

Home range methods on indoor data

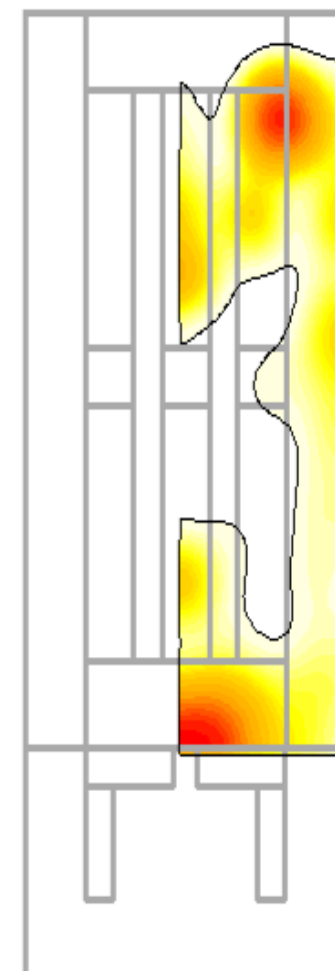
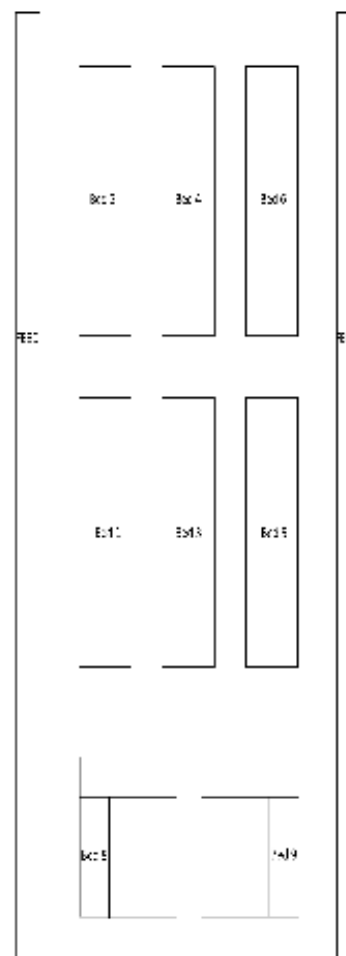
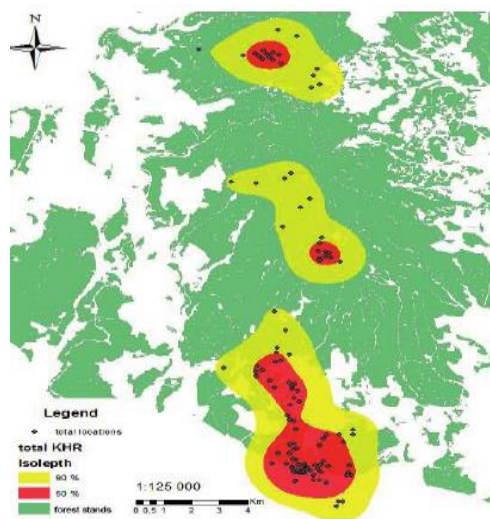
Hector Marina



Home range:

- Area where it spends its time.
- Encompasses all the resources the animal requires to survive and reproduce.

(Burt, 1943)



