

Guido Camps PhD DVM

VoedingNL22 | Biologisch ritme en voeding | 17 juni 2022

KU LEUVEN



Europese Unie

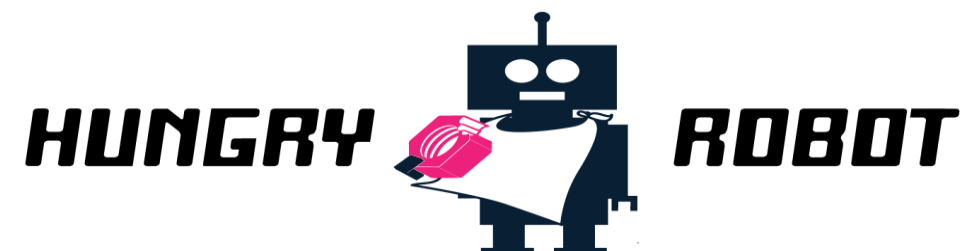
Europees Fonds voor Regionale Ontwikkeling



WAGENINGEN
UNIVERSITY & RESEARCH



OnePlanet
Research Center

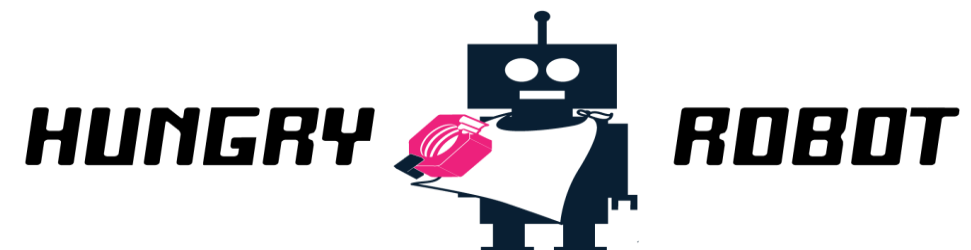


Biologisch ritme en techniek

Wat ga ik vertellen

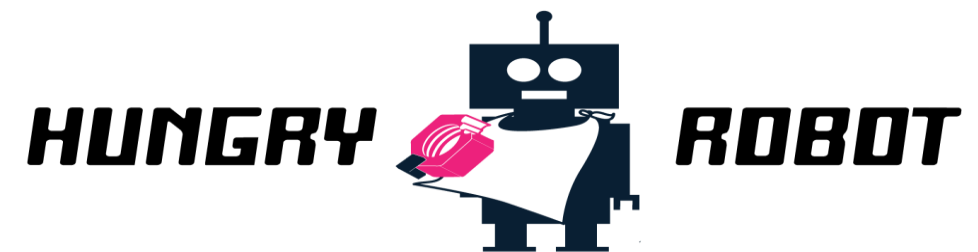
Tracken van

- Stress
- Slaap
- Voeding



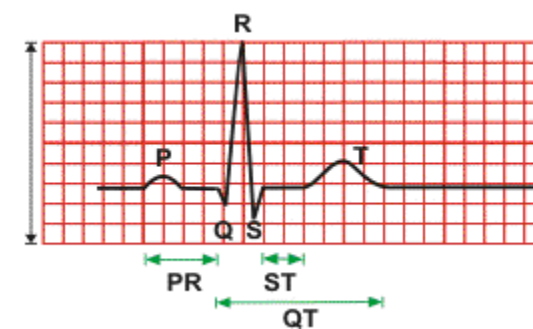
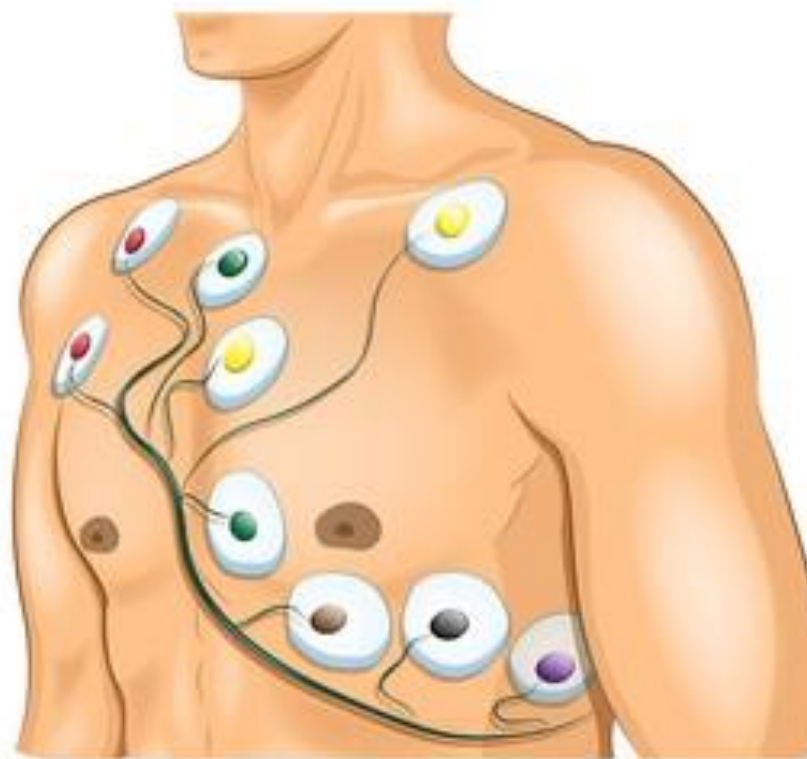
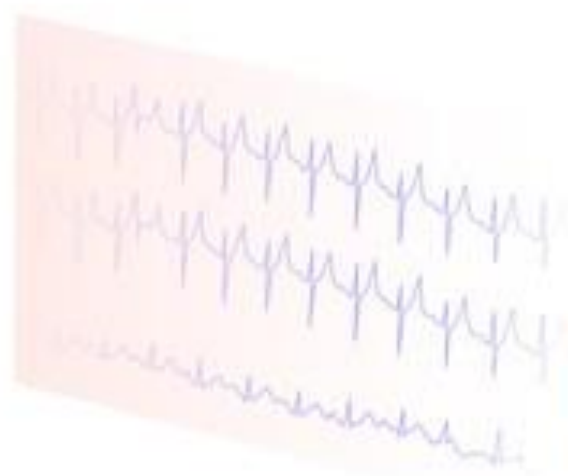
Biologisch ritme en techniek

Tracken van stress

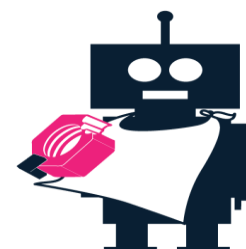


Meten van hartslag

ECG is de gouden standaard

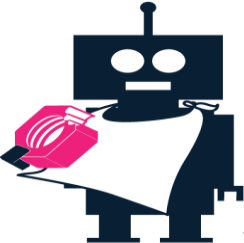


HUNGRY

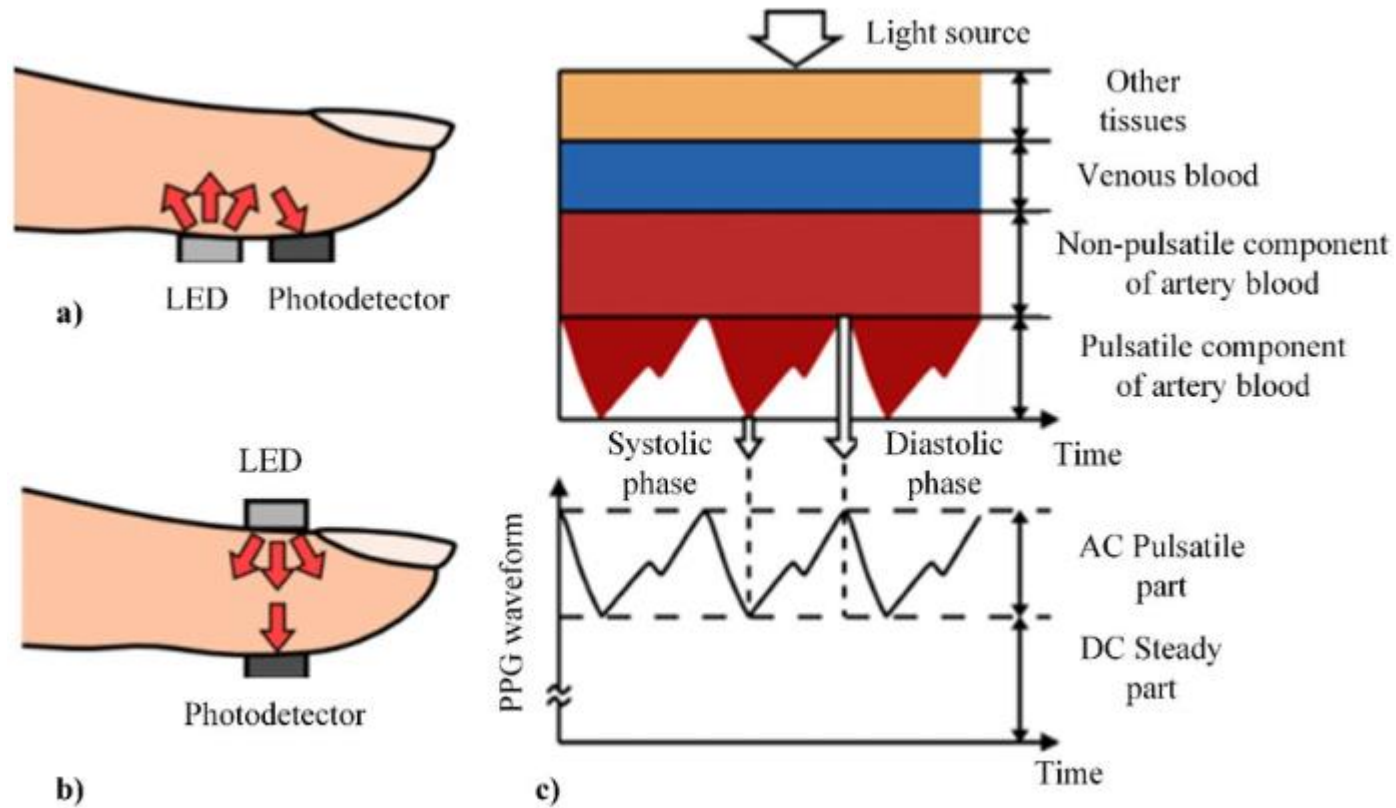


ROBOT

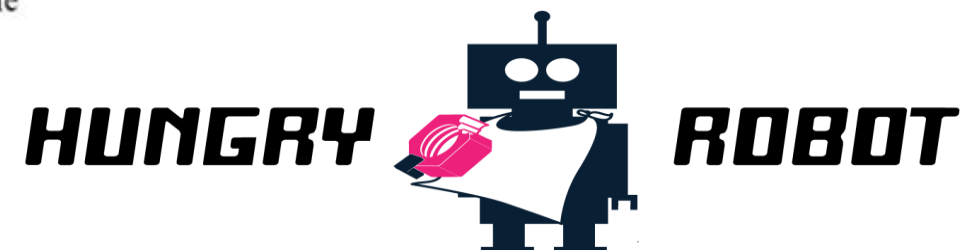


HUNGRY  **ROBOT**

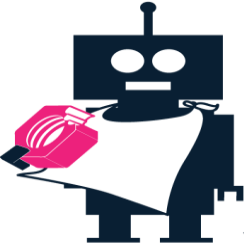
Photoplethysmography (PPG)



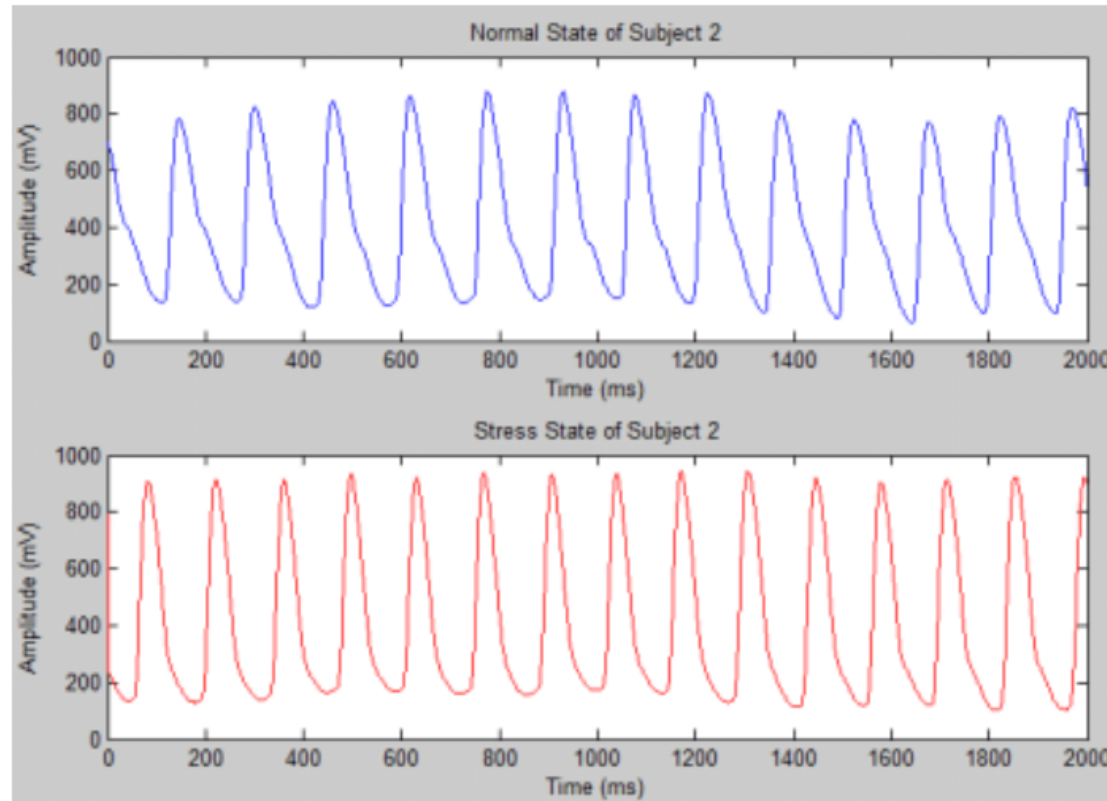
Ref 1



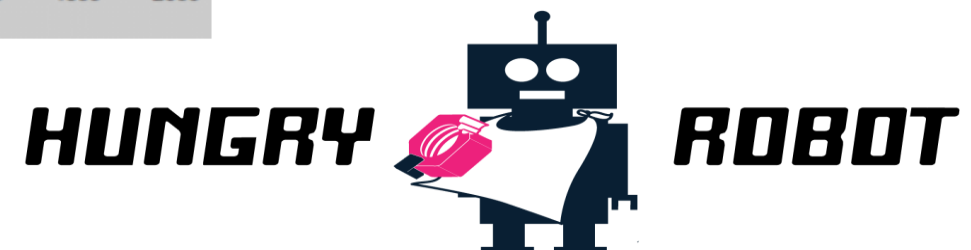


HUNGRY  **ROBOT**

These results suggest changes in the morphology of PPG pulses possibly revealing marks of arterial stiffness occurring due to psychological stress.



