

# Lab 05

Dominik Csatári FV1TW4

2024.04.02

## Task 1

- Discretize the dynamical model with the Euler method:

Using Euler Method and the given data in 'vessel.mat' I have discretized the model and stored the data in y.

- Give the model in predictive form for least squares estimation:

With the y I have calculated and the data X, which is the regressor I have calculated  $\theta_{\text{hat}}$ , with the inverse form:  $\theta_{\text{hat\_sum}} = \text{inv}(X_{\text{sum}}' * X_{\text{sum}}) * X_{\text{sum}}' * y_{\text{sum}}$ .

- Estimate the unknown parameter values:

For this calculation I have decided to use a higher lambda, so my output would be less noise. This also means, for prediction good theta values I need more data, to make greater predictions. This is why I have chosen to plot the figure of theta values through out time in a range of [100:499] on Figure 1.

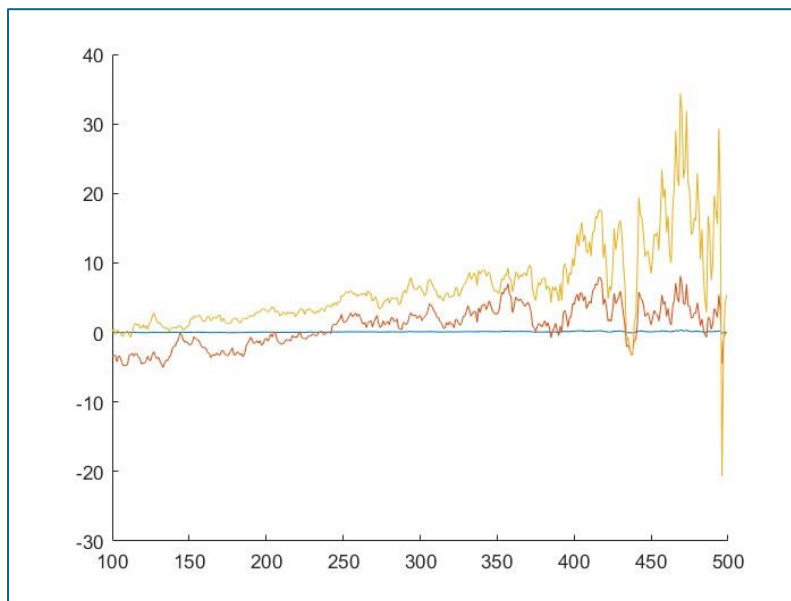
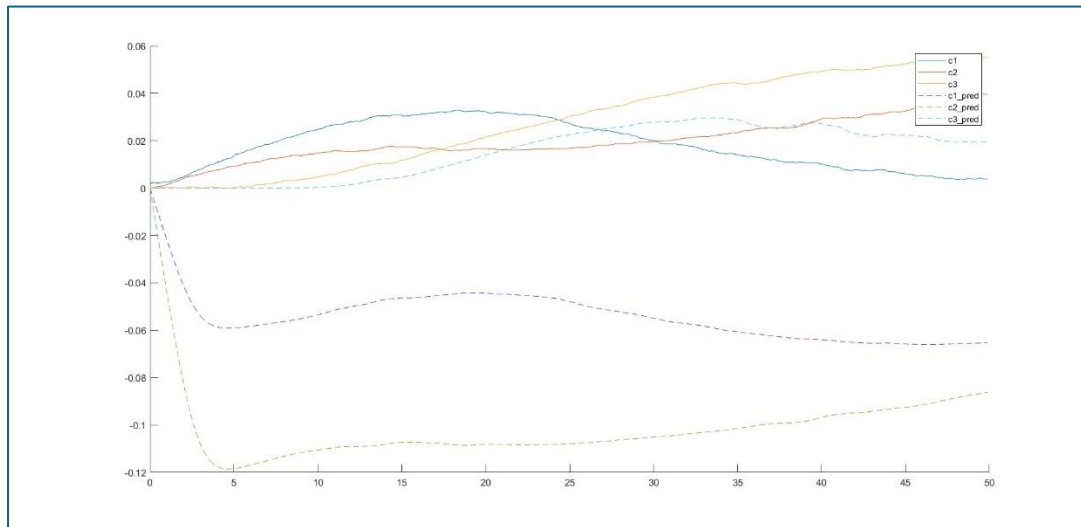


Figure 1 time-dependent estimates of the parameters

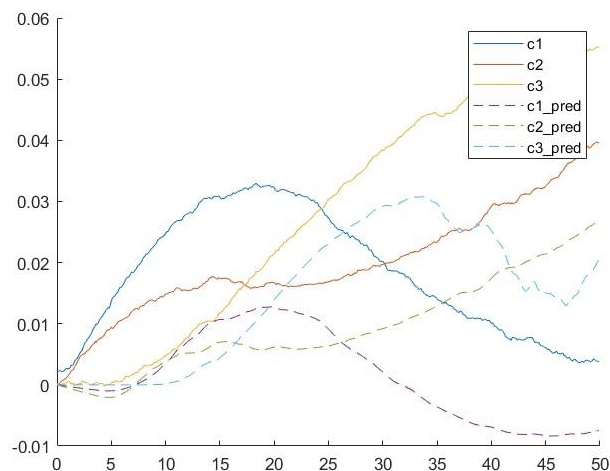
With the recursive method I seemingly got good results, which were, for example:

$k_r = 5.4326$  ,  $F_1 = 0.0499$ ,  $F_2 = -0.0223$ . Which fits the problem quit well. Unfortunately, I di have some struggles with the plotting part of the exercise, that is why with estimating with Euler method the next element of the sequence did not manage to keep track of the concetrations nicely. However, in the case of concetration 3, it keeps track quit well. The plot can be seen on *Figure 2*.



*Figure 2*

When in the scripct I change  $c_{01}$  and  $c_{02}$  to 0.1 and 0.2 in the formulas respectively it gives a way better prediction than before, shown on *Figure 3*.



*Figure 3*