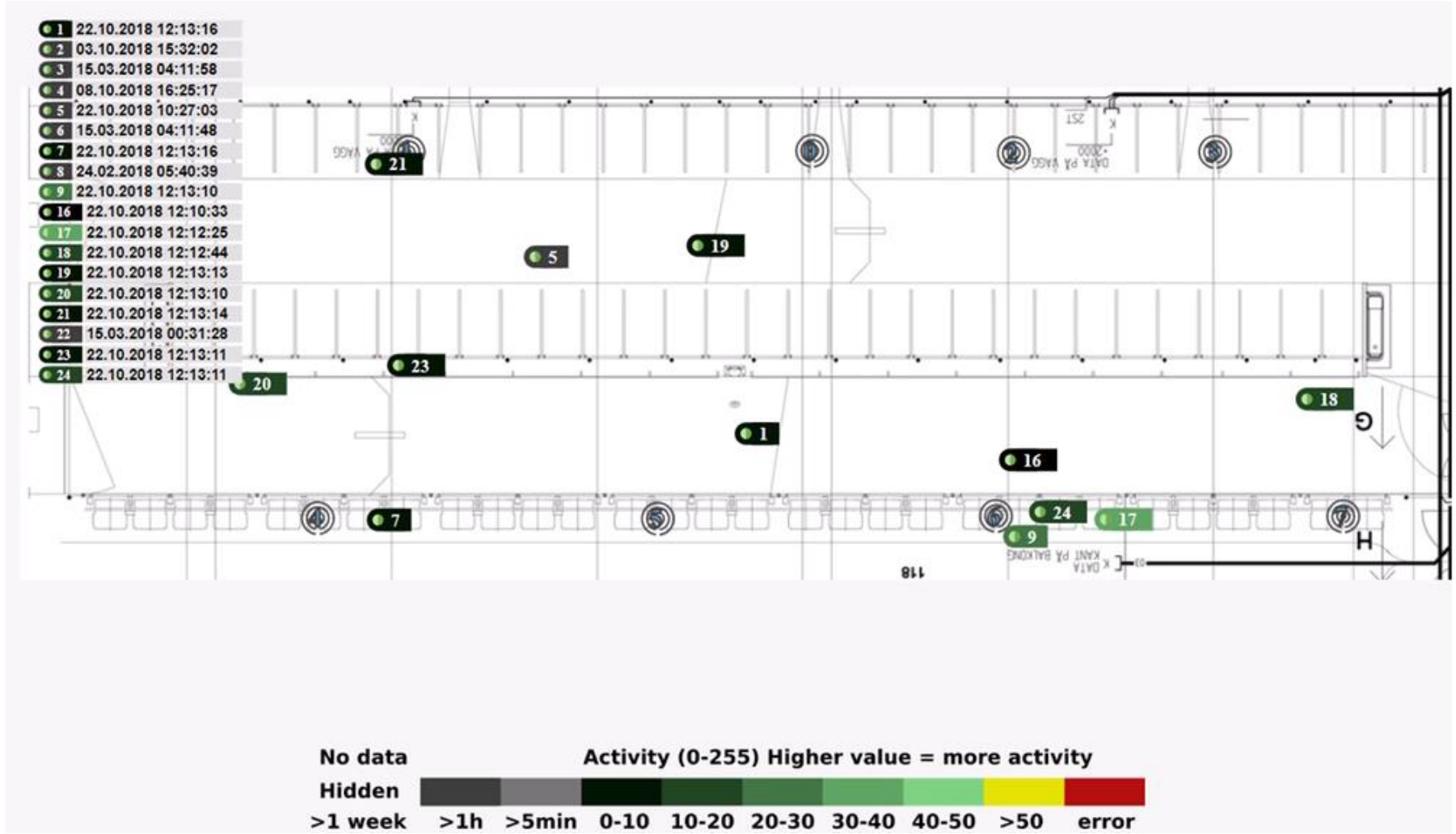
Time Budget Analysis

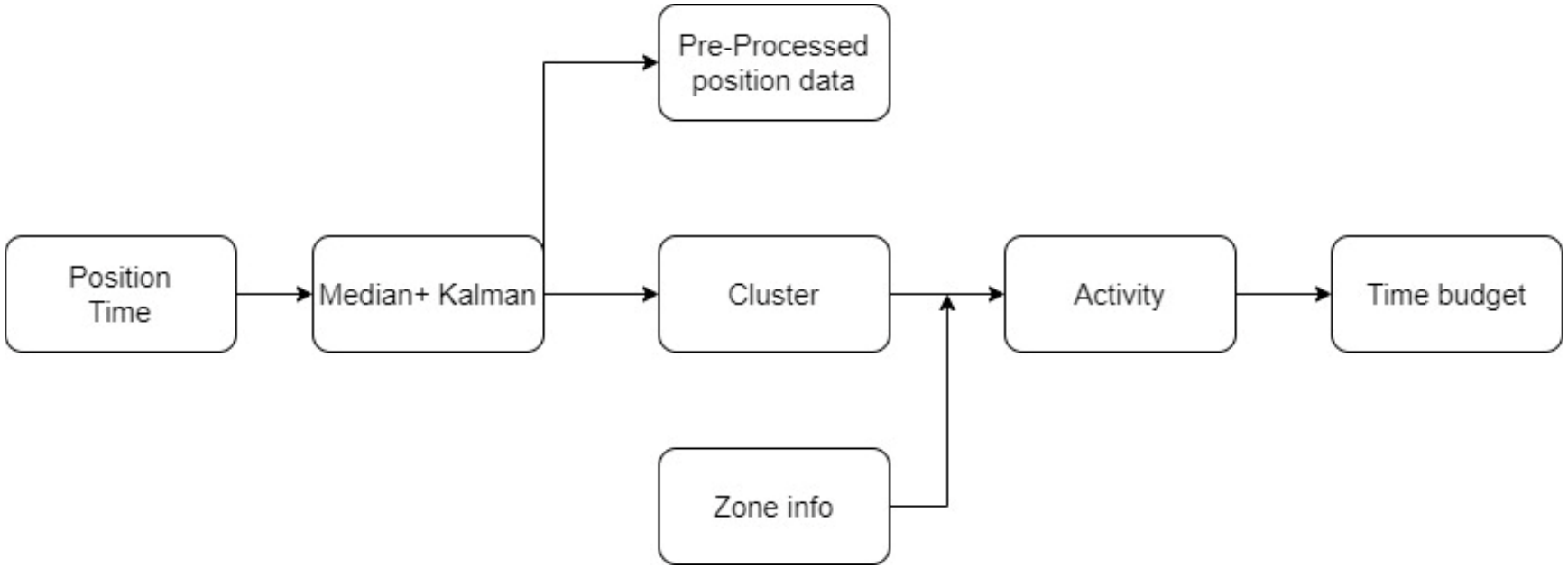
Keni Ren


1 22.10.2018 12:13:16
2 03.10.2018 15:32:02
3 15.03.2018 04:11:58
4 08.10.2018 16:25:17
5 22.10.2018 10:27:03
6 15.03.2018 04:11:48
7 22.10.2018 12:13:16
8 24.02.2018 05:40:39
9 22.10.2018 12:13:10
16 22.10.2018 12:10:33
17 22.10.2018 12:12:25
18 22.10.2018 12:12:44
19 22.10.2018 12:13:13
20 22.10.2018 12:13:10
21 22.10.2018 12:13:14
22 15.03.2018 00:31:28
23 22.10.2018 12:13:11
24 22.10.2018 12:13:11
21
5
19
23
20
18
1
16
7
24
17
9
G
H
No data
Hidden
>1 week
Activity (0-255) Higher value = more activity
>1h
>5min
0-10
10-20
20-30
30-40
40-50
>50
error

Ren, Keni, et al. "Tracking and analysing social interactions in dairy cattle with real-time locating system and machine learning." *Journal of Systems Architecture*

Indoor RTLS data

- ID, Timestamp, x, y ,(z).
- Blueprint with function zones



Data

DATA FROM POSITION SYSTEM

- FA, PA, PAA, PC
- .csv
- Everyday
- Around 800Mb/day

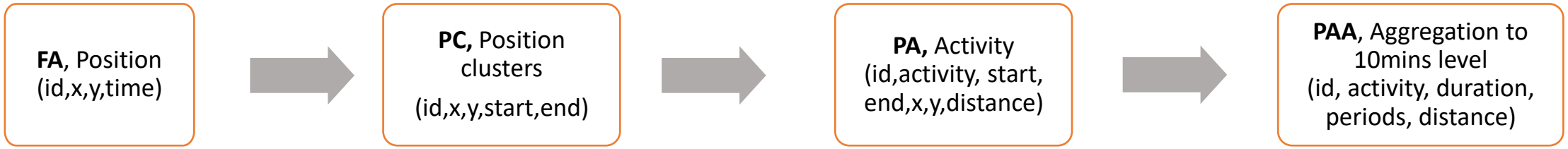
DATA FROM FARM

- Cow traits, insemination records , productions traits
- KO info, Översikt hälsotillstånd X, Avkastn 14 dag…
- .txt