Ref 2, 3

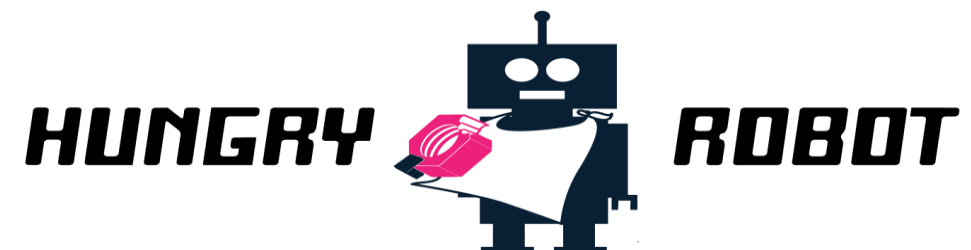


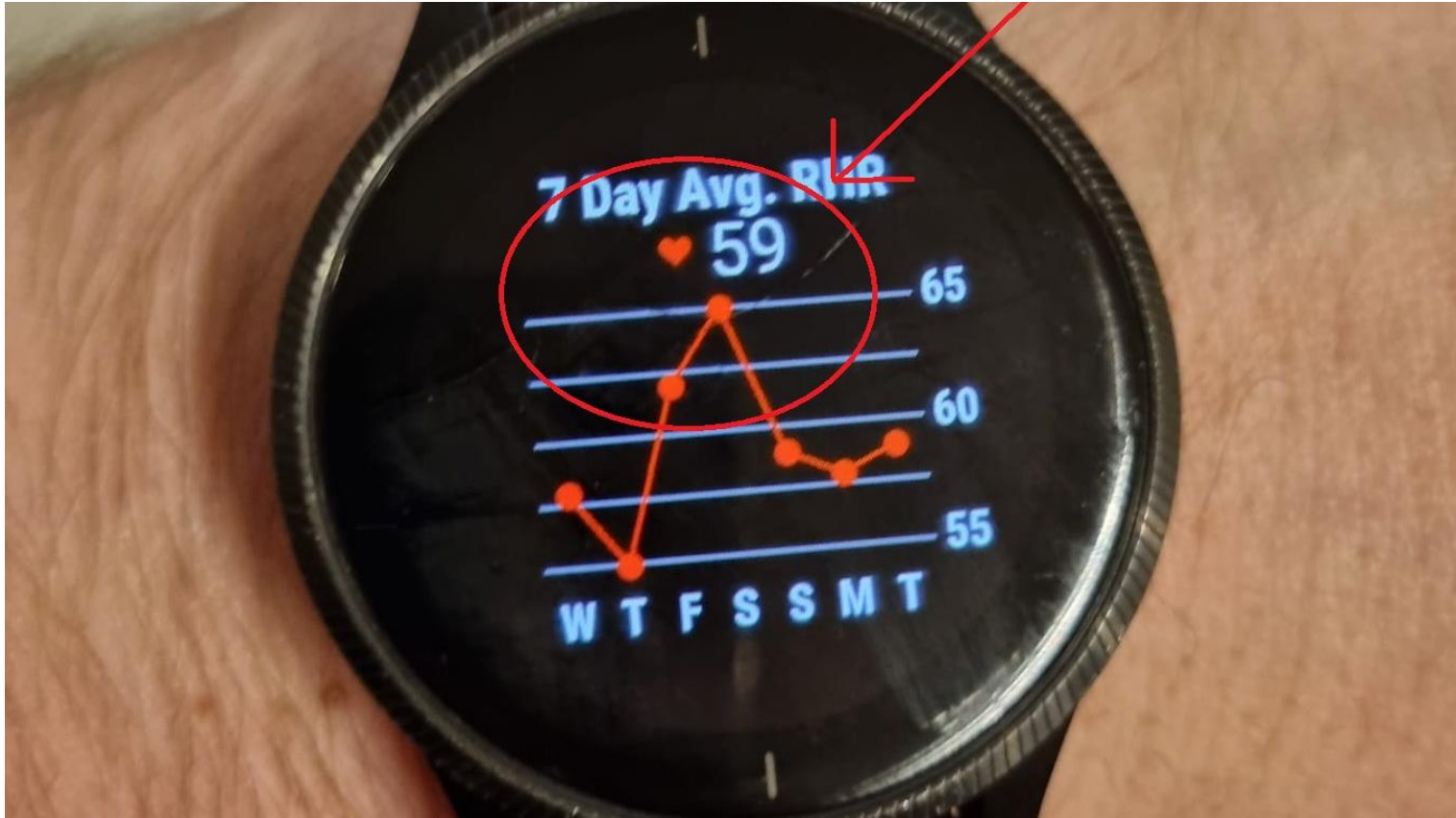
Biologisch ritme en techniek

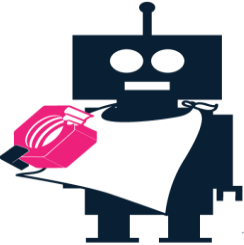
Tracken van stress - conclusie

Therefore, the outcome of this study suggest the reliability of implementing PPG signal for stress recognition.

Gegeven de aanname dat hartslag gezien wordt als marker van stress, dan zijn deze metingen zijn dus betrouwbaar genoeg om een indicatie te geven van stress.



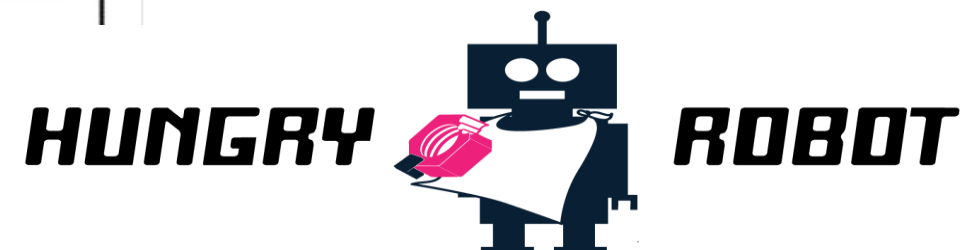
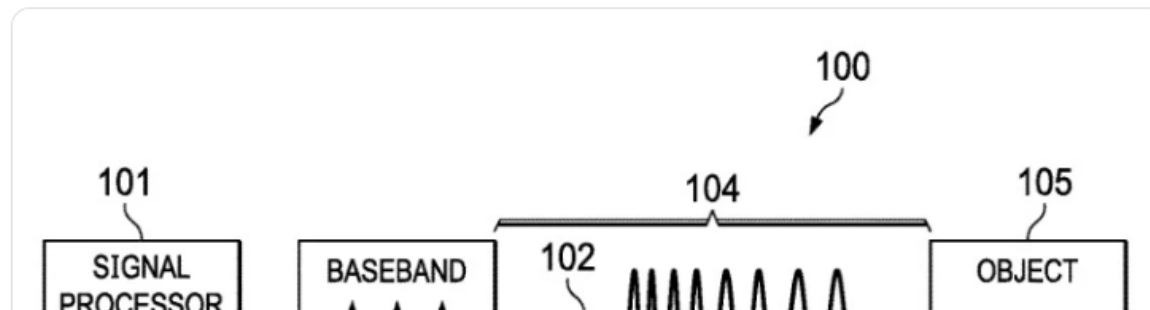


HUNGRY  **ROBOT**

Kleine inkijk in de toekomst

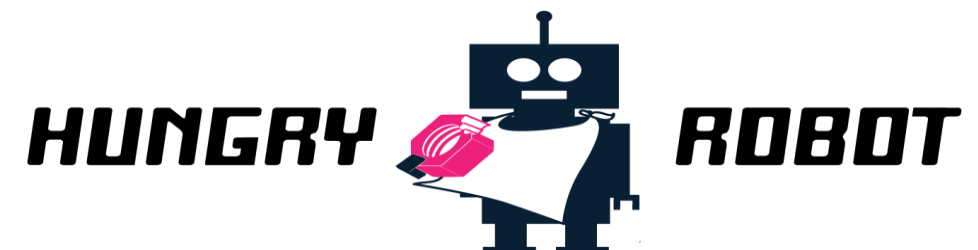
Apple seeks patent on technology that will be used to monitor Apple Watch users' blood sugar readings

If Apple can make the technology work, those with the Series 7 Apple Watch who are insulin dependent diabetics will be able to monitor their blood sugar without paying for the disposable test strips. More importantly, they won't have to feel the pain of pricking their finger with a little needle called a lancet. Since many diabetics don't like to go through the process of obtaining a reading, the new feature could lead to improved monitoring on the part of these patients and help them control their diabetes better. And the Apple Watch will eventually pay for itself since there are no more test strips to buy.



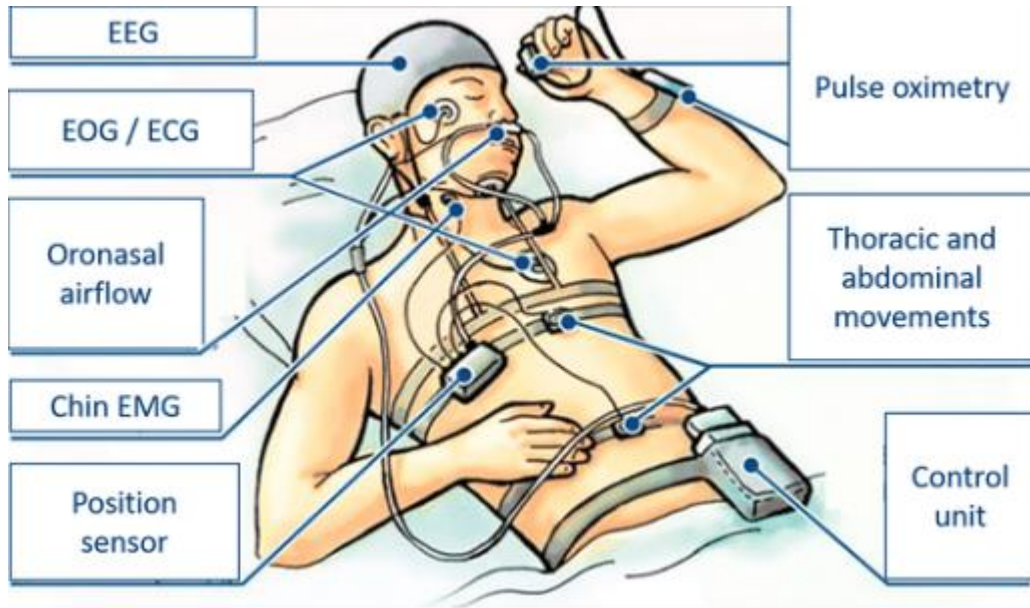
Biologisch ritme en techniek

Tracken van slaap

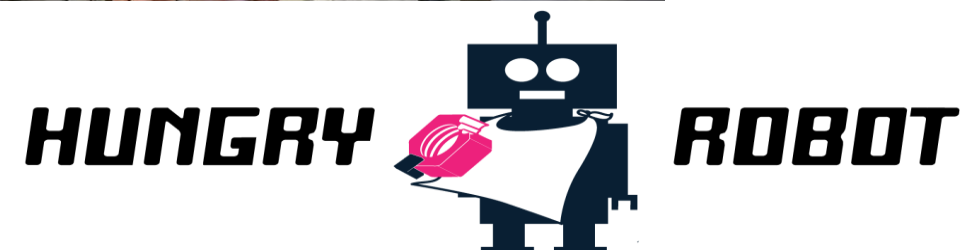


Meten van slaap

polysomnography (PSG) is de gouden standaard

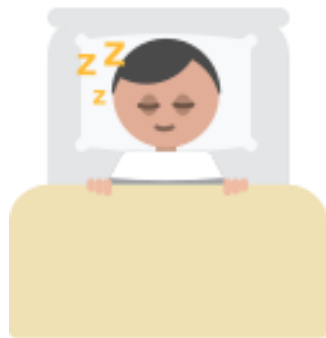


Ref 4



Wrist actigraphy is based on the principle that physical movements are increased during wakefulness and reduced during sleep

Less movement
0-7 PLMs an hour



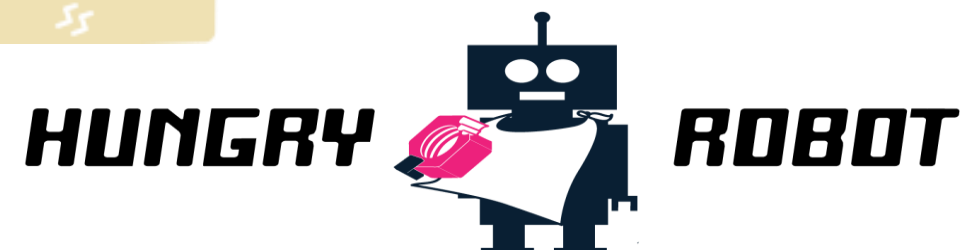
Average
13 PLMs an hour



More movement
16+ PLMs per hour



Ref 5, 6



Meten van slaap – wat is er op de markt?

software



measure sleep

Apps en games

Apparaat

Over deze resultaten

A grid of six app cards from the Google Play store search results. Each card features an app icon, a title, and a brief description. The apps shown are Sleep Cycle, Sleep Monitor: Slaap Volger, Sleep as Android: Slaapcyclus, SleepScore™, Sleep Theory - Sleep Tracker, and Sleepzy: Slaapcyclus-tracker.

Slaap Monitor: Slaap Volger

SM Health Team

Eenmalige advertenties In-app aankopen

3,8 ★ 50,1k reviews 5 min+ Downloads PEGI 3

Installeren Aan verlanglijstje toevoegen

Deze app is beschikbaar voor al je apparaten



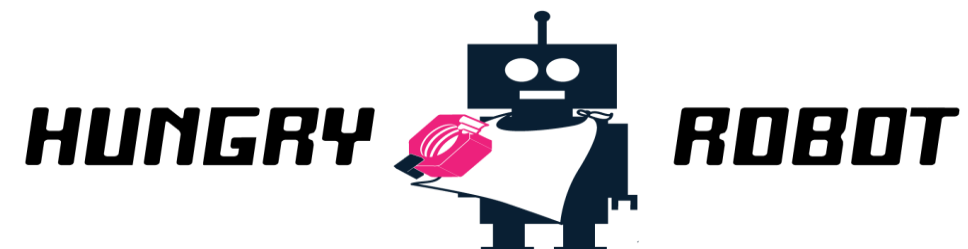
Contactgegevens van ontwikkelaar

Vergelijkbare apps

- Sleep Time - Cycle Alarm Timer
Olga Filimonov
4,4 ★
- Sleep Cycle: Sleep Tracker
Sleep Cycle AB
4,2 ★
- Sleepy - Sleep Cycles
Mobile Code México

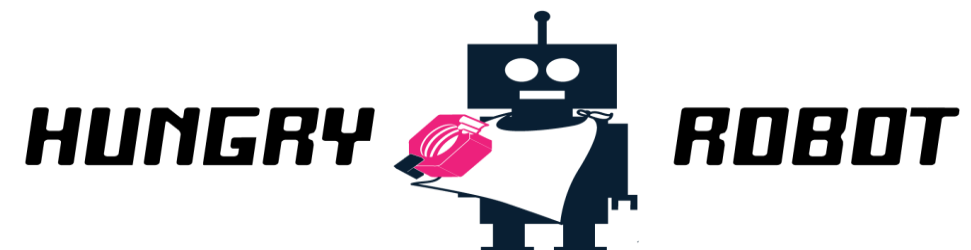
Over deze app

Hoe heb je geslapen afgelopen nacht?



Meten van slaap – wat is er op de markt?

Smart watch gebaseerd



Meten van slaap – wat is er op de markt?

Dedicated tracker

Gezondheid > Licht- & Elektrotherapieën > Slaaphulpen

Terraillon Dot - Smart slaapmonitor

Merk: Terraillon | ★★★★★ Schrijf een review | Delen



36,99

Op voorraad

Nu besteld, maandag in huis

[No Title]

Verkoop door [NXT Retail Sales B.V.](#) 9,1

In winkelwagen



- ✓ Bestellen en betalen via bol.com
- ✓ **Inclusief** verzendkosten, verstuurd door NXT Retail Sales B.V.
- ✓ 30 dagen bedenktijd en **gratis** retourneren
- ✓ Wettelijke garantie via NXT Retail Sales B.V.

Anderen bekeken ook



Boostiv[®] Sleep & Focus -
Bevordering melatonin...

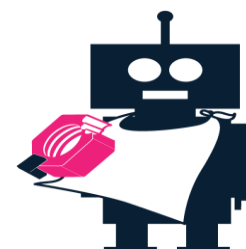


Take Care Sleep Tracker
RestOn - Bluetooth...



Boostiv[®] Sleep & Focus -
Bevordering melatonin...