Different methods

First-generation estimators

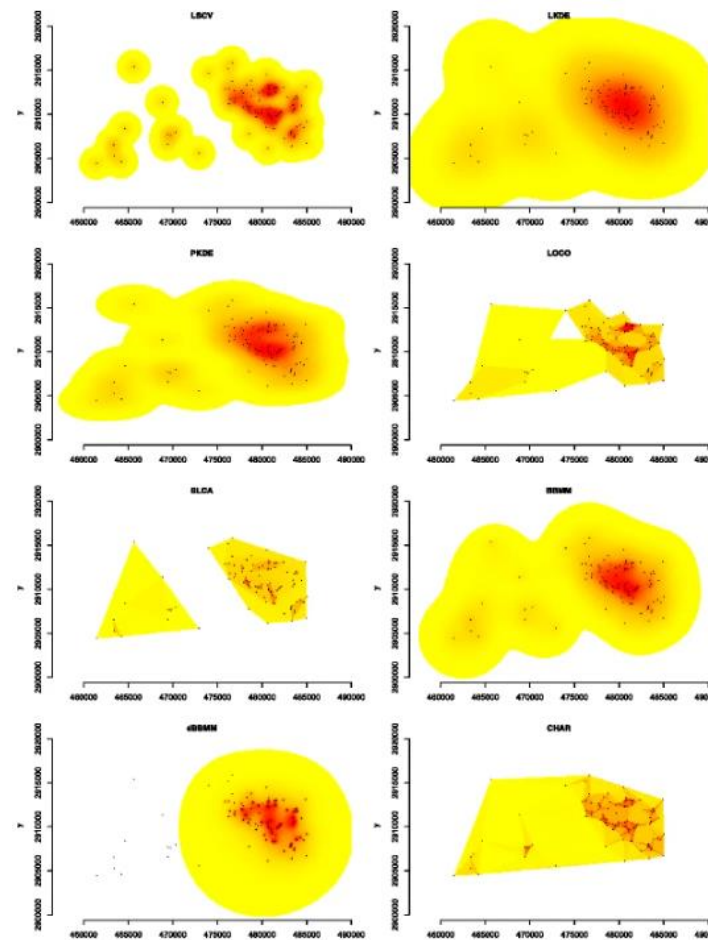
- Local convex hull
- Fixed kernel home range