- Every week or longer period

1	data_entity	tag_id	tag_string	time	x	y	z
2	FA	2428773	00250F65	1.57E+12	107	4756	198
3	FA	2428044	00250C8C	1.57E+12	13	4752	198
4	FA	2433145	252079	1.57E+12	3105	1732	198
5	FA	2428747	00250F4B	1.57E+12	2240	3098	198

KO	RESP	TAG	GR	STAT	LAKT	KALVN	DIM
601	13418550	00250cdd	11	DRÄKT	3	4-12-19	285
607	13419990	00250c8c	11	DRÄKT	3	7-01-20	251
611	14966783	00250de6	11	DRÄKT	3	15-07-19	427
659	13418482	00250dcc	21	TIDIG	3	3-09-20	11

DATA FROM POSITION SYSTEM



Sloth, Karen Helle, and Daniel Frederiksen. "Computer system for measuring real time position of a plurality of animals." U.S. Patent No. 10,234,535. 19 Mar. 2019.

FA
(id,time,x,y,z)

data_entity,tag_id,tag_string,time,x,y,z

FA,2198225,00218AD1,1427847365285,2170,2376,137

FA,2200003,002191C3,1427847361618,2827,6220,137

FA,2199224,00218EB8,1427847365333,433,6159,137

FA,2200407,00219357,1427847365379,3091,6972,137

FA,2201318,002196E6,1427847363445,404,5903,137

FA,2199144,00218E68,1427847361227,2731,2114,137

FA,2199938,00219182,1427847350225,2186,5239,137

FA,2201146,0021963A,1427847365635,1148,7545,137

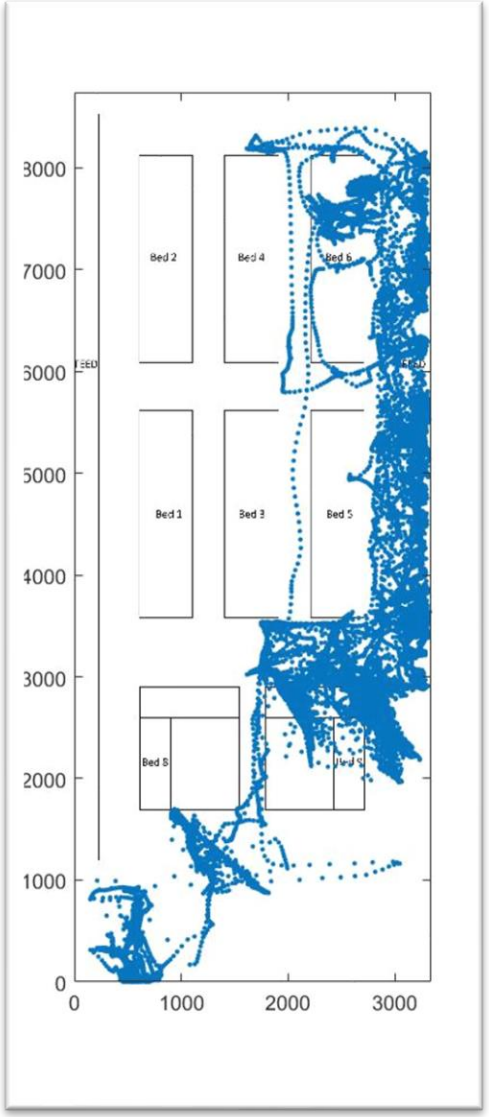
FA,2201418,0021974A,1427847355830,2799,2424,137