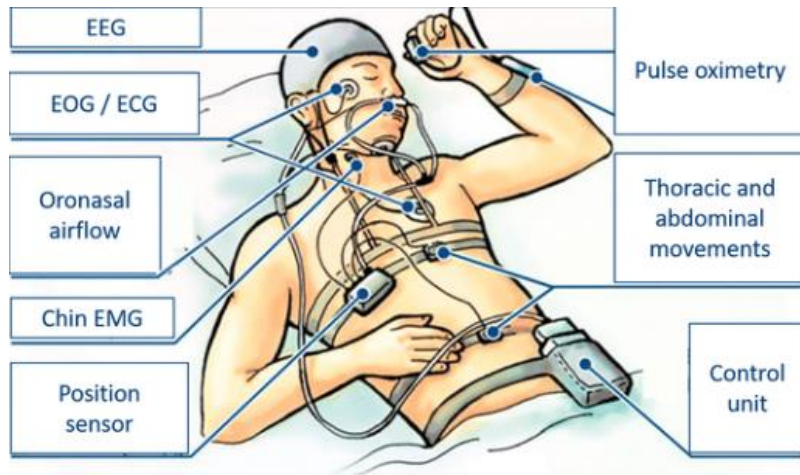
HUNGRY



ROBOT

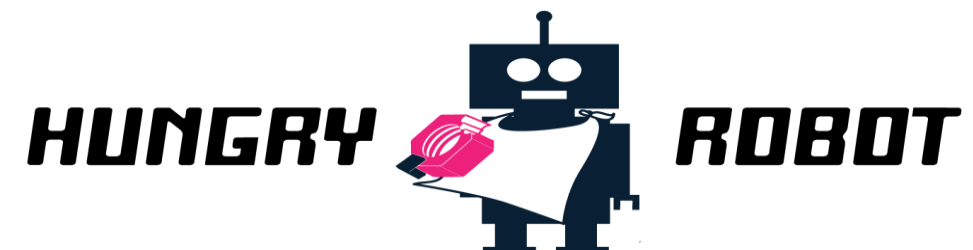
Meten van slaap

Validiteit



It has been found to have a reasonable degree of agreement with PSG, with reported agreement rates of 78.8–99.7% for sleep and 48.5–79.8% for wake

However, its validity in special populations such as the elderly, in subjects with poor sleep quality, or in those with major health problems is not well established

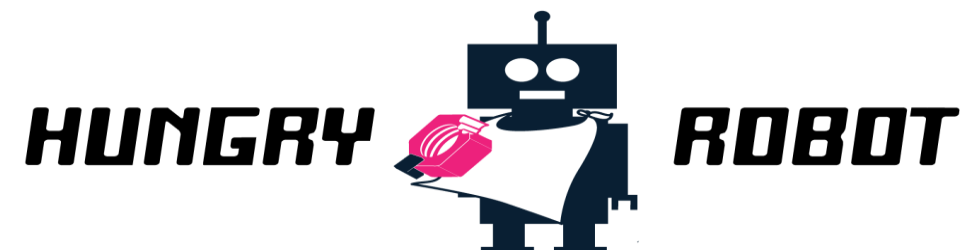


Biologisch ritme en techniek

Tracken van slaap - conclusie

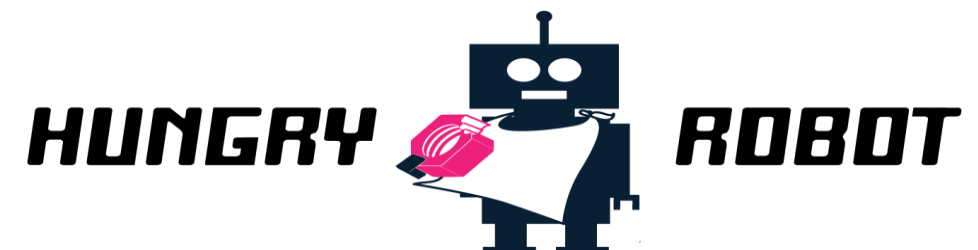
Slaap kan gemeten worden, maar algoritmes geven geen zekerheid over hun resultaat.

Vooraf bij de voor ons interessante subgroepen is er twijfel over de validiteit, maar het geeft wel een indicatie.



Biologisch ritme en techniek

Tracken van voeding

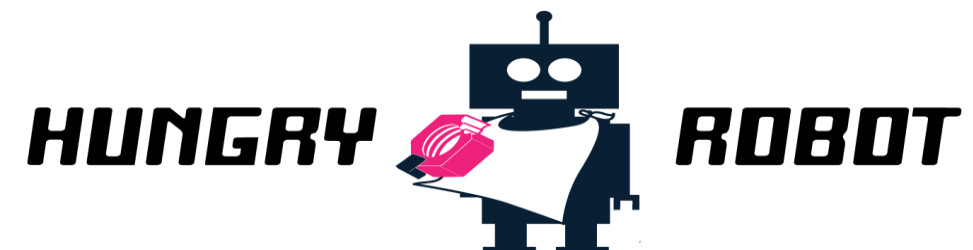


Kijkje in ons huidig onderzoek

Wanneer eten we?

Hoe eten we?

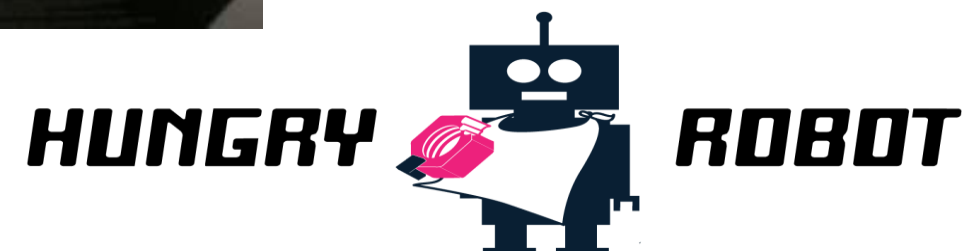
Wat eten we?



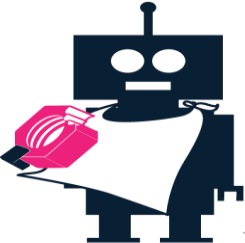
Wanneer eten we?



Femke de Gooijer



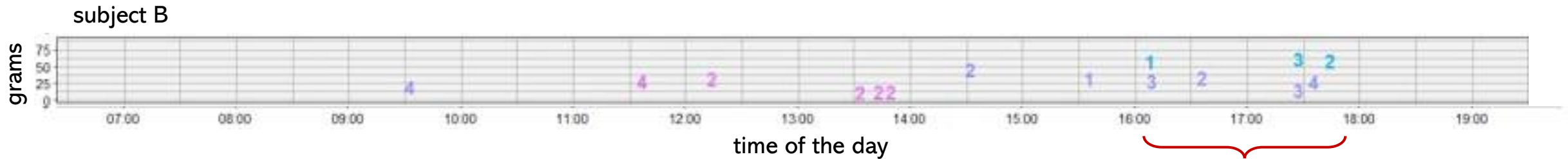
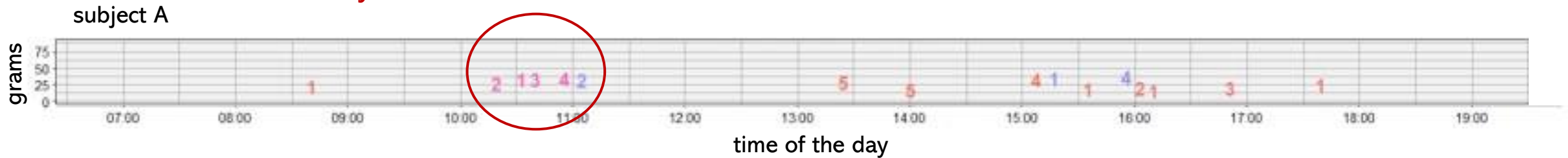


HUNGRY  **ROBOT**

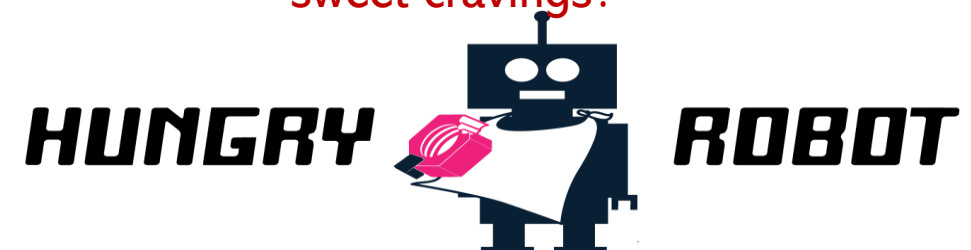
When do people eat?

Inbetween meal consumption

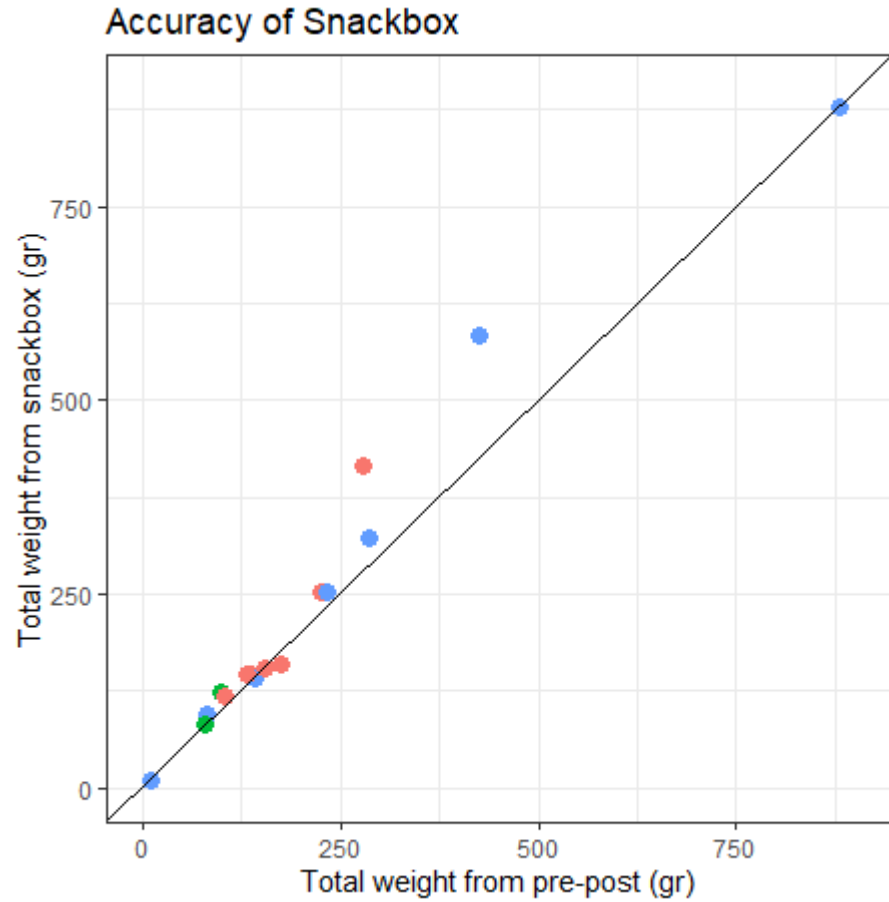
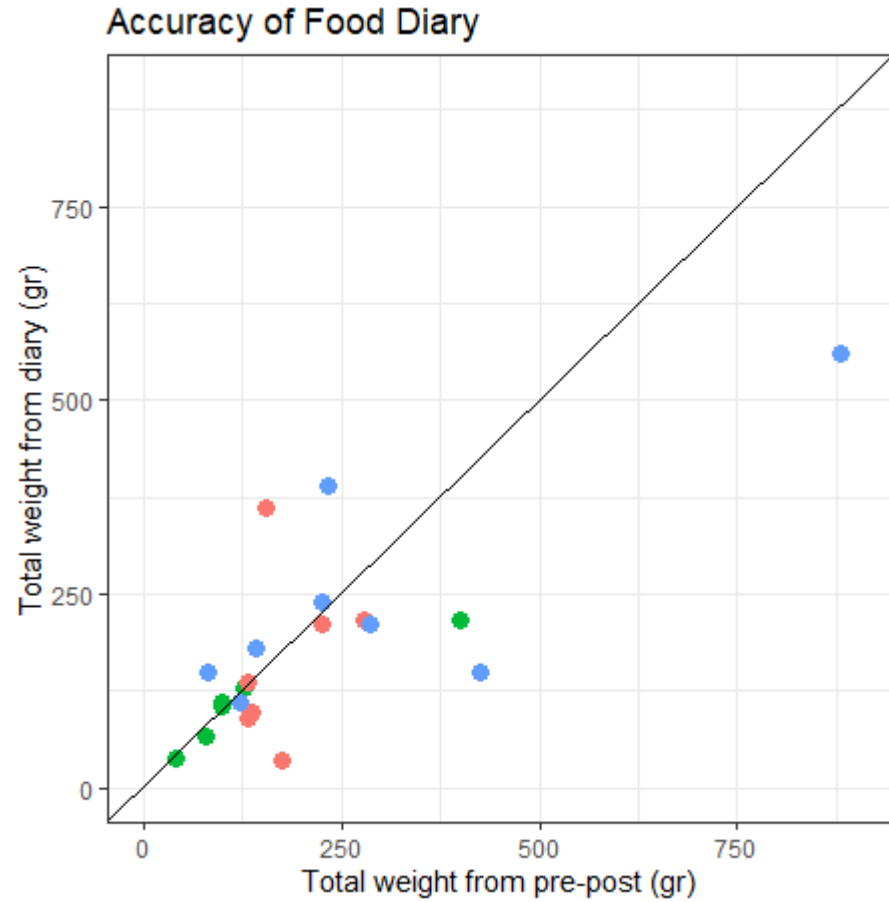
daily coffee break?

