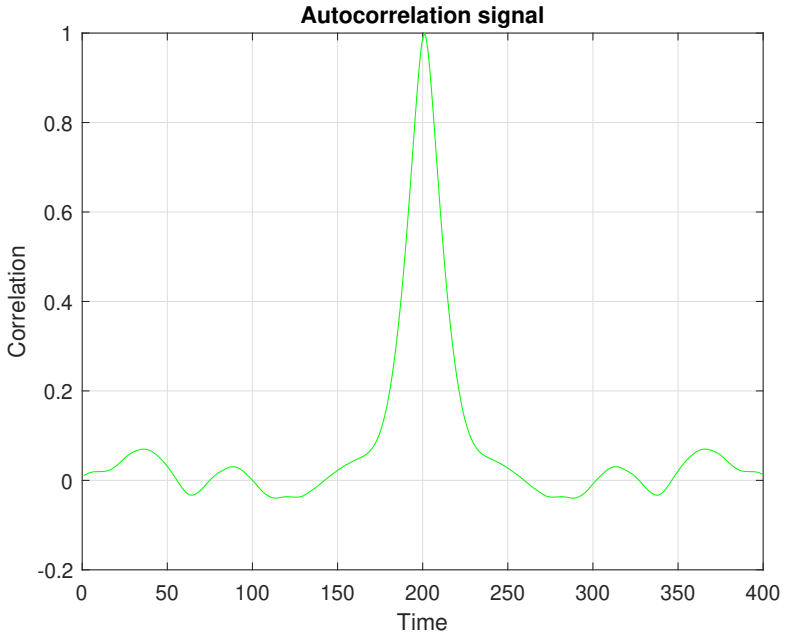

Figure 2: Auto correlation signal

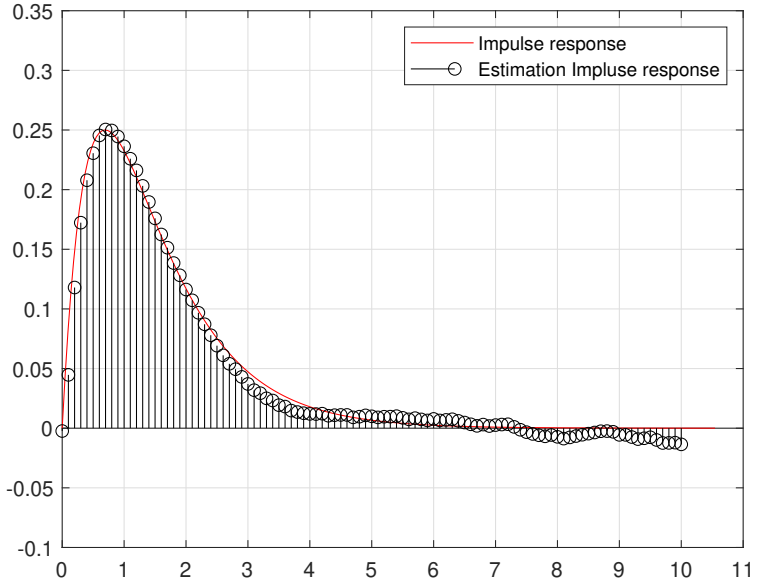

Figure 3: Impulse response and estimate impulse response

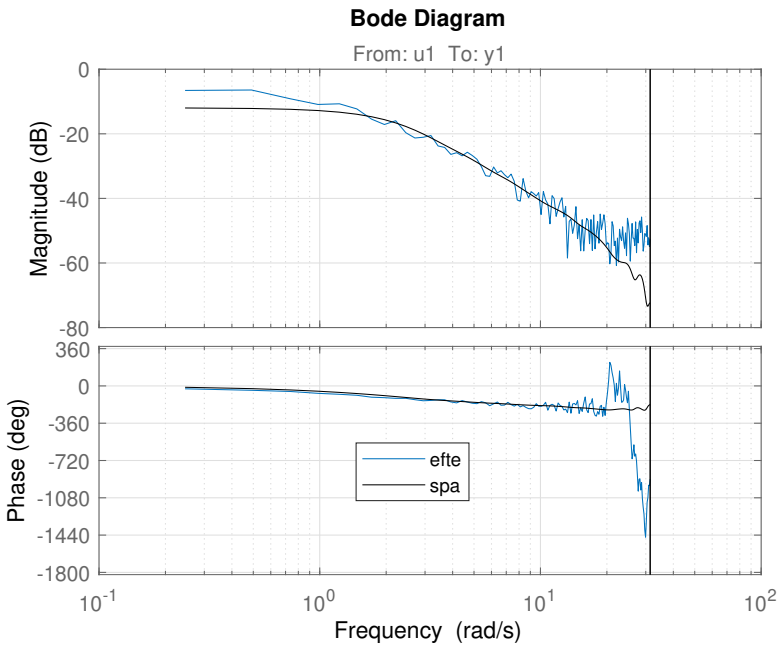

Figure 4: Bode plots of the transfer function and frequency response

2 Exercise 2

2.1 part a

The chosen method for the analysis of the oil consumption and economic growth in the US was cross correlation. It has been found a maximum correlation of 0.75 in time lag 0, measured in years. Therefore it can be said that the oil consumption and economic growth are correlated to each other, however not in a strong manner as that would have implied a correlation coefficient with a value larger than 1.

2.2 part b & c

In Fig. 6 the results of the estimated model for the forecast of economic growth and oil consumption is presented. For the development of the model the oil consumption data