FA,2199316,00218F14,1427847365300,1588,3090,137

FA,2196981,002185F5,1427847360796,731,2757,137

FA,2199374,00218F4E,1427847364776,1337,3720,137

Time in epoch

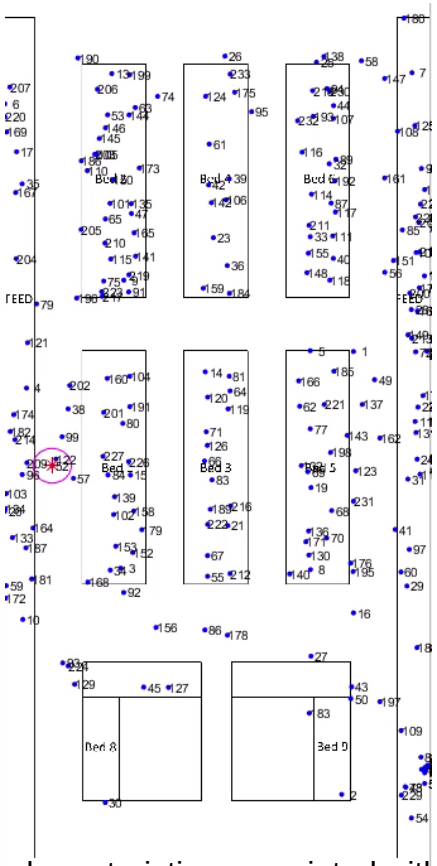


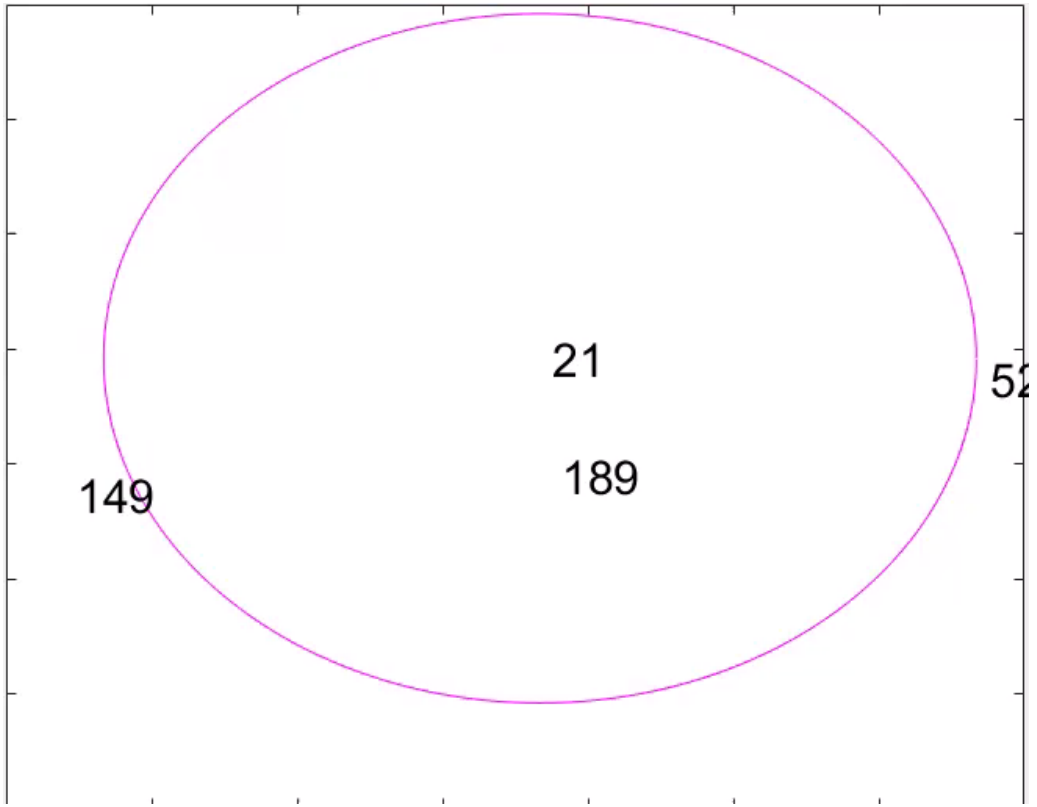
ID=2421875

15-Nov-2019 00:00:00-23:30:00

How we use FA data?