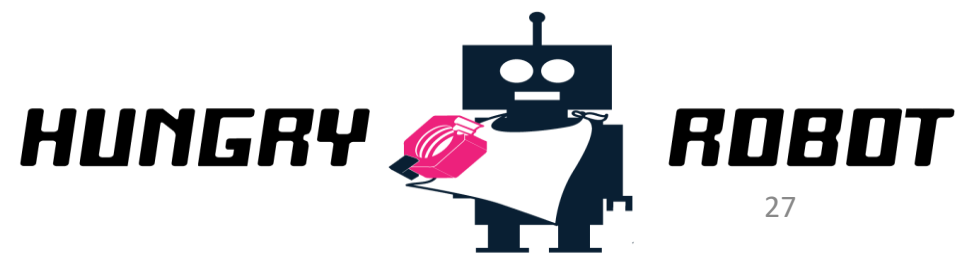
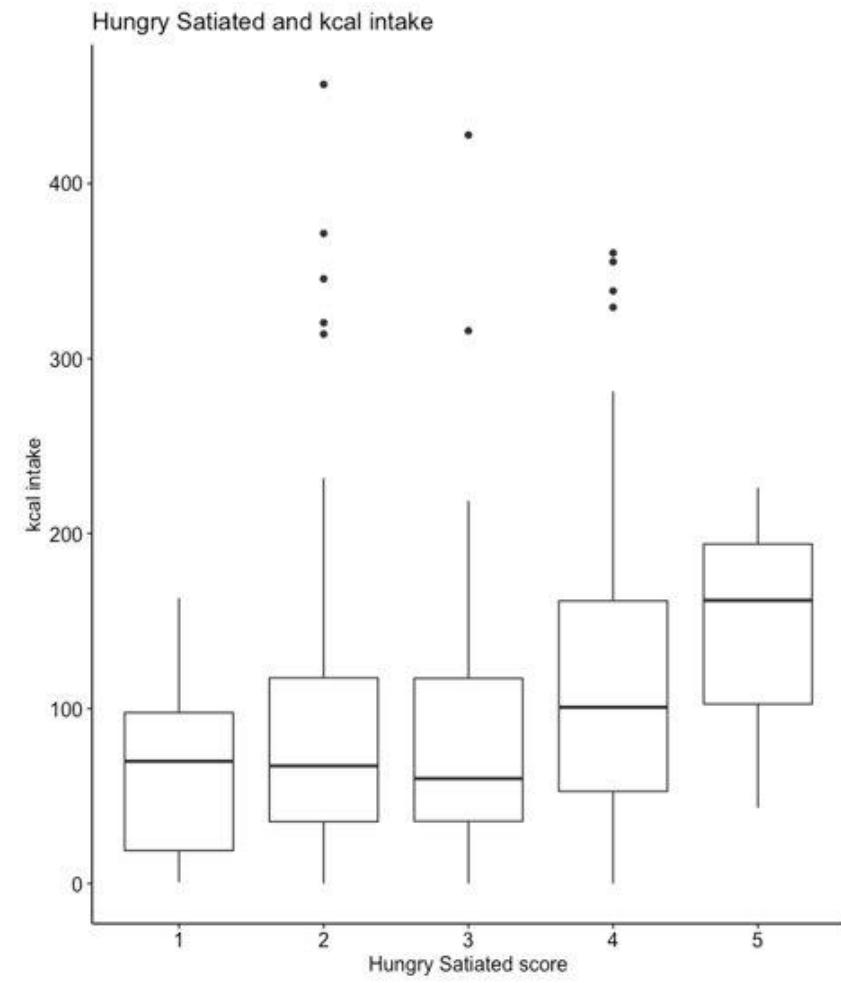
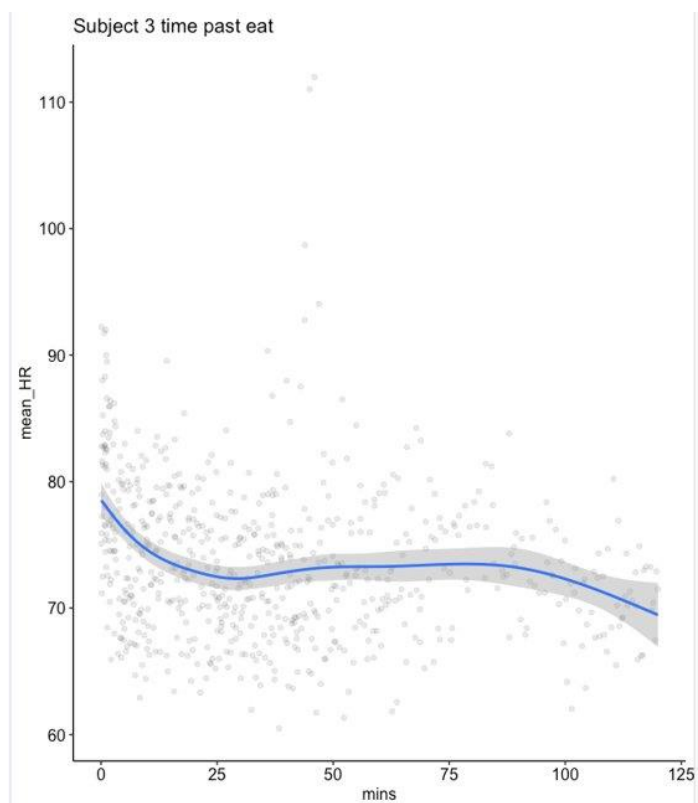
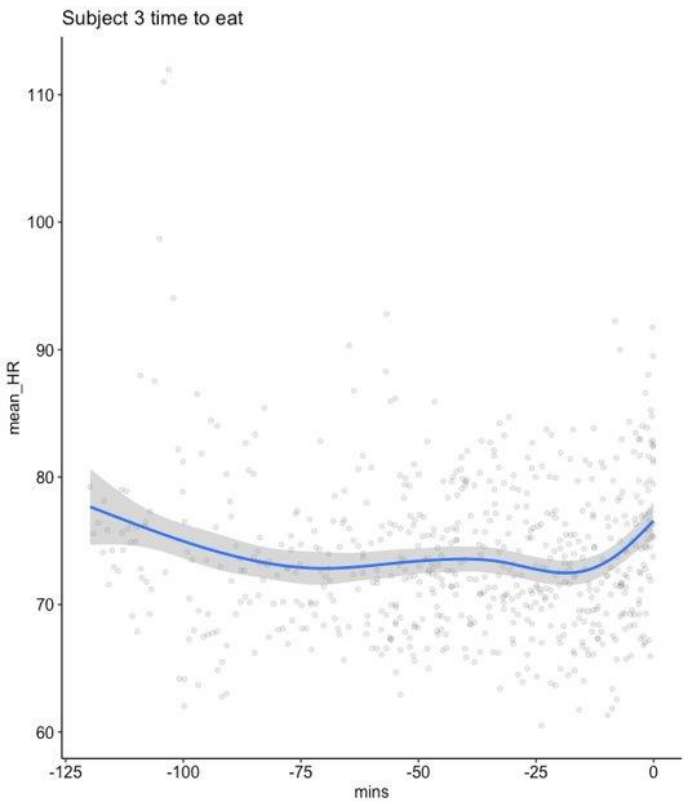


sweet cravings?

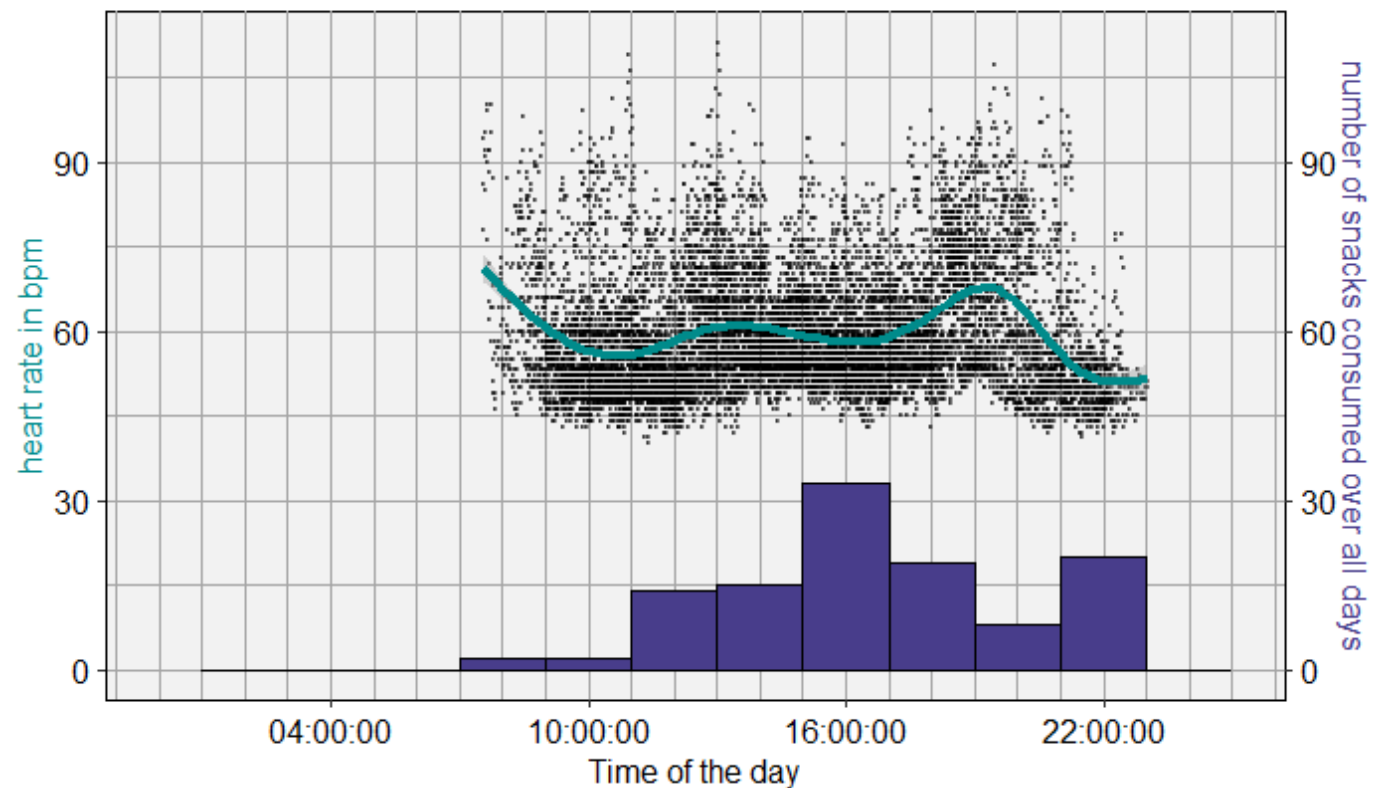


When do people eat?

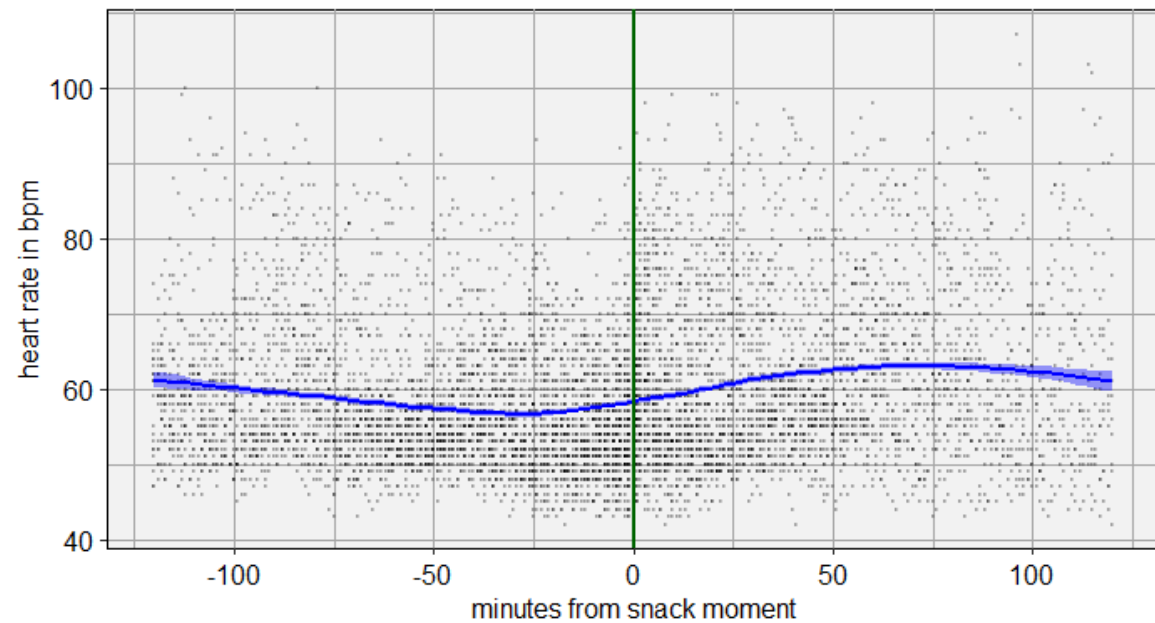




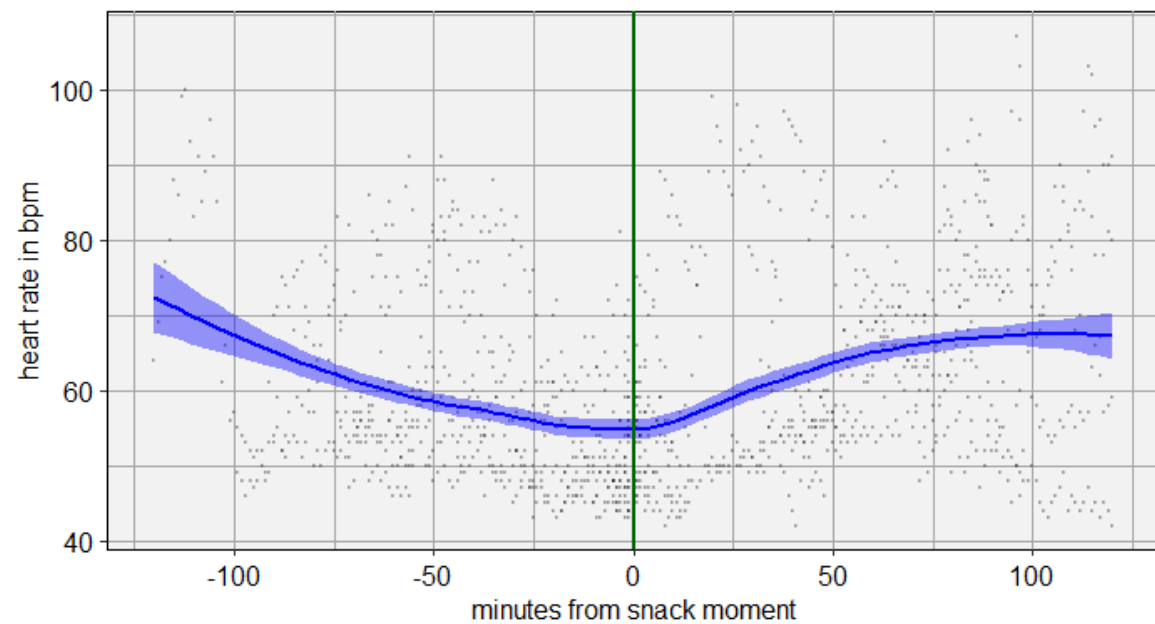
Average HR and Snack Consumption over Time



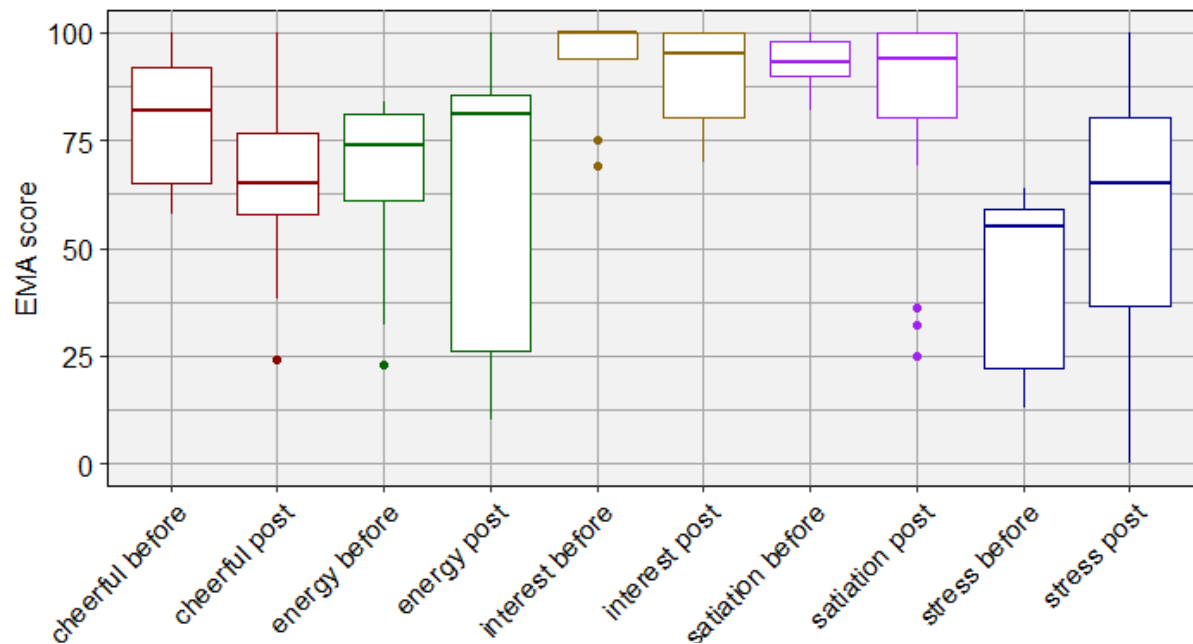
the heart rate per snack moment
including snack moments of the entire day