Second-generation estimator

- Plug-in Kernel home range

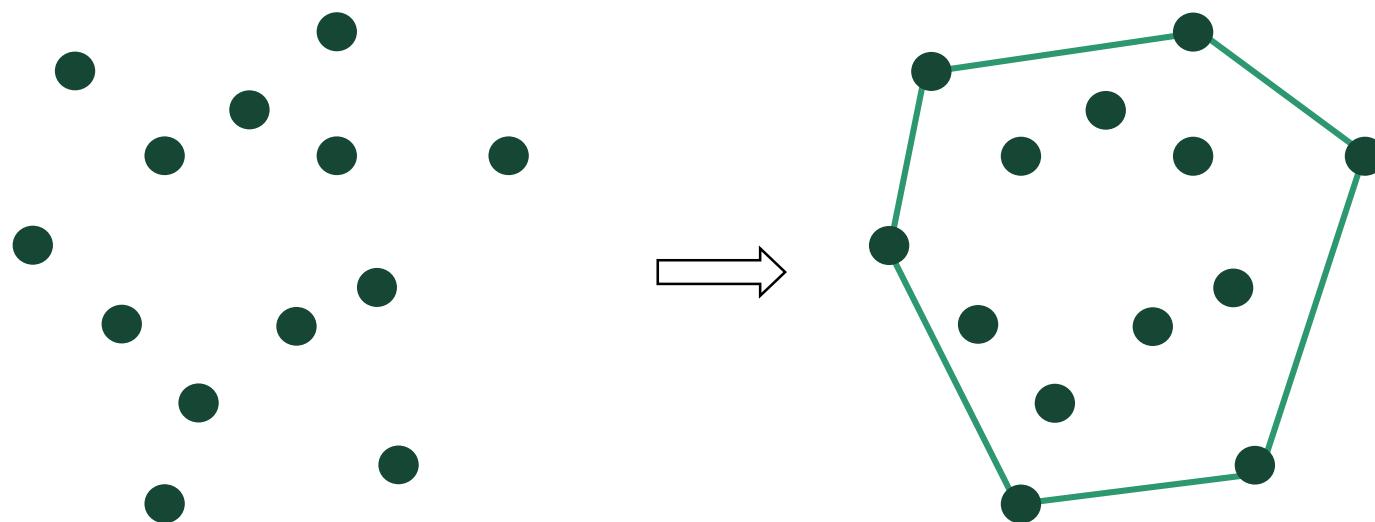
Third generation estimators

- Movement-based kernel density estimator
- Brownian bridge movement model



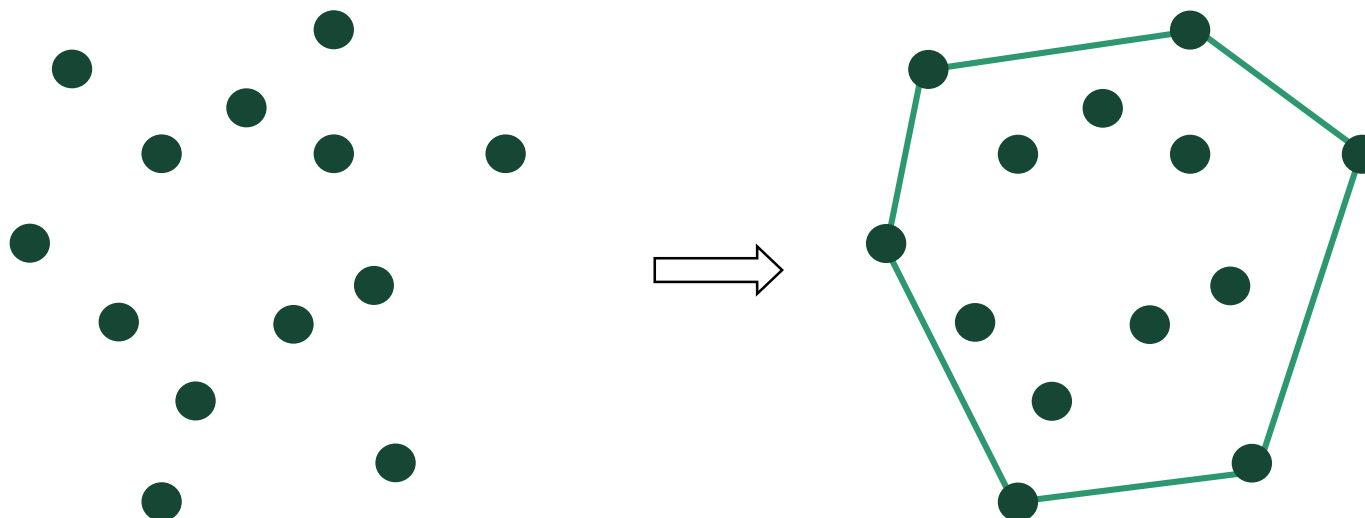
(Walter, 2015)





Minimum Convex Polygon

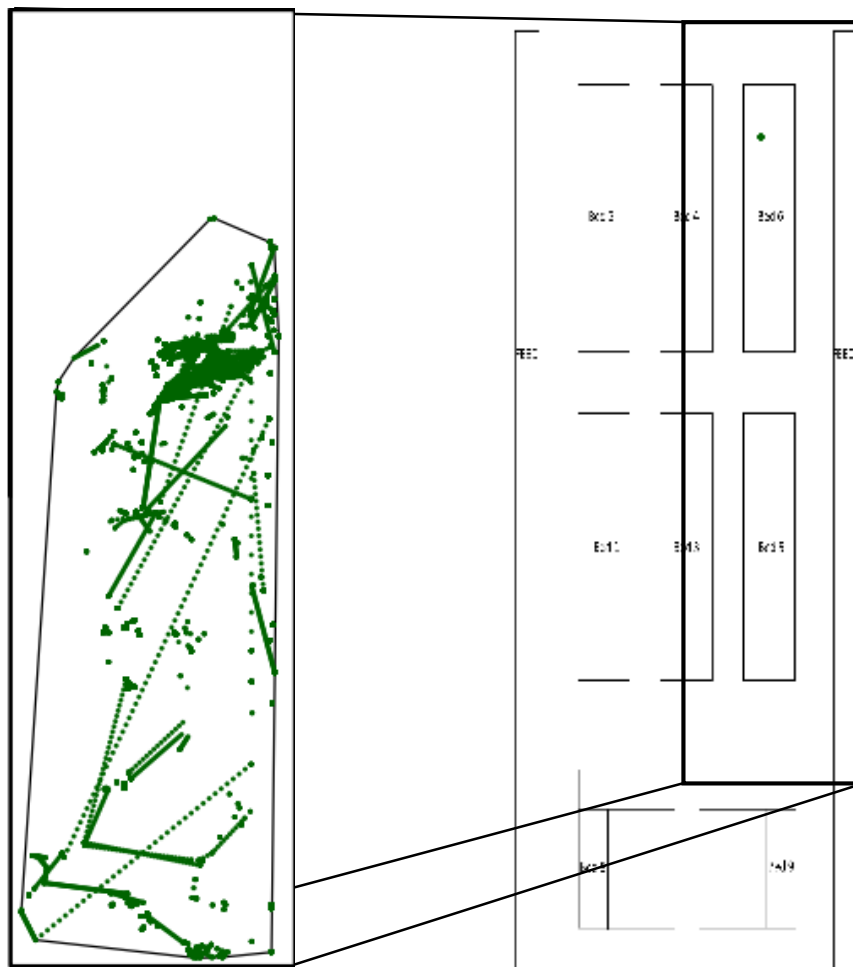
- Convex hull or convex envelope or convex closure