An example: Social contact





Hansson, Ida, et al (2022). Cow characteristics associated with the variation in number of contacts between dairy cows. Journal of Dairy Science.
Marina, Hector, et al. (2023) Social Network Analysis of Dairy Cow Interactions Journal of Dairy Science

PC

(id,start,end,x,y,z)

data_entitiy,tag_id,tag_string,start,end,x,y,z

PC,2198225,00218AD1,1427847365285,1427847365285,2170,2376,137

PC,2200003,002191C3,1427847361618,1427847365259,2827,6220,137

PC,2199224,00218EB8,1427847365333,1427847365333,433,6159,137

PC,2200407,00219357,1427847365379,1427847365379,3091,6972,137

PC,2201318,002196E6,1427847363445,1427847364673,404,5903,137

PC,2199144,00218E68,1427847361227,1427847364819,2731,2114,137

PC,2199938,00219182,1427847350225,1427847365511,2186,5239,137

PC,2201146,0021963A,1427847365635,1427847365635,1148,7545,137

PC,2201418,0021974A,1427847355830,1427847365494,2799,2424,137

PC,2199316,00218F14,1427847365300,1427847365300,1588,3090,137

PC,2196981,002185F5,1427847360796,1427847360796,731,2757,137

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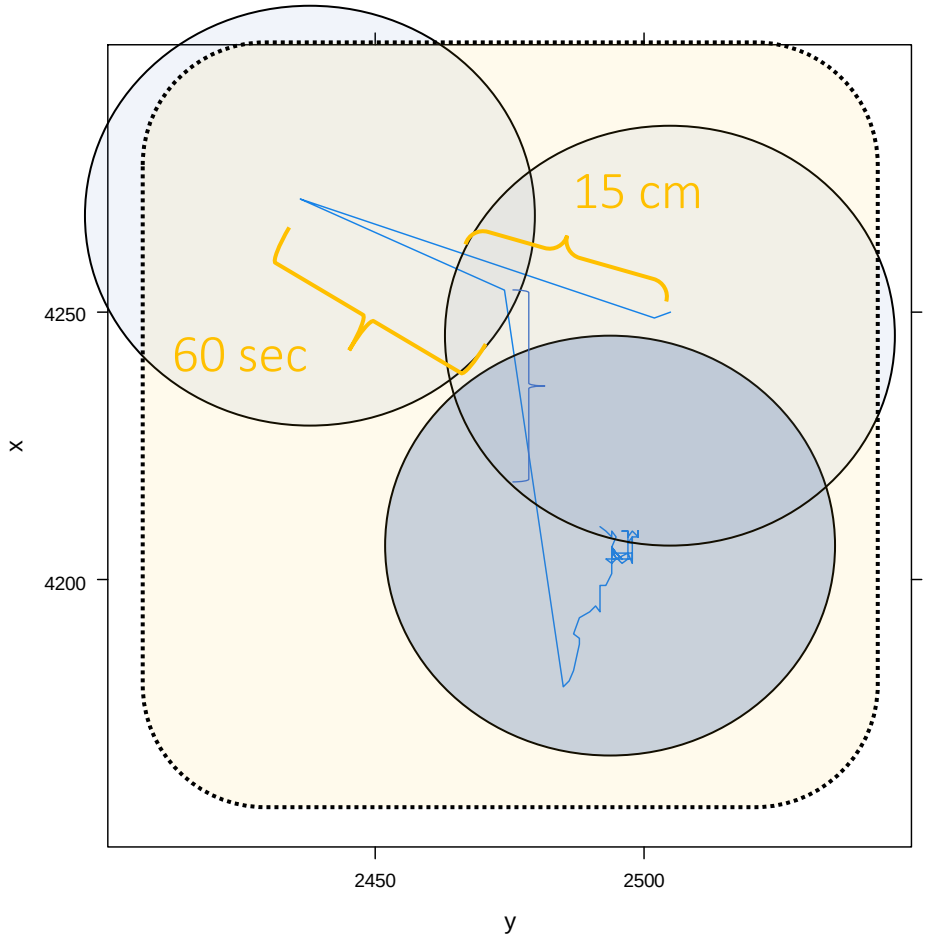
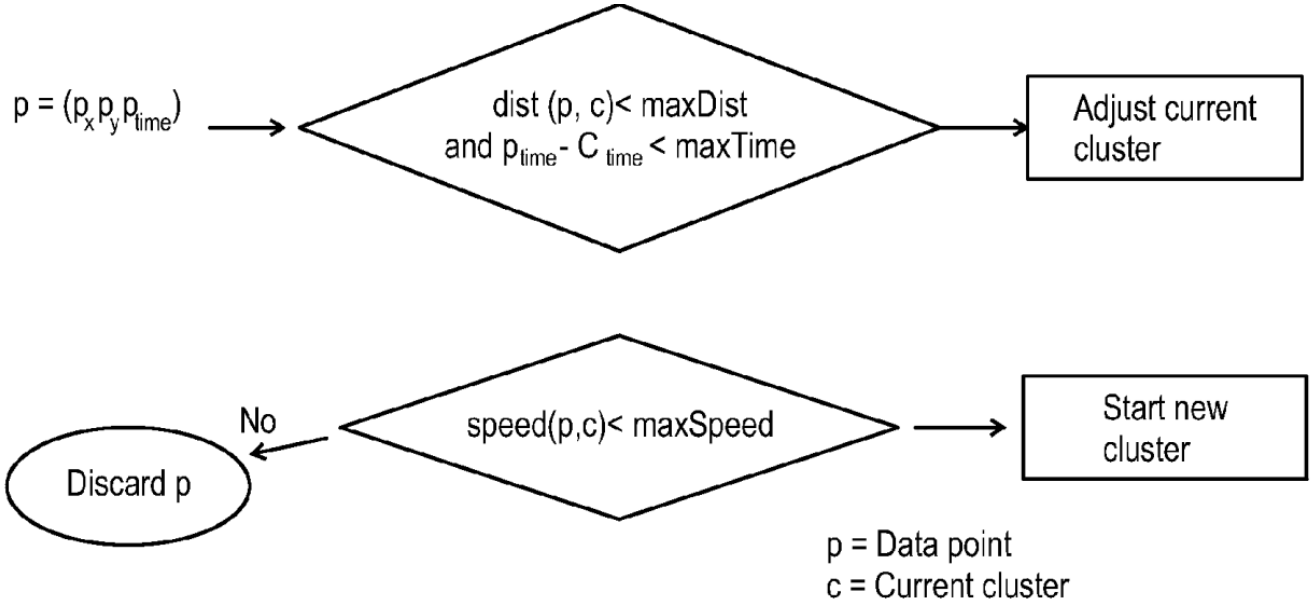
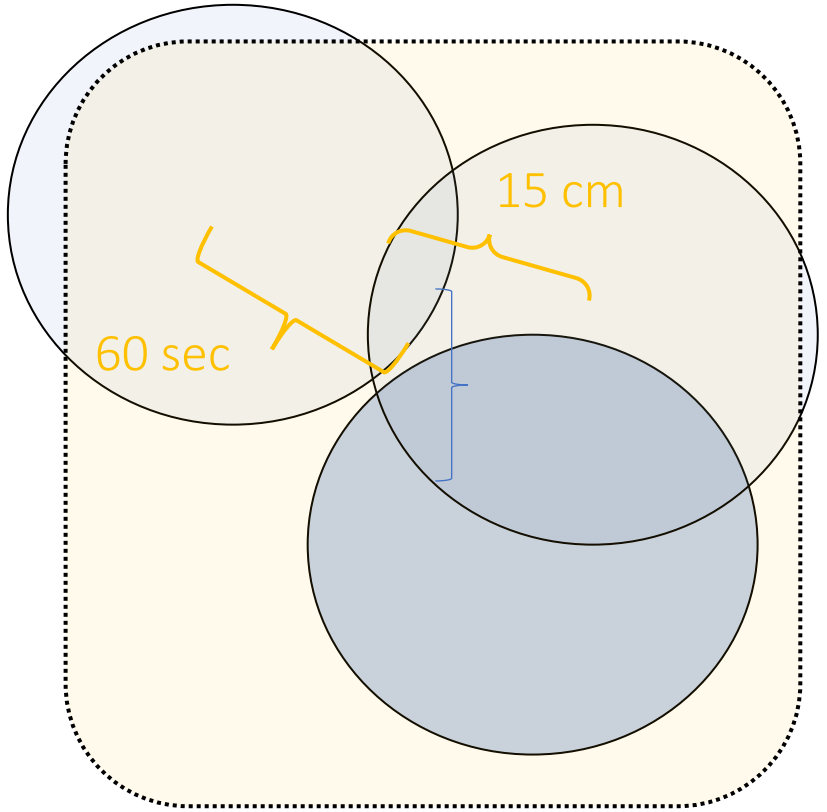