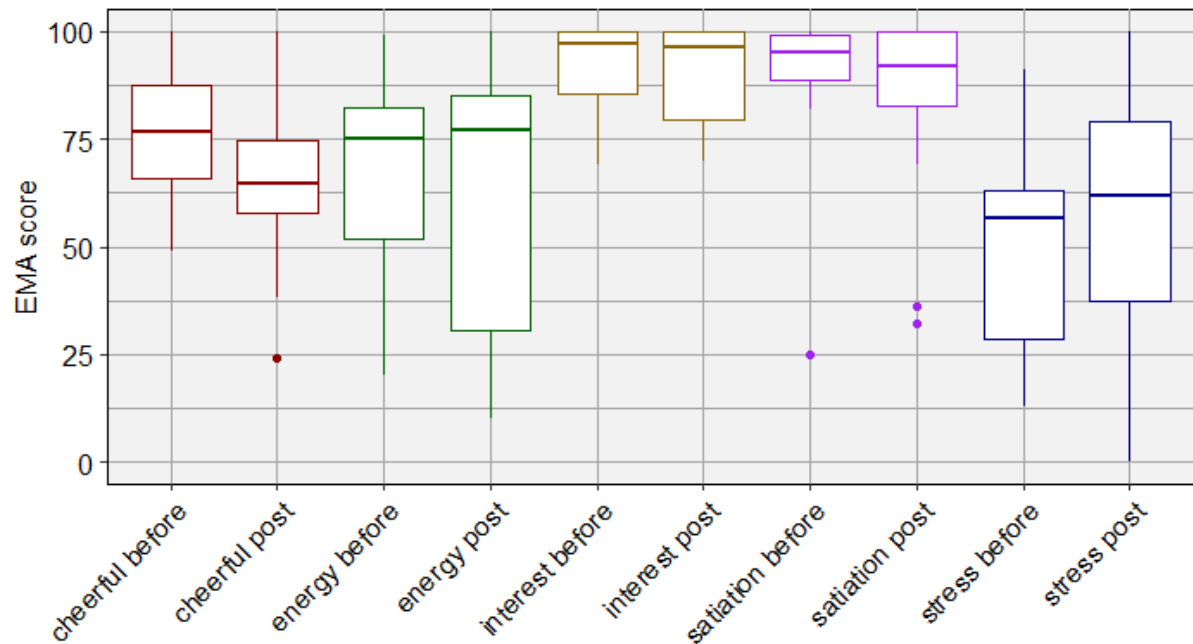
the heart rate per snack moment
including snack moments after 19:00



The EMA Scores before and after a Snack Moment

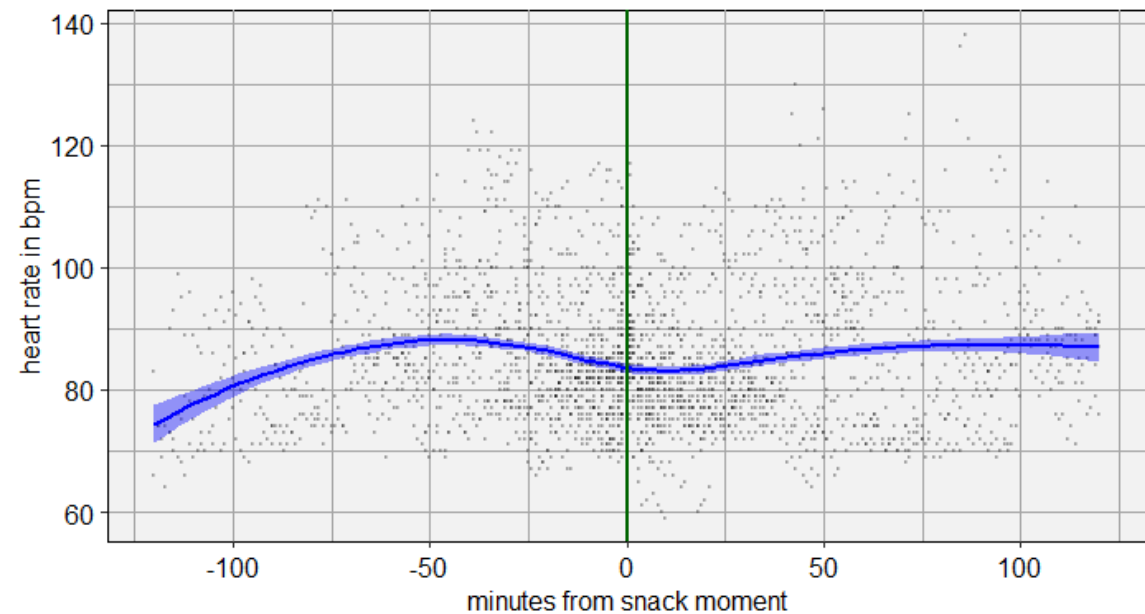


The EMA Scores before and after a Chaudfontaine drink



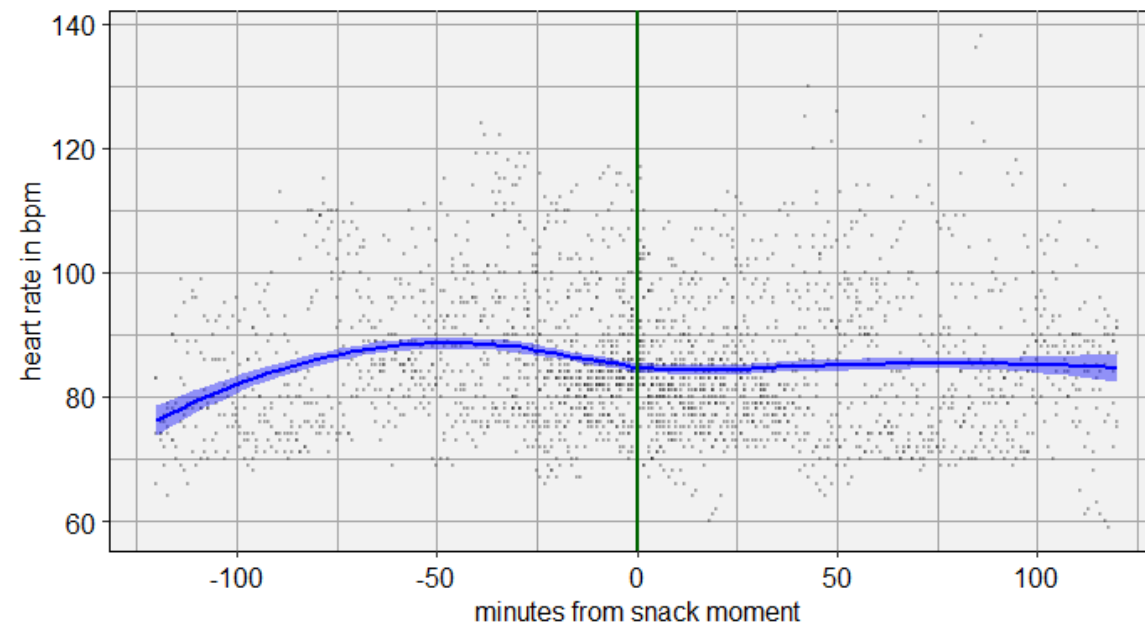
the heart rate per snack moment

including snack moments of the entire day



the heart rate per snack moment

including only Chaudfontaine consumption of the entire day



Wanneer eten we?

Eten
Drinken
Radar!

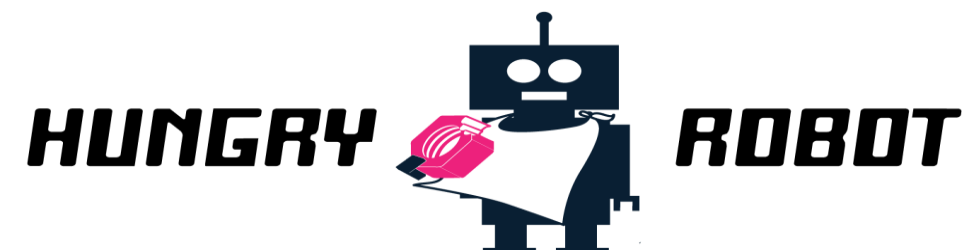
KU LEUVEN



Chunzhuo Wang

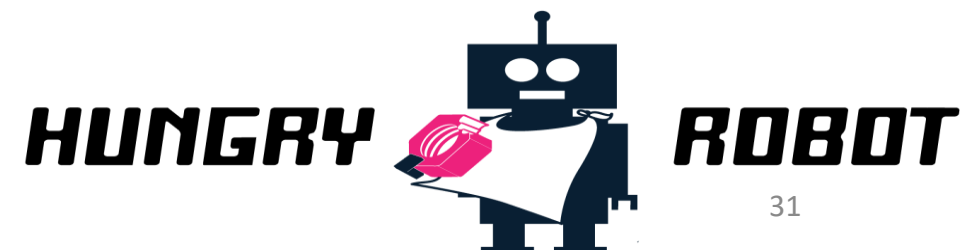
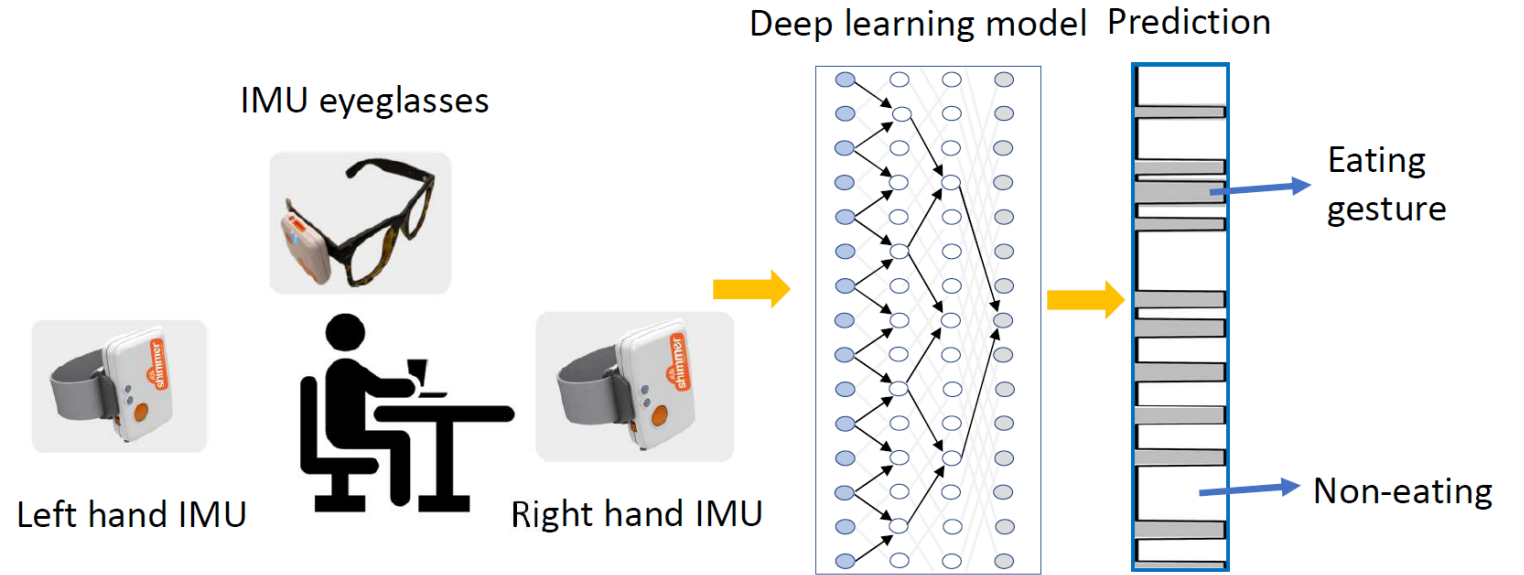


Prof. Bart Vanrumste Prof. Hans Hallez

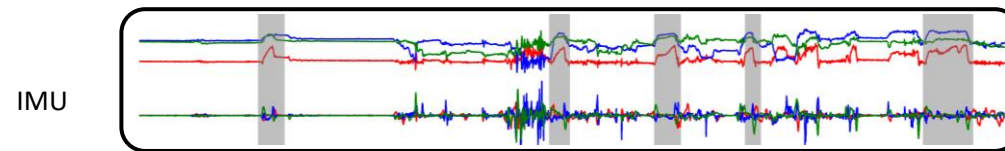


Eten

- Sensor: Shimmer3 IMU wristband
- Collected Dataset:
 - 24 meal sessions from 24 subjects
 - 1461 bites in total
- Model:
 - 1D-TCN
 - Conv1d
 - Dilated layer
 - Residual connection
- Results: F1-score 94.4%



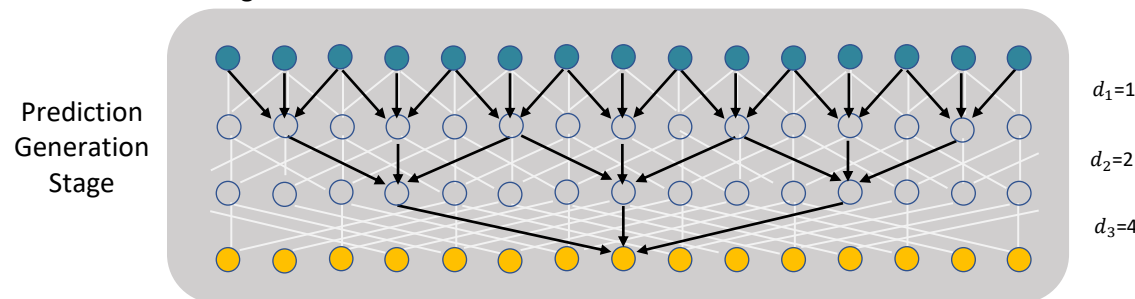
Model: Multi-Stage Temporal Convolutional Network (MS-TCN)



IMU

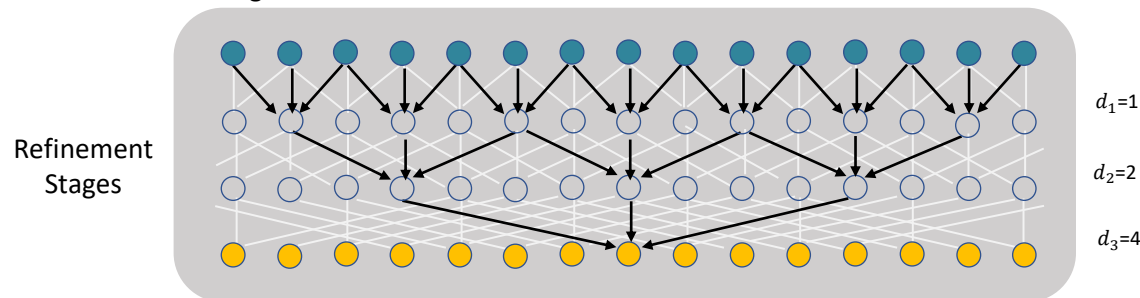
IMU Signal

Stage 1 Non-causal SS-TCN



Single-stage TCN
(SS-TCN)

Stage n Non-causal SS-TCN



Single-stage TCN
(SS-TCN)