Minimum Convex Polygon



- Convex hull or convex envelope or convex closure

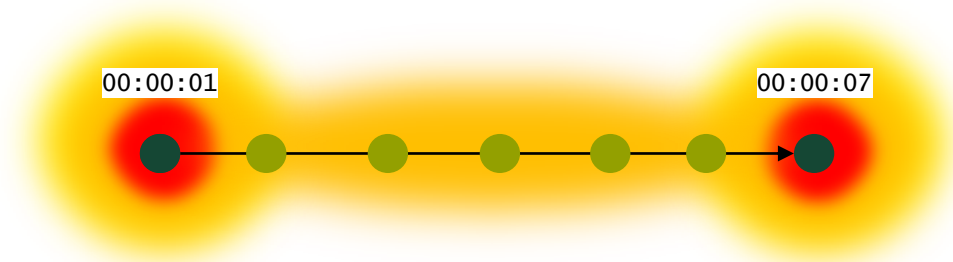


Minimum Convex Polygon

- Convex hull or convex envelope or convex closure



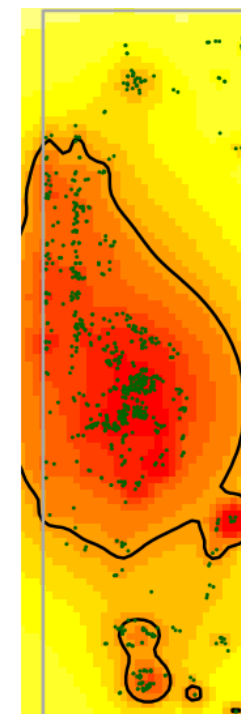
- Brownian bridge movement model
 1. Sequential location data
 2. Estimated error
 3. Grid-cell size for utilization distribution
 - Paired locations becomes less realistic as the time interval increases



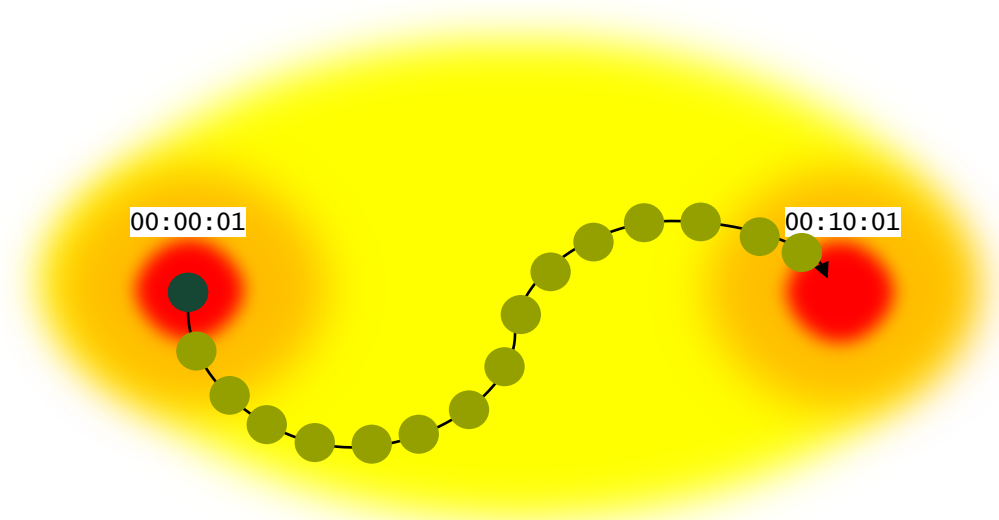
Convex hulls



Brownian bridge



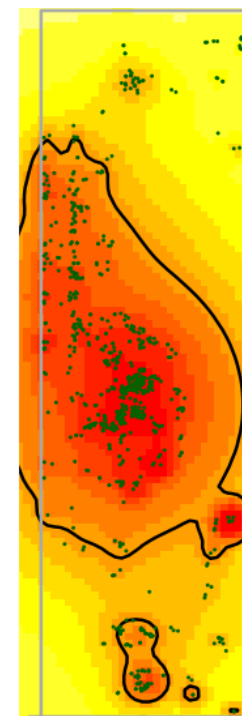
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Convex hulls