New cluster if radius > 15 cm or time between two points > 60 sec.





New cluster if radius > 15 cm or time between two points > 60 sec.

PA
(id, start, end, x, y, z, activity type, distance)

data_entity,tag_id,tag_string,start,end,x,y,z,activity_type,distance

PA,2196869,00218585,1427847353100,1427847376698,3222,5504,137,1,0

PA,2196869,00218585,1427847376698,1427847379119,3221,5522,137,2,25

PA,2196869,00218585,1427847379119,1427847381544,3221,5522,137,1,0

PA,2196869,00218585,1427847381544,1427847383959,3202,5490,137,2,15

PA,2196869,00218585,1427847383959,1427847385171,3202,5490,137,1,0

PA,2196869,00218585,1427847385171,1427847393644,3258,5679,137,2,52

PA,2196869,00218585,1427847393644,1427847413007,3277,5702,137,1,0

PA,2196869,00218585,1427847413007,1427847416637,3230,5686,137,2,26

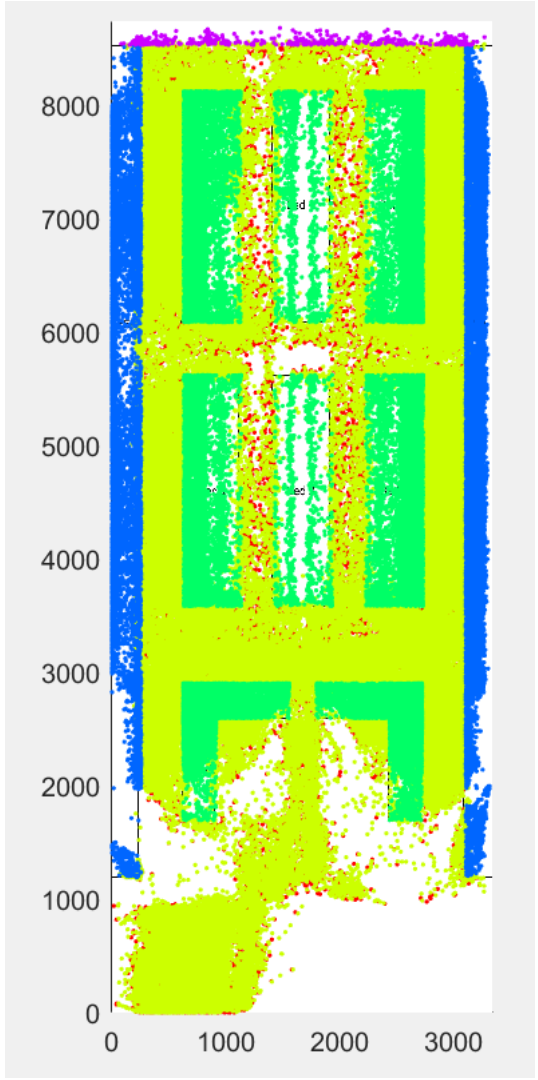
PA,2196869,00218585,1427847416637,1427847437212,3206,5662,137,1,0