Prediction



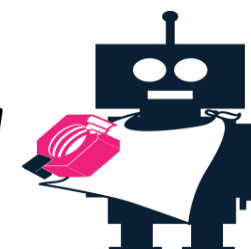
— prediction

■ ground truth drinking gesture

TCN Model

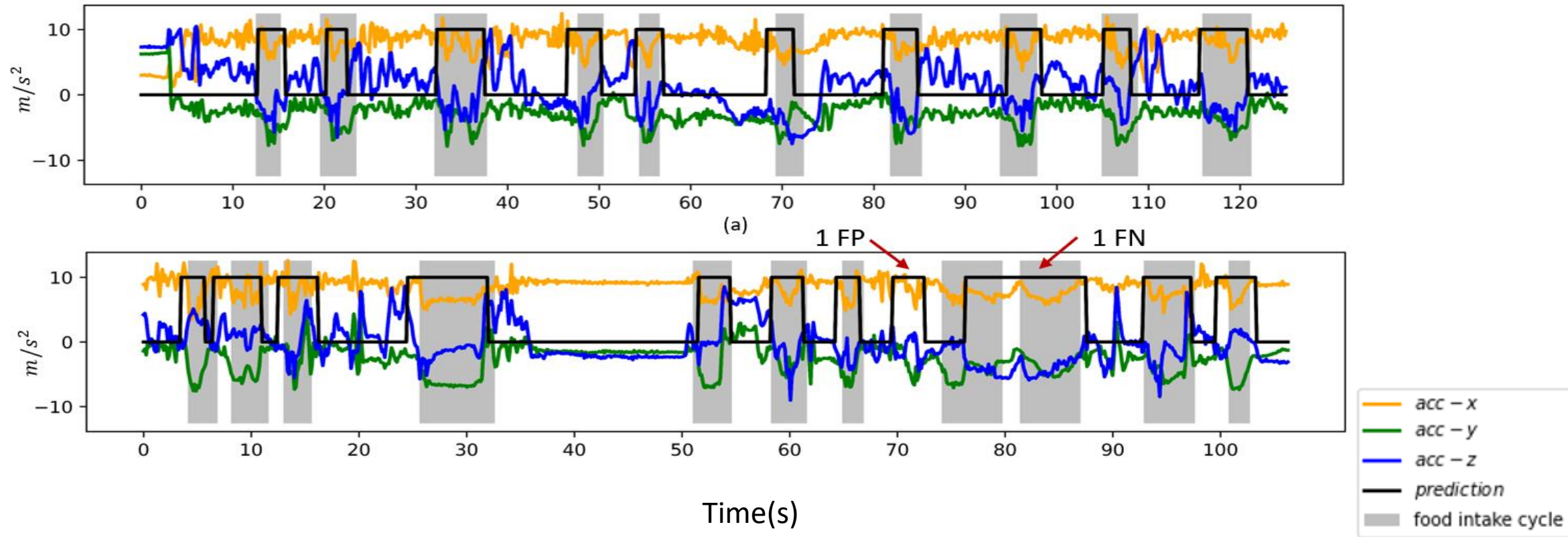
Prediction

HUNGRY



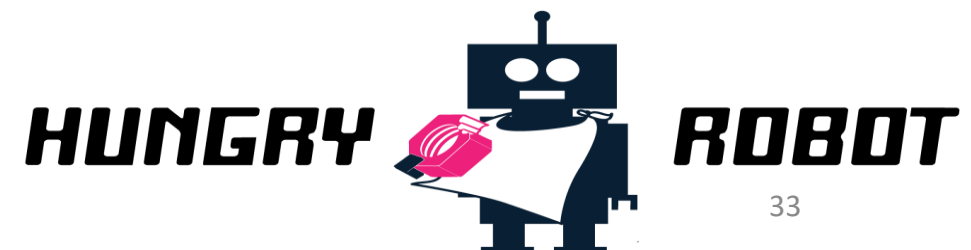
ROBOT

Result : Leave-one-subject-out (LOSO) Method



Results:

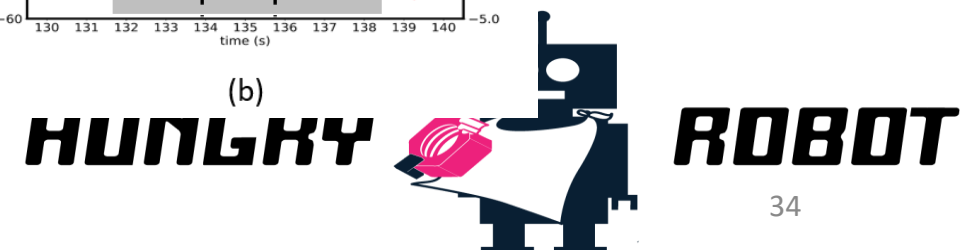
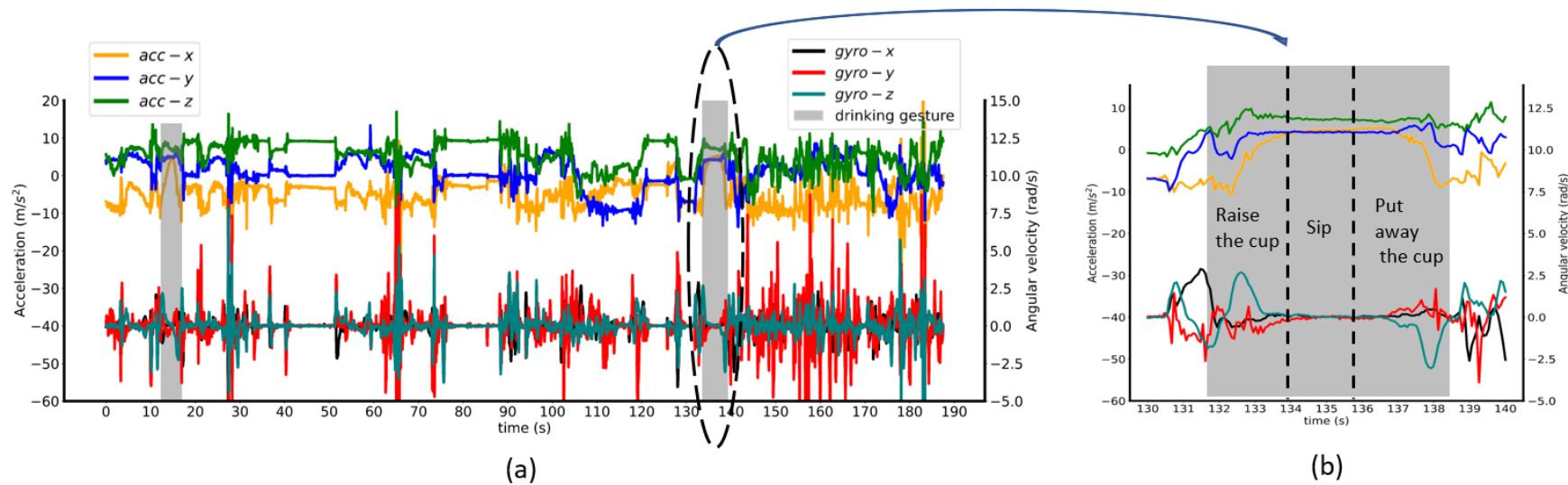
F1-score : ~95.0 %



Drinking

Challenges

- Distribute in all over the day
- Sparse
- Non-specific hand



Data collection

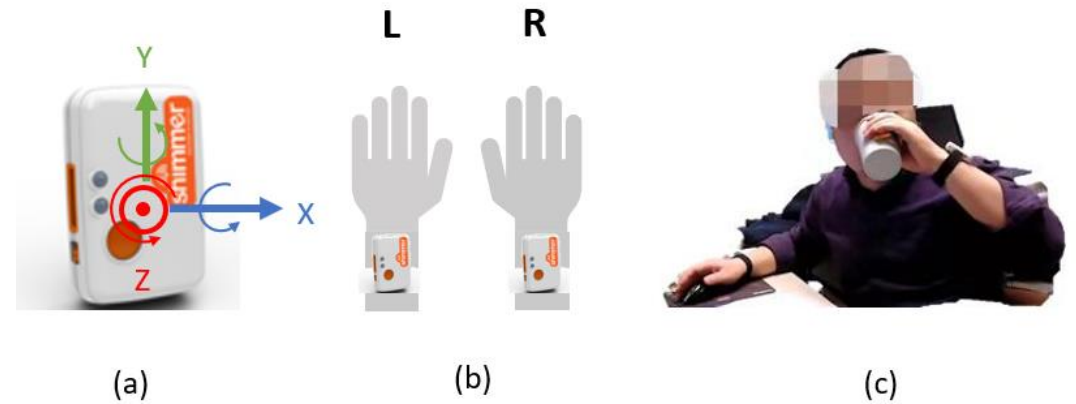
- Dataset description:

- Dataset I (short term)- (DX-I)

- 13 participants,
- 486 drinking events: 101(L):266(R):43(L&R)
- 10.3 hour
 - Duration ratio left hand null : drinking = 32.7 : 1
 - Duration ratio right hand null : drinking = 21.6 : 1

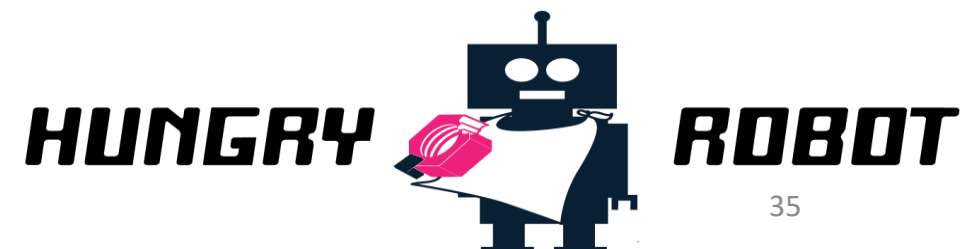
- Dataset II (long term)- (DX-II)

- 7 participants (from 10am to 4 or 5 pm)
- 314 drinking events: 142 (L) :152 (R) : 10(L&R)
- 45.2 hour
 - Duration ratio left hand null : drinking = 218.7 : 1
 - Duration ratio right hand null : drinking = 175.1 : 1



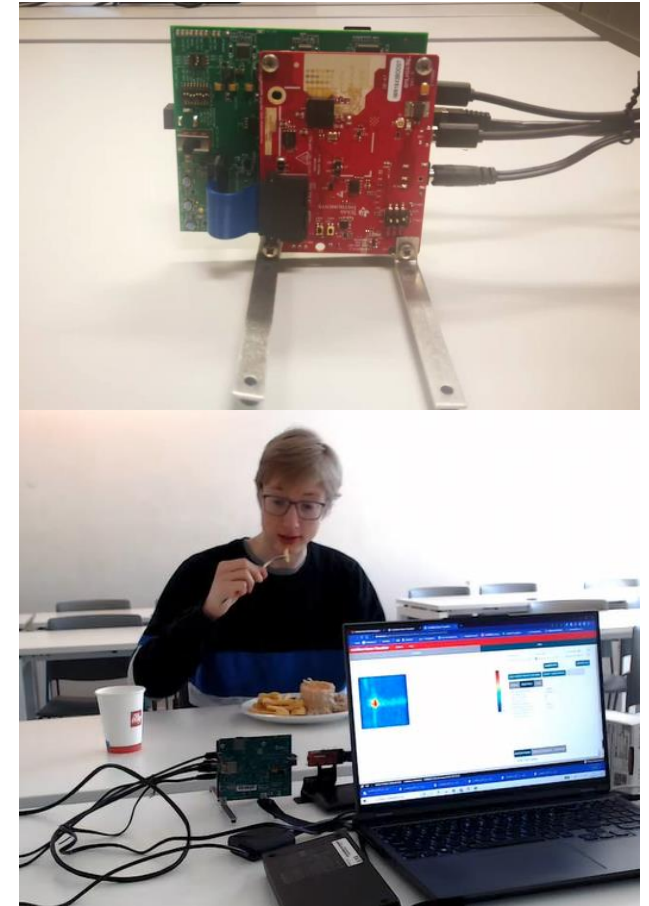
Results:

F1-score : 90.0 %

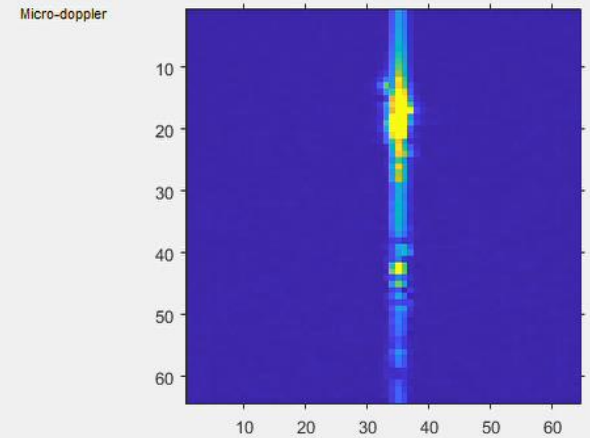
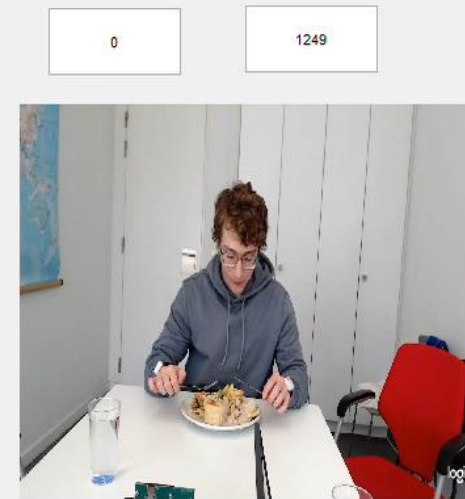
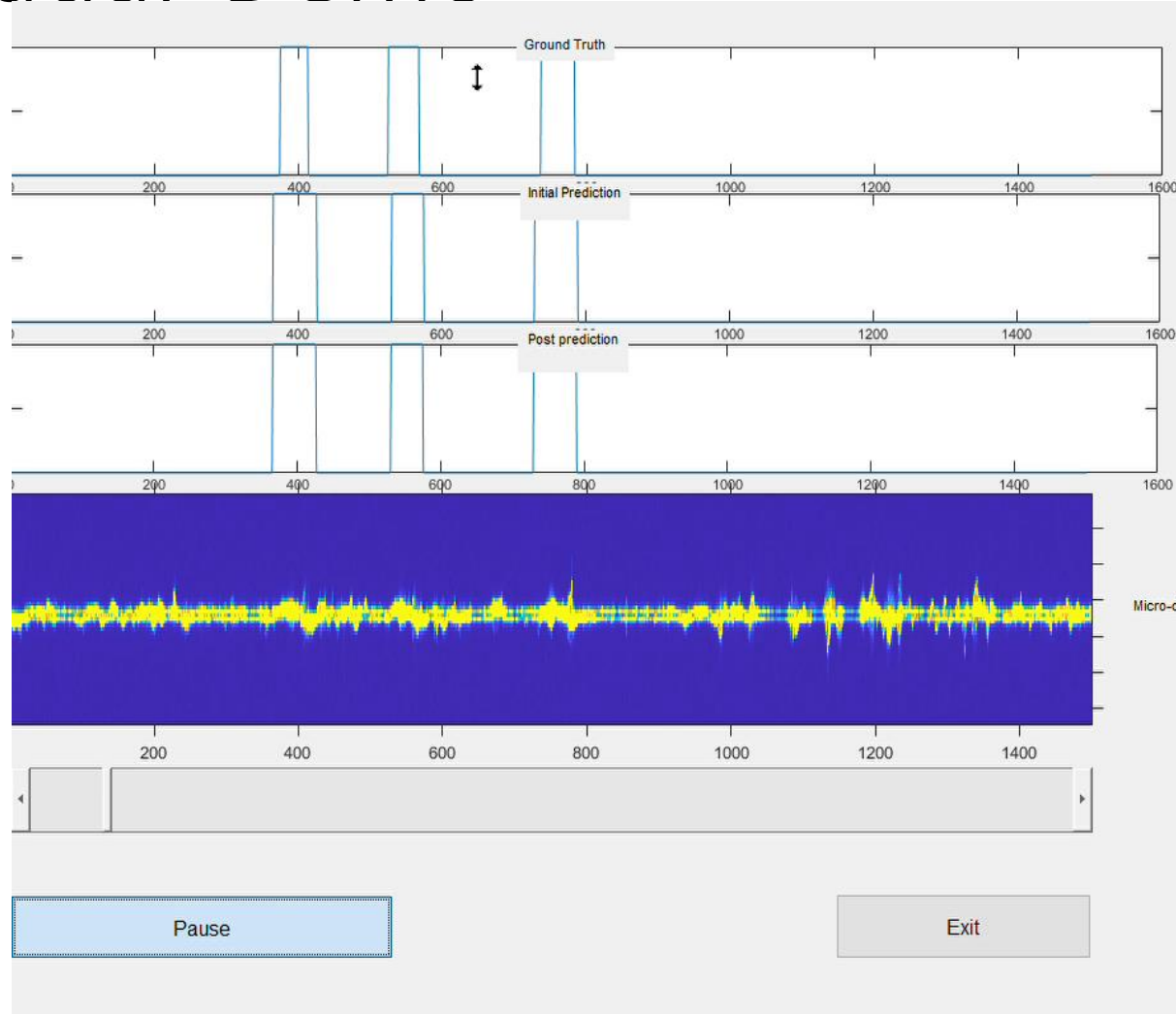


3. Radar-based Eating Gesture Detection

- Sensor: TI FMCW radar
- Collected Dataset:
 - 22 meal sessions from 22 subjects
 - 1138 bites in total
- Input data:
 - Range-Doppler Cube
 - 25 Frames per Second
 - 64 x 64 per frame
- Model:
 - 3D-TCN
 - Conv3d
 - Dilated layer
 - Residual connection
- Results: F1-score 93.3%



Radar Demo



Hoe eten we?