was used as input and the economic growth data as output. The data sets were equally split into 70% of the total to be used for the training of the model and 30% for the validation.
I assumed that a first degree polynomial was the best choice for this problem as the higher the degree of the polynomial used the higher will be the chance of overfitting the estimation of the data. Furthermore the SSE between the data and the estimation needs to be minimized so either a first degree or a secodn degree polynomial should be taken into consideration, however given the reasons concerning the overfitting I opted to use a first degree polynomial.

For 2015 with an oil consumption inflection of -0.5% the economic growth is equal to 2.43 %.

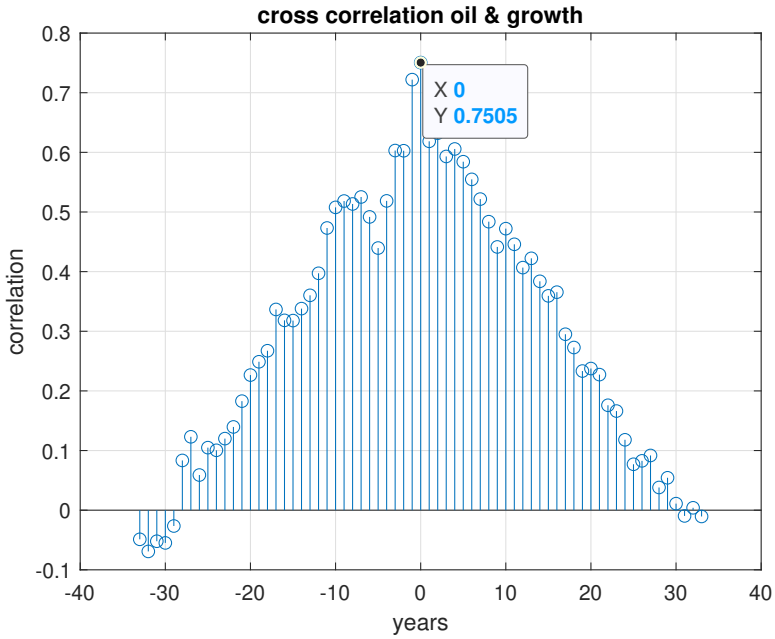

Figure 5: Cross correlation

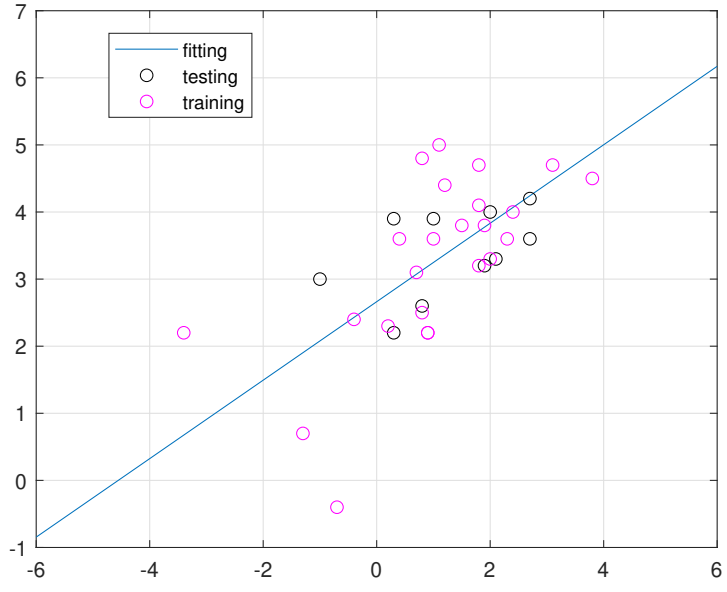

Figure 6: Scatter plot of data and polynomial fitting curve