



EINDHOVEN UNIVERSITY OF TECHNOLOGY

COMPUTATIONAL BIOLOGY GROUP

Bachelor Eind Project SBMD Report Logs

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1 Preface

The purpose of this **Report Log** is to keep track of the notes, tasks and every other information provided during the Bachelor Eind Project (BEP) meetings. The table of contents contains a list of many different dates. For each of the given date, with the name ***Notulen***, there is a description, notes or information received during the meeting. The dates named ***SSA***, contain a summary or listings of all the findings/information and tasks performed on that day as a self-study assignment.

2 Introductory meeting 19-march-2020

This section contains information regarding the introductory meeting of this BEP.

2.1 Notulen

The introductory meeting was mainly focused on the different kind of subjects regarding the **BEP SBMD**.

The different **subjects** were:

1. **Hospital patient's data/clinical data regarding:**

- (a) Obesitas after gastric bypass surgery
- (b) Heart failure, monitoring Troponin
- (c) Liver transplantation template model

2. **Dynamic, biological data:**

- (a) Diabetic patients
- (b) Metabolism/reaction on different meals
- (c) Parameter estimation

3. **Sars-Cov-2, aka COVID-19:**

- (a) Epidemic models
- (b) estimation of the infected/exposed

2.2 SSA

The tasks to be completed for this self-study assignment are:

- Fill and sign BEP form
- Read the articles and give preferred subject

3 "Startbijeenkomst" 08-april-2020

The very first meeting after choosing the preferred subject.

3.1 Notulen

The chosen subject for this BEP is **COVID-19**.

Interesting topics to research regarding the subject of COVID-19:

1. Kalman filter to predict the number of daily infection
(<https://towardsdatascience.com/using-kalman-filter-to-predict-corona-virus-spread-72d91b74cc8>)
2. The main programming language to be used is Python
3. Public Data as resource for model training
4. John Hopkins map and data is useful
(<https://coronavirus.jhu.edu/map.html>)
5. Using the SIR/SEIR model
6. Making a blogspot and Github as "final report"
7. Should focus on the Netherlands
8. Would be good to compare 2 or 3 models (Kalman vs Logistic fit vs SEIR model)

Furhtermore, there is an outreach of the TU/e regarding research of the COVID-19.

3.2 SSA

The tasks to be completed for this self-study assignment are:

- Study the Kalman filter and its applications
- Take a look at the outreach of TU/e regarding research of the COVID-19
- Make a github repositories for the codes of this BEP

4 Meeting on 16-april-2020

This time, dr. D. Bosnacki joined the team as a supervisor.

4.1 Notulen

It is difficult to use the SEIR model, since there are currently no available data regarding the **Recovered** patients of COVID-19 in the Netherlands. dr. Bosnacki suggested to use a model without the recovered, since the recovery at the beginning is almost negligible. Furthermore, it is difficult to know the **Exposed**, since it is difficult to track the amount of people who are actually exposed to this virus, due to lack of test kits.

It is still advisable to study the Kalman filter, and applying this to the data of RIVM, made available to the public. This way it is possible to check the performance of the Kalman filter on the data of the Netherlands. Another suggestion from dr. Bosnacki, was to use the data regarding the amount of patients taken in the hospital or ICU. This is more trustworthy and this data is also available. Furthermore, it would be possible to use the Kalman filter to predict the daily hospitalized patients due to COVID-19. Lastly, it is advisable to write a proposal for the TU/e innovation space, regarding the outreach and offering help to the research of COVID-19.

4.2 SSA

The tasks to be completed for this self-study assignment are:

- Try to model and find a parameter for **Exposed**
- Model the hospital intake
- Try to implement the codes of Kalman filter, specifically on the data of the Netherlands (predicting the daily infected people)
- Proposal for TU/e innovation space (Offer help)
- Study the potential SEIR model

5 Meeting on 23-april-2020

5.1 Notulen

It is quite difficult to estimate the parameters using the SIR or SEIR models, since this is a dynamic model. Therefore, one would have to estimate the parameters and solving the differential equations, simultaneously.

It is interesting to apply the SEIR model on the hospital admissions or ICU admissions. Furthermore, it is also possible to add extra compartments to this model, taking hospital and ICU admissions into account.

Instead of estimating the parameters, since these are sensitive (sensitivity can be tested by taking the derivative of these parameters function as time). One can also use **parameter sweep**. However, it might be better to use values obtained from literature or the ongoing research on COVID-19.

It is recommended to focus on the **Logistic Growth Curve (Verhulst)** and using this function to estimate the parameters (it is easier), with the help of *Maximum Likelihood Estimation*. With these estimations, the SEIR model can be tweaked and a simulation can be performed on the SEIR model. Finally, the combination of the information obtained from the SEIR and Verhulst model, can be applied on the Kalman Filter.

From now on, prepare the work and questions on a Powerpoint Presentation, same as OGO computational biology (recap, work done, upcoming, questions for supervisors.

5.2 SSA

The tasks to be completed for this self-study assignment are:

- Implement Logistic Growth Curve on Python
- Use Logistic Growth Curve to estimate the parameters using MLE
- Tweak and improve the Logistic Growth Curve
- (Optional) Implement these estimated parameters in the SEIR model

6 Meeting on 30-april-2020

6.1 Notulen

6.2 SSA