Automatische registratie van:

Houding

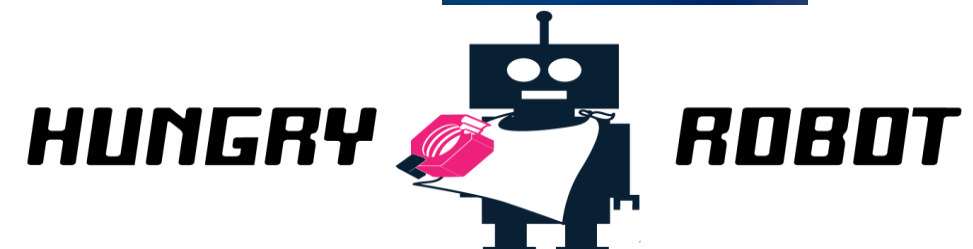
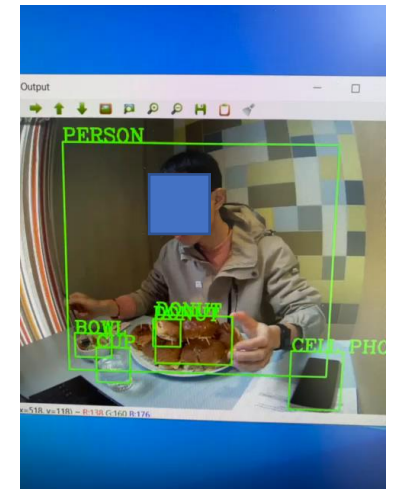
Happen

Slikbewegingen

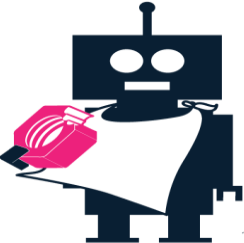
Kauwbewegingen



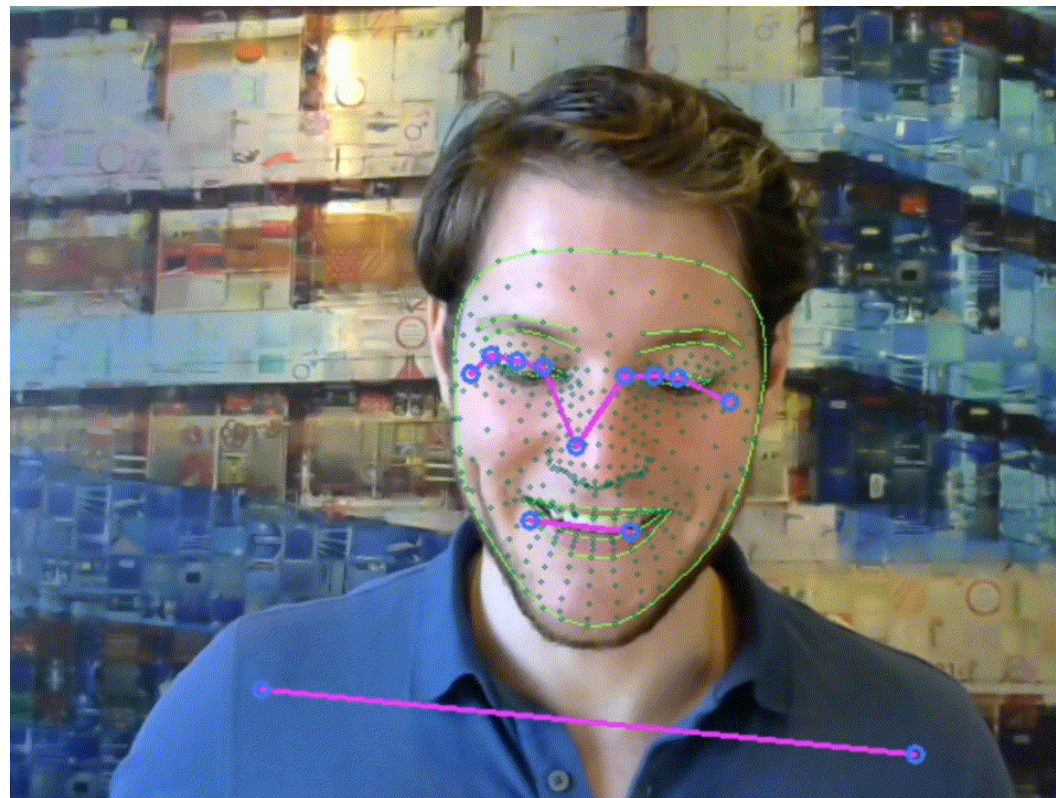
Michele Tufano

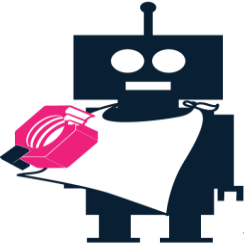


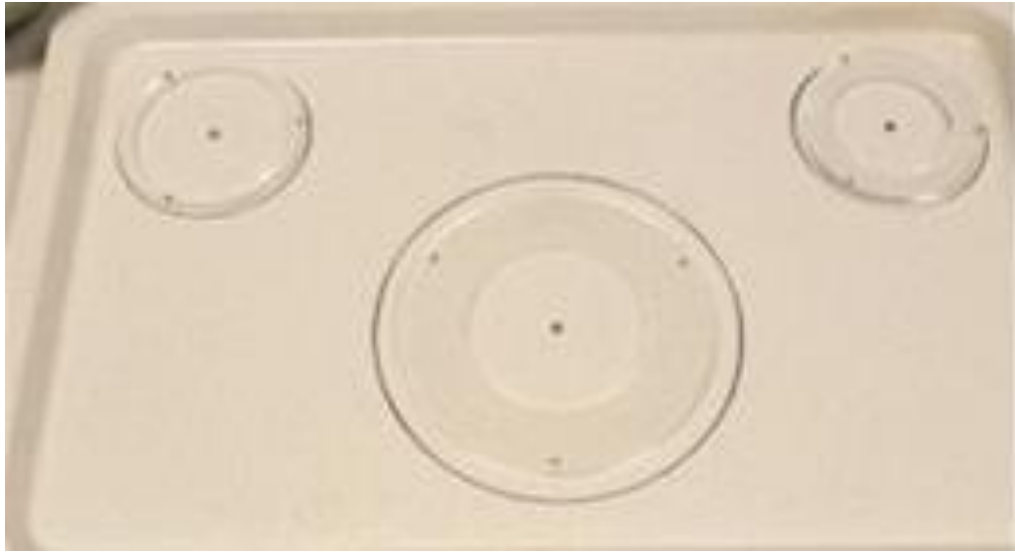


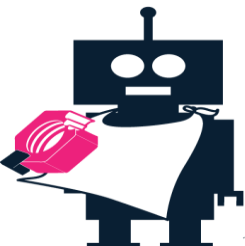
HUNGRY  **ROBOT**

How do people eat?



HUNGRY  **ROBOT**



HUNGRY  **ROBOT**





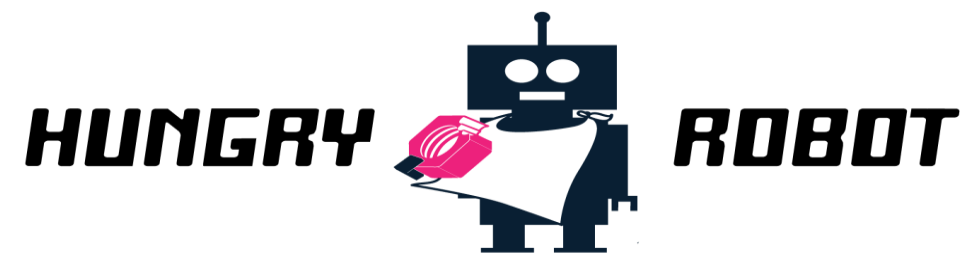
45 cm from the center of the tray
at a 30 cm height

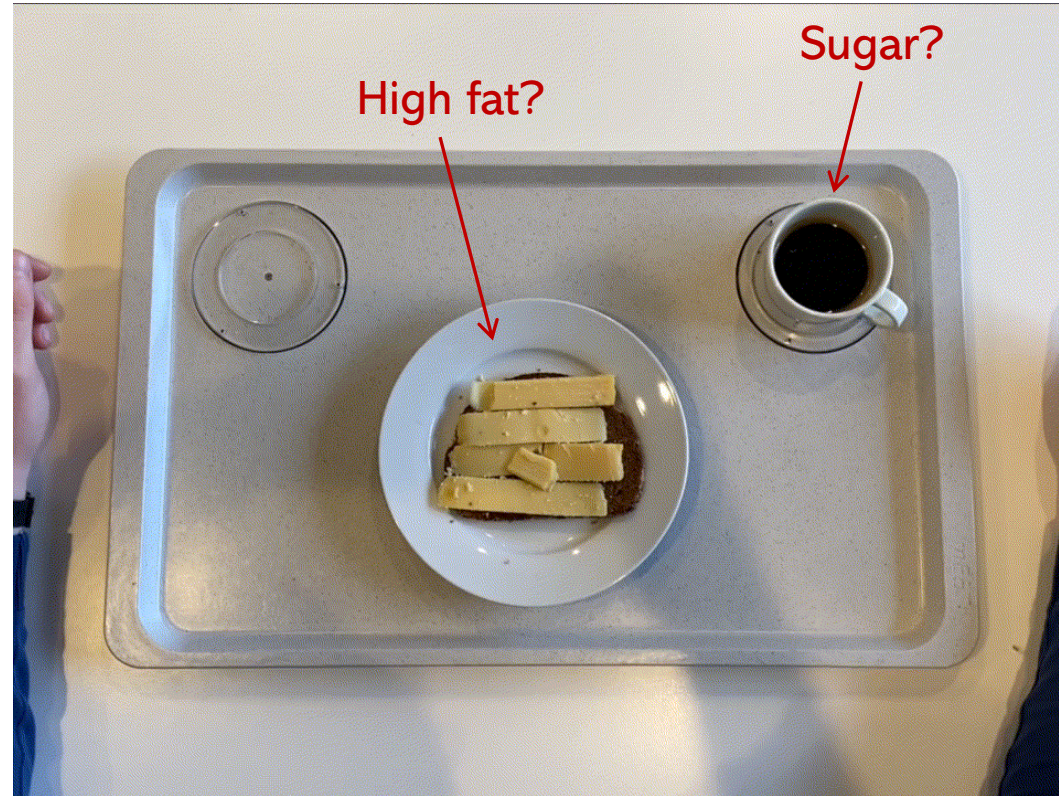
48.5

Bite Count: 0

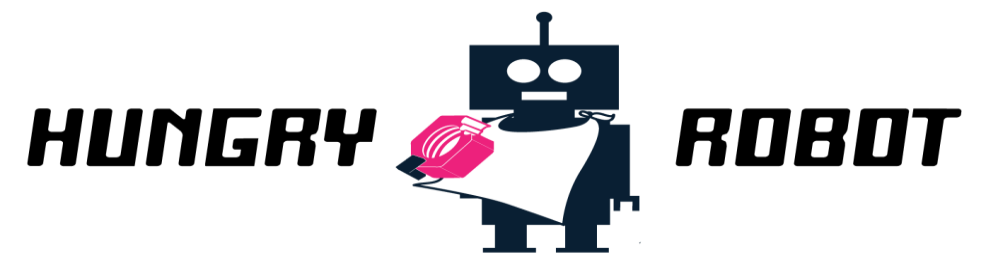
OBOT

Wat eten we?