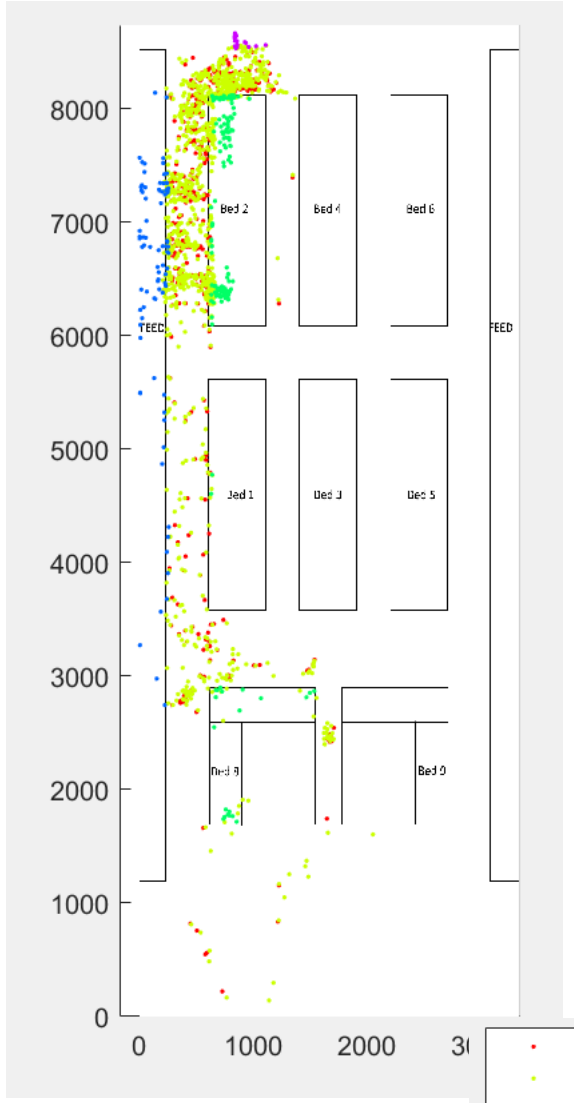
PA,2196869,00218585,1427847437212,1427847442656,3244,5717,137,2,8

PA,2196869,00218585,1427847442656,1427847486835,3216,5682,137,1,0

PA,2196869,00218585,1427847486835,1427847489255,3156,5713,137,2,25

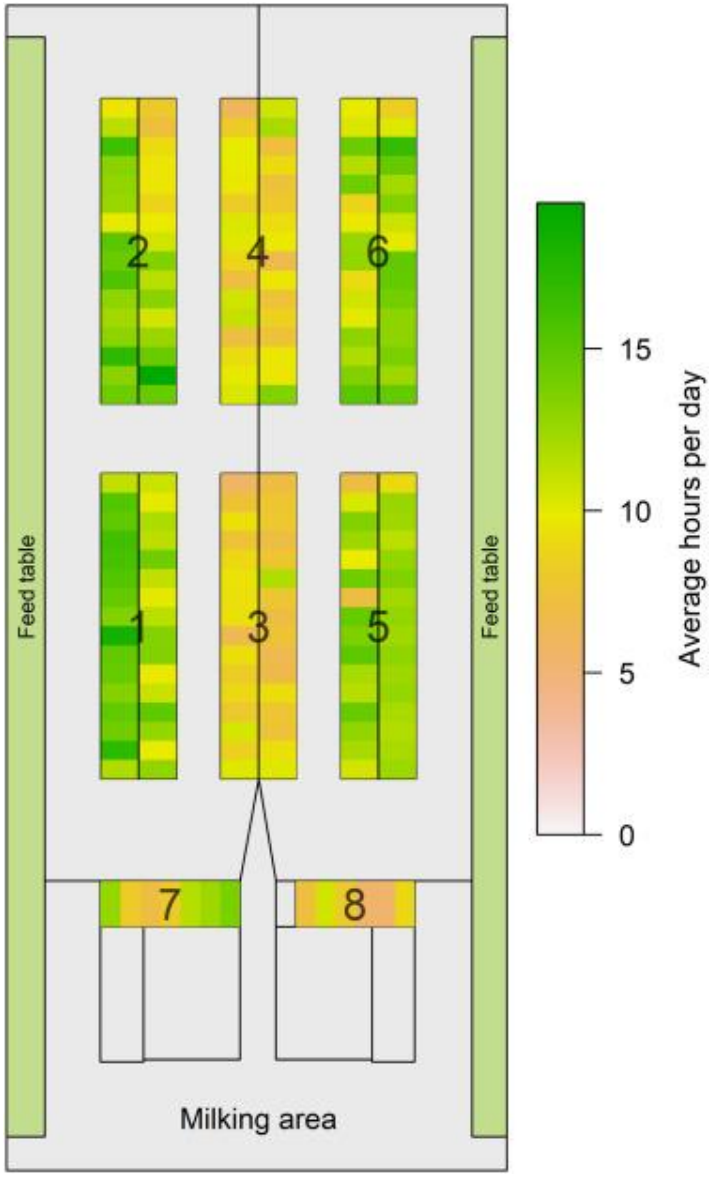
PA,2196869,00218585,1427847489255,1427847796661,3134,5735,137,1,0





1 Standing
2 Walking
3 Bed
4 Feeding
999 Out range

How we use PA data?
An example: Cubic Choice



Churakov, M., Silvera, A. M., Gussmann, M., & Nielsen, P. P. (2021). Parity and days in milk affect cubicle occupancy in dairy cows. *Applied Animal Behaviour Science*, 105494.