Brownian bridge



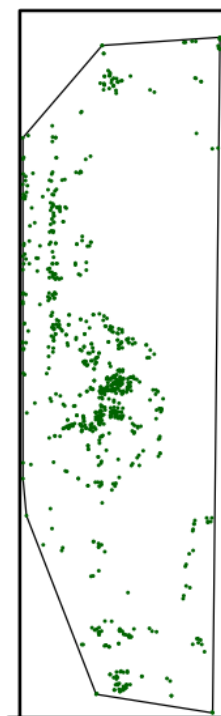
- Kernel density estimators
 - One of the most popular methods for measuring home ranges.
 - Several types of kernels
 - Similar results
 - Smoothing bandwidth (*ad hoc* method)

$$h = \sigma * n^{-1/6}$$

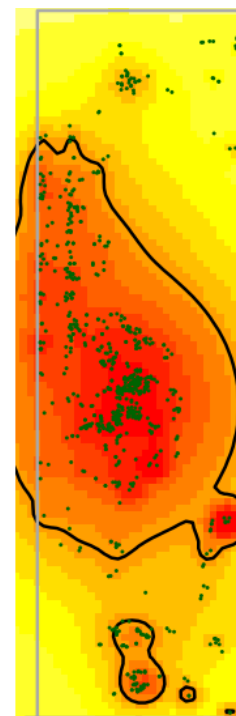
Number of data points

$\sigma^2 = 0.5(\text{var}(x) + \text{var}(y))$

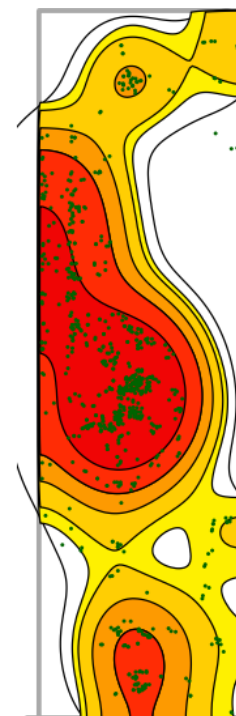
Convex hulls



Brownian bridge



Kernel



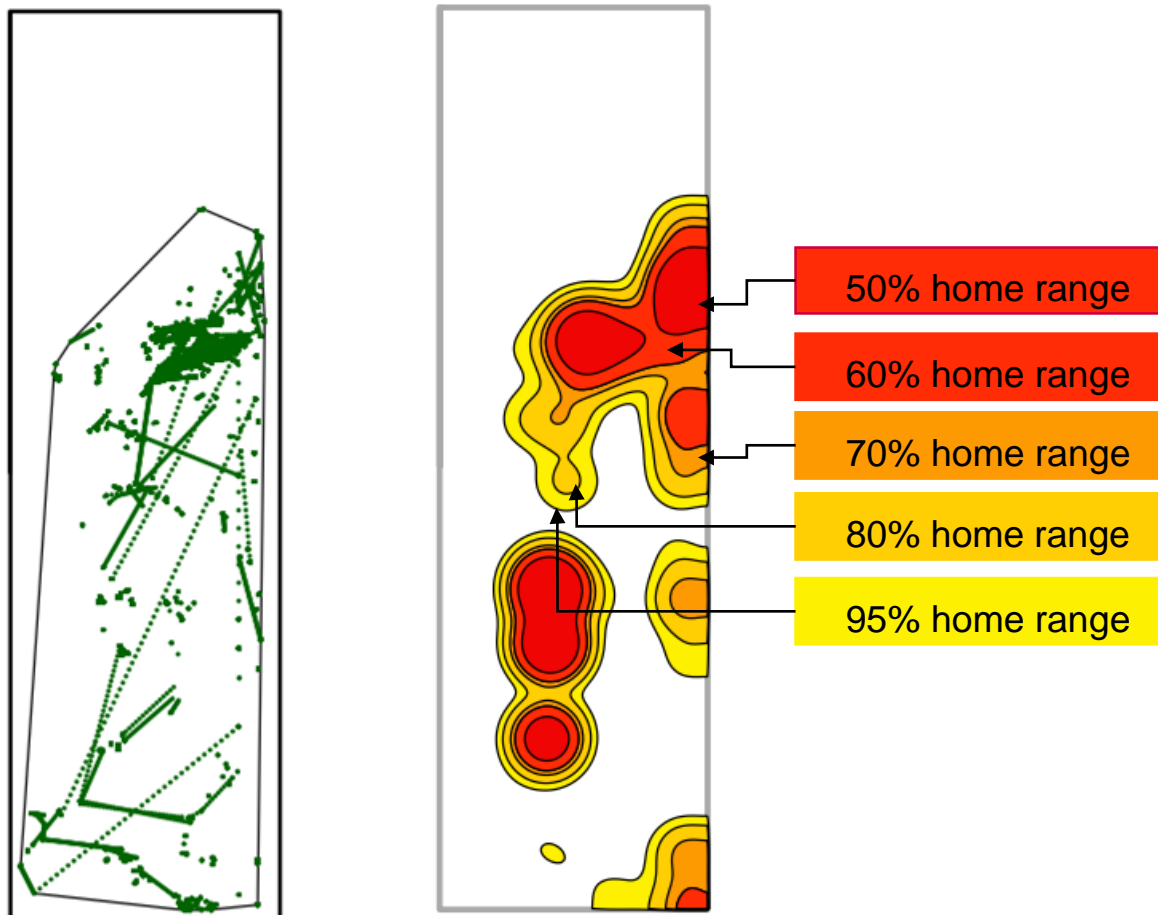
Krysten et al., (2014):