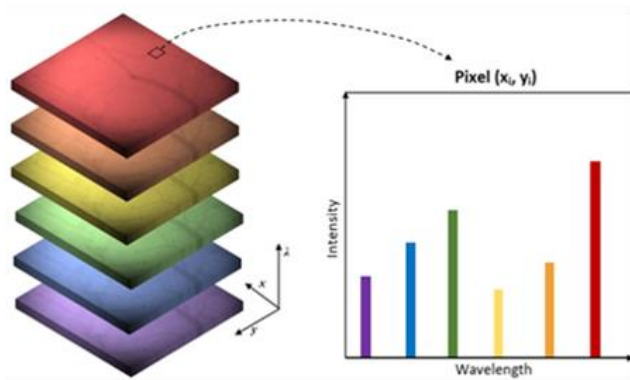
Esther Kok



Hyper Spectral Imaging

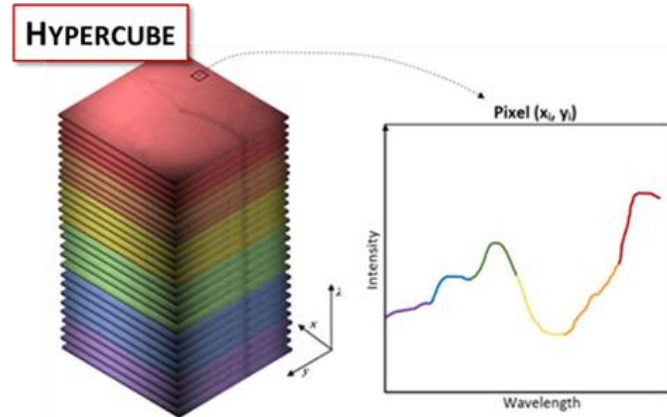
MULTISPECTRAL IMAGING

- N separated bands



HYPERSPECTRAL IMAGING

- Continuous spectrum



ENABLES SPECTRAL ANALYSIS

- Segmentation
- Spectral unmixing
- Evolution of spectra in time

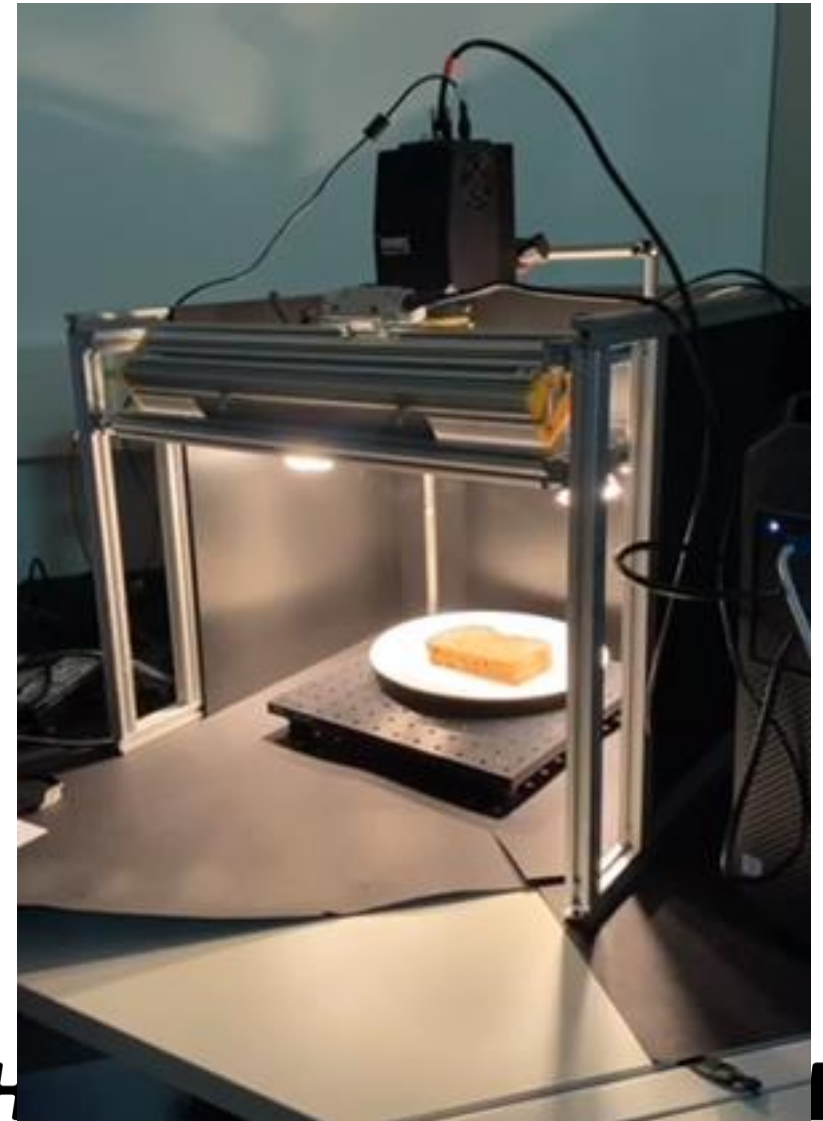
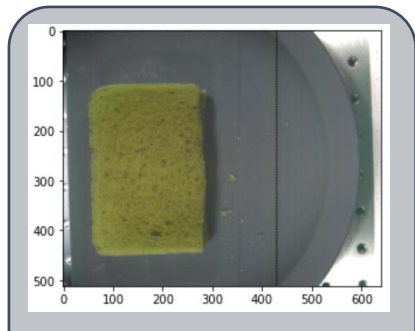
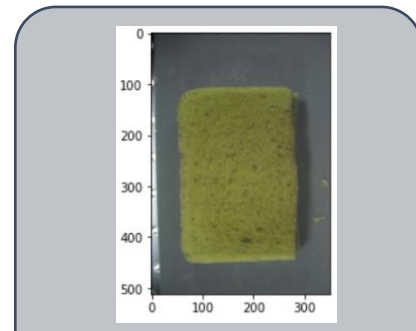


Image Processing



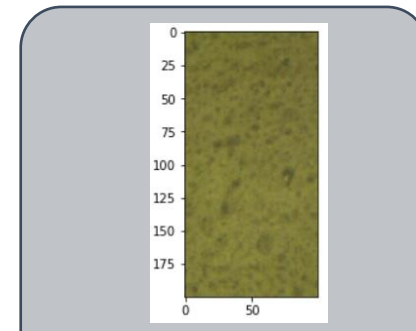
Original
HS Image

(512, 640, 108)



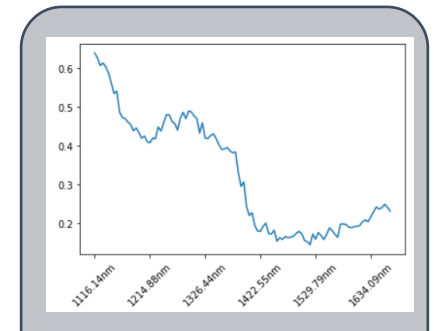
Resized

(512, 350, 108)



Chunk
Selected

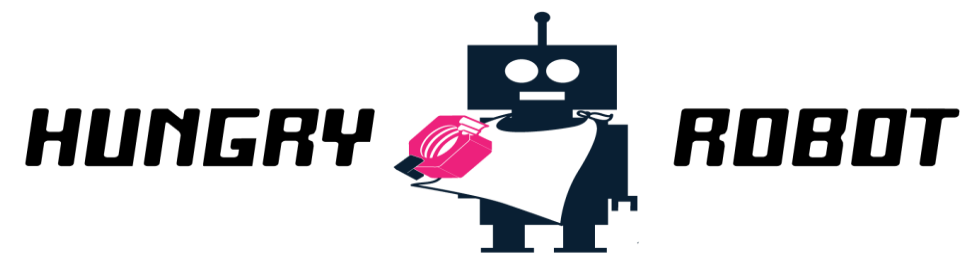
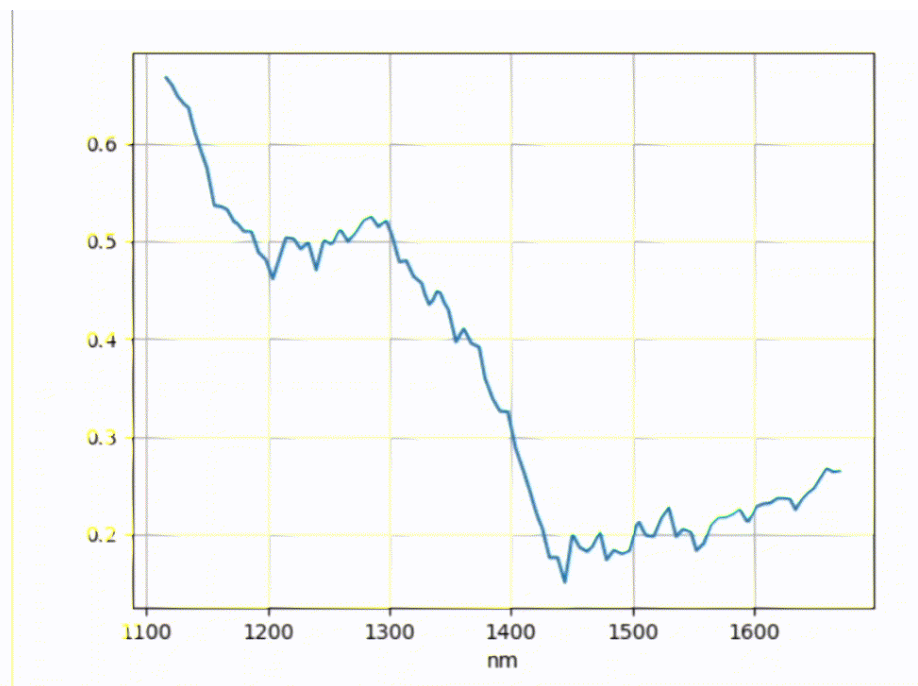
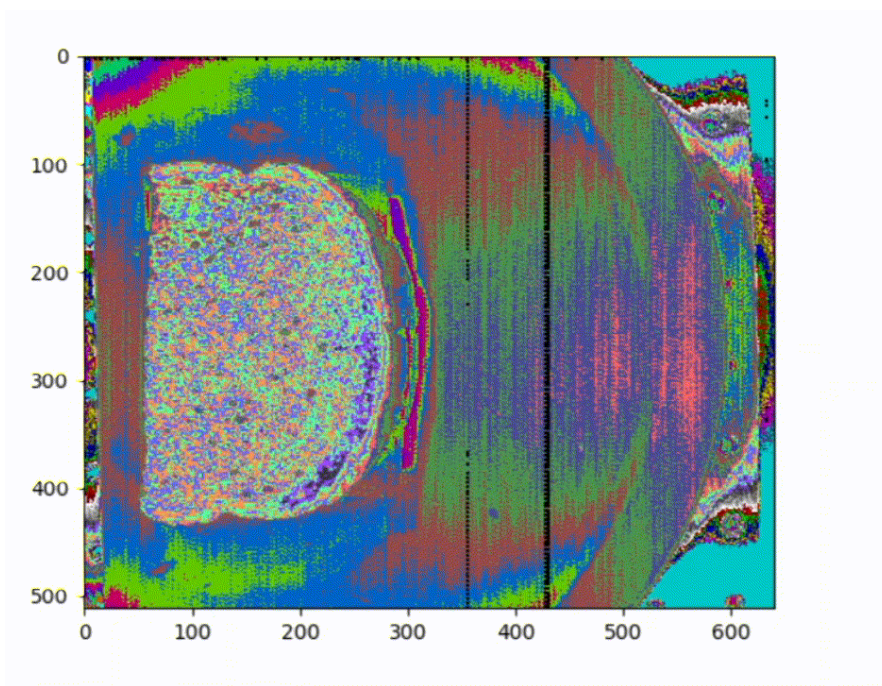
(200, 100, 108)



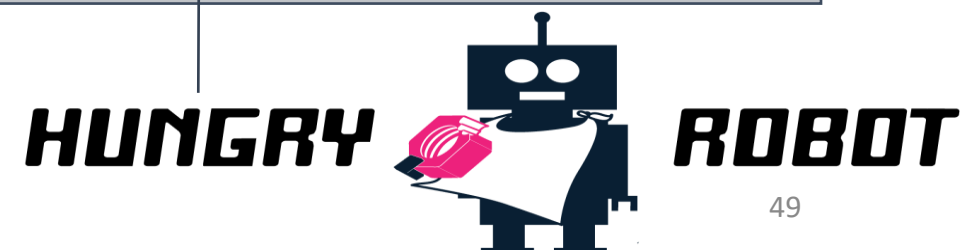
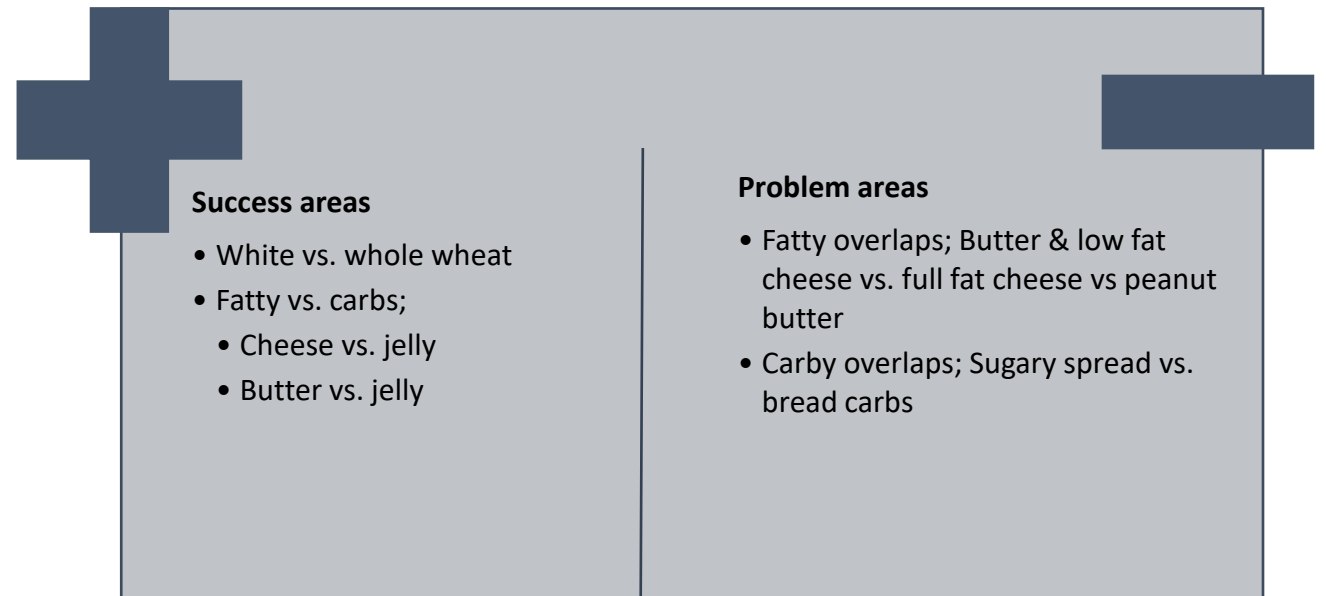
Spectra
Filtering

(20000, 108)

What do people eat?

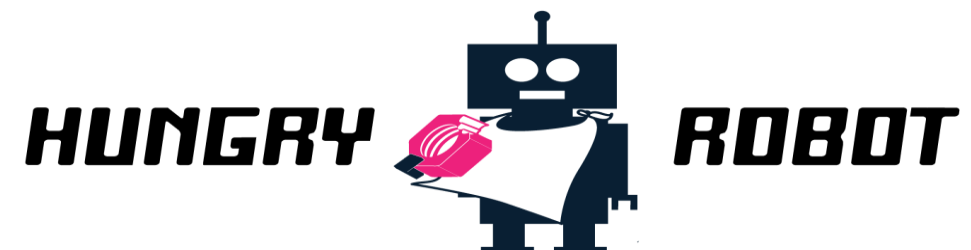


- **Model parameters;** 3 hidden layers, adam solver, relu activation, 1000 epochs
- **Evaluation metrics problem;**
 - multi label multi output classification, e.g. no confusion matrix or other straightforward metrics
- Custom **accuracy score** calculated;
 - 0.8146
- **Conclusion;**
 - Higher granularity needed
→ macronutrients



Als dit allemaal werkt, dan weten we:

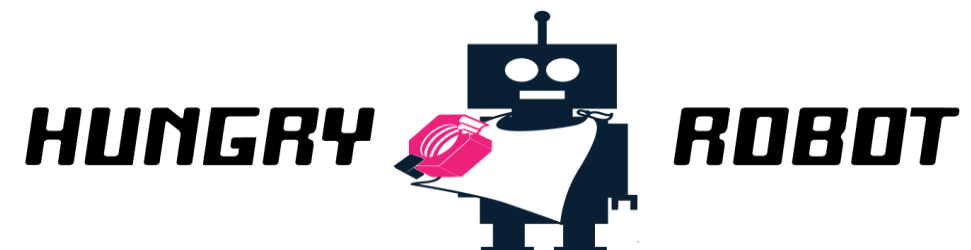
Wat je eet, wanneer je eet en hoe je eet, en dat geheel automatisch.



Biologisch ritme en techniek

Tracken van voeding - conclusie

Er komen mooie methoden aan, maar de grote vraag is of deze overeind blijven in de echte wereld. Voor de komende jaren blijven de 'ouderwetse' methoden de belangrijkste bron van informatie.

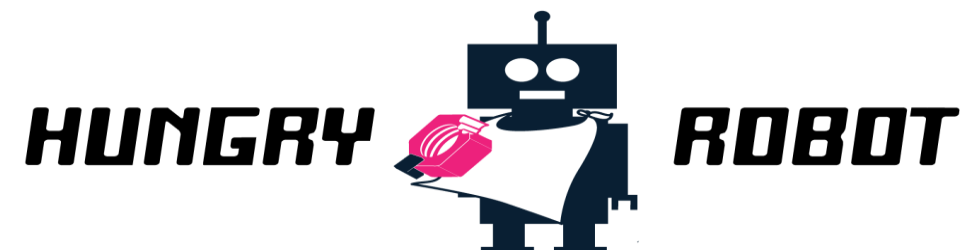


Biologisch ritme en techniek

Uiteindelijke conclusie

Qua hartslag, stress en slap is een (relatief goedkope) tracker wellicht een slimme investering.

Qua voeding zijn we nog niet zo ver.

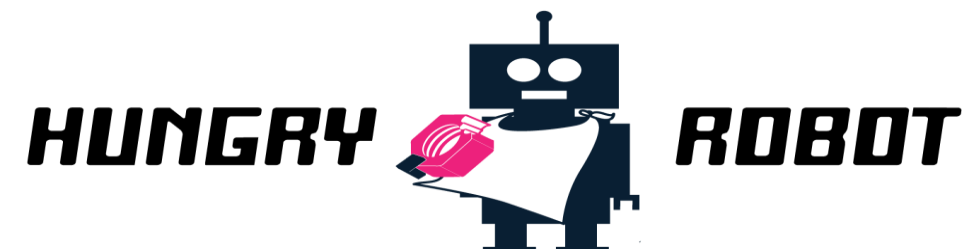




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