Gussmann, Maya, et al. “Variations in cow behavior after regrouping in a conventional Swedish dairy herd”

PAA
(id, span, interval, activity type, duration, periods, distance)

data_entity,tag_id,tag_string,span,interval,activity_type,distance,periods,duration

PAA,2197312, 00218740,1381755600000,3600000,1,0,88,1204757

PAA,2197312, 00218740,1381755600000,3600000,2,2710,92,1352724

PAA,2197312, 00218740,1381755600000,3600000,3,0,3,555727

PAA,2197312, 00218740,1381755600000,3600000,4,0,2,486791

PAA,2197139, 00218693,1381755600000,3600000,1,0,29,209335

PAA,2197139, 00218693,1381755600000,3600000,2,3502,58,186696

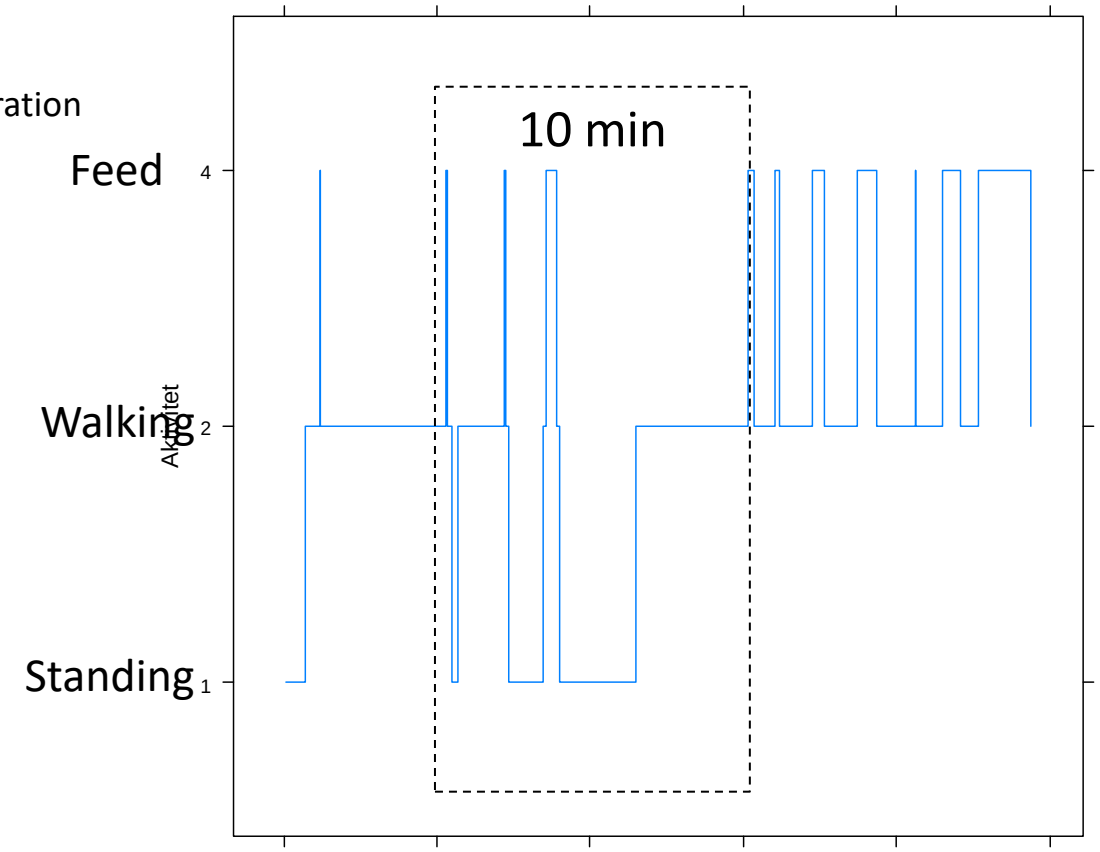
PAA,2197139, 00218693,1381755600000,3600000,3,0,29,3203968

PAA,2196892, 0021859C,1381755600000,3600000,1,0,19,194937

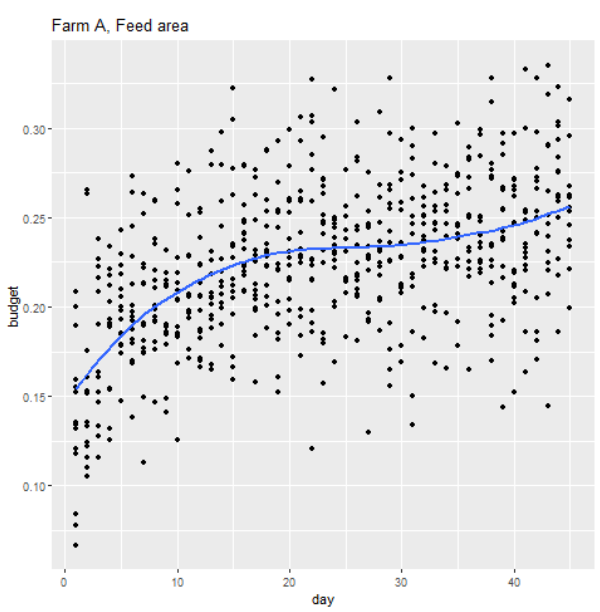
PAA,2196892, 0021859C,1381755600000,3600000,2,2055,30,388698

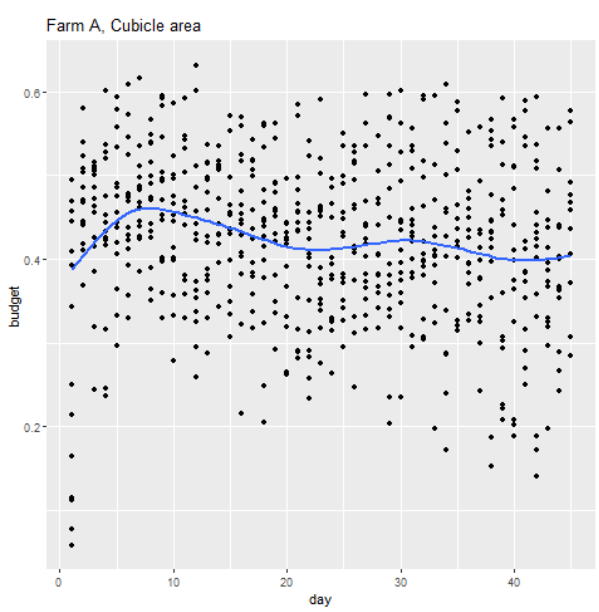
PAA,2196892, 0021859C,1381755600000,3600000,3,0,4,58709