“Examine the point distribution; justify the choice of smoothing parameter based on the objectives of the study.”

Utilization Distributions



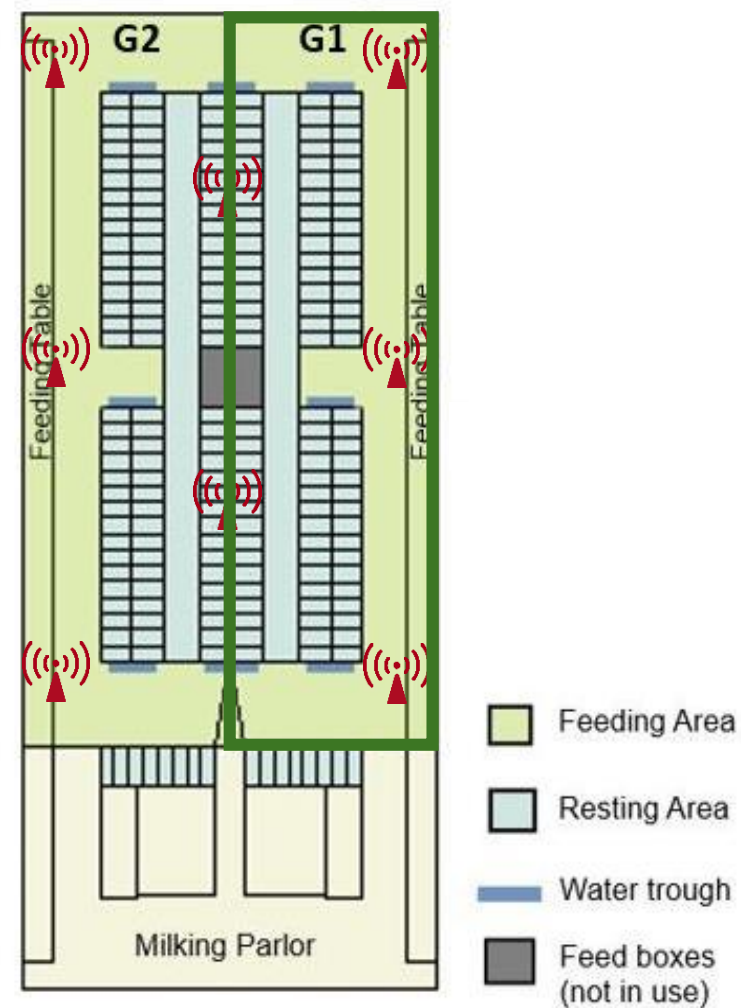
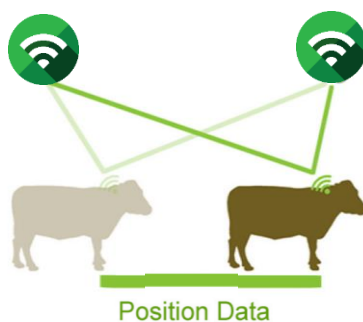
- Kernel density estimators



Data manipulation