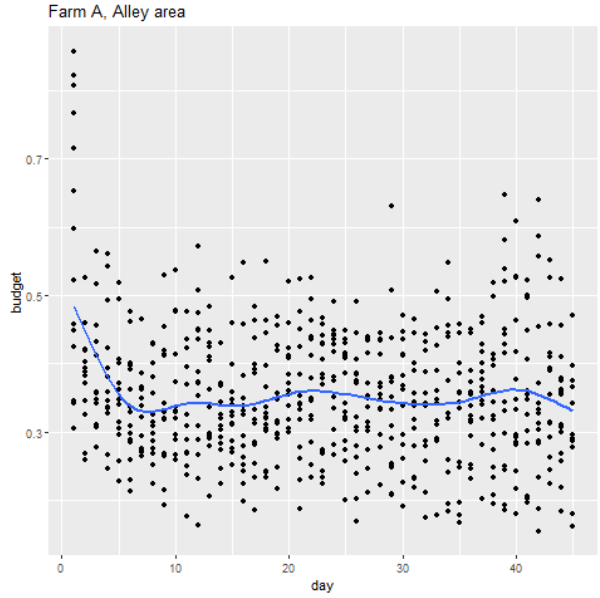
PAA,2196892, 0021859C,1381755600000,3600000,4,0,8,2957655



How we use PAA data?
An example: Activity budget







Johansson, Teresa, et al. “Development of stability in heifer time budgets after introduction to the milking herd.”
Ren, Keni, et al. “Time budgets differ between lactation periods after the calving period ”

Combine time budget to activity

Fourier-Based Approximation with Thresholding (FBAT)

Git: https://github.com/nicolas-wagner/FBAT

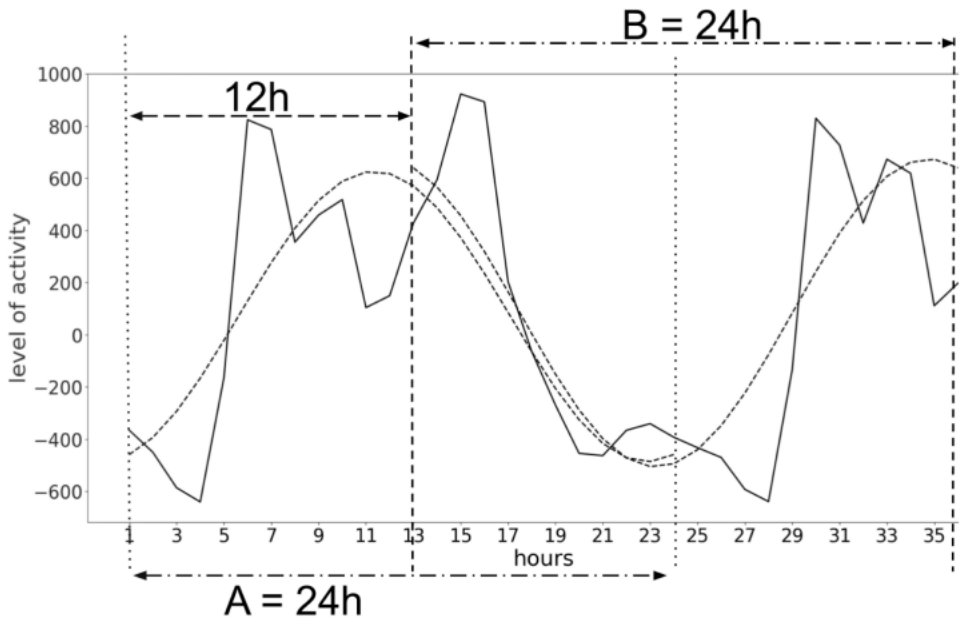


Fig. 1. Example of a 36-h time series of cow activity modelled with a Fourier transform. Solid line: activity level calculated from basic activities (weighted sum of the time spent 'resting', 'in alleys' or 'eating', unitless). Dotted lines: Fourier transform of the first and last 24-h segments of this 36-h time series.

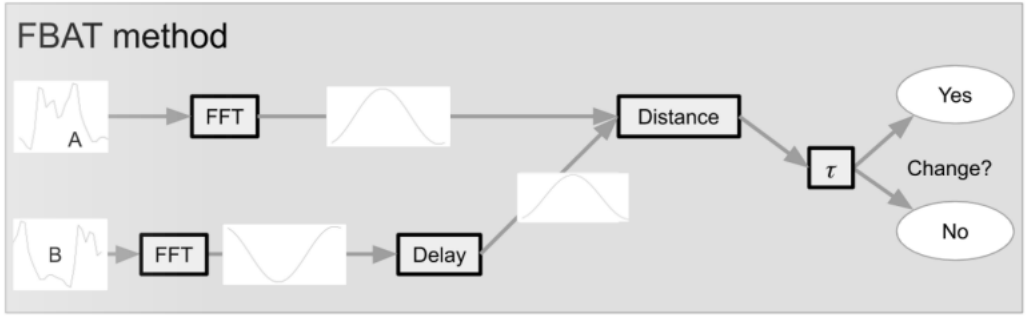


Fig. 2. Framework of the FBAT method to detect changes in circadian activity rhythm. Within a 36-h time series, we used Fast Fourier Transform (**FFT**) to model the variations in activity during the first and last 24-h segments of this 36-h series. After aligning the two models in time, we calculate the Euclidian distance between them and then compare that distance to a given threshold, above which we consider that the rhythm has changed.

Wagner, Nicolas, et al. "Detection of changes in the circadian rhythm of cattle in relation to disease, stress, and reproductive events." *Methods* 186 (2021): 14-21.

Exercise time

A few questions after you finished go through the script:

- From the *analysis. R* you have the *getMeanPos* function to get the mean position of an individual (or a group). You can compare one individual's mean position with the cubic preference.
- Compare the cubic preference differences between Mid-lactation &&Parity 1 and Mid-lactation Parity 3+.
- Get the average time each cubicle was occupied of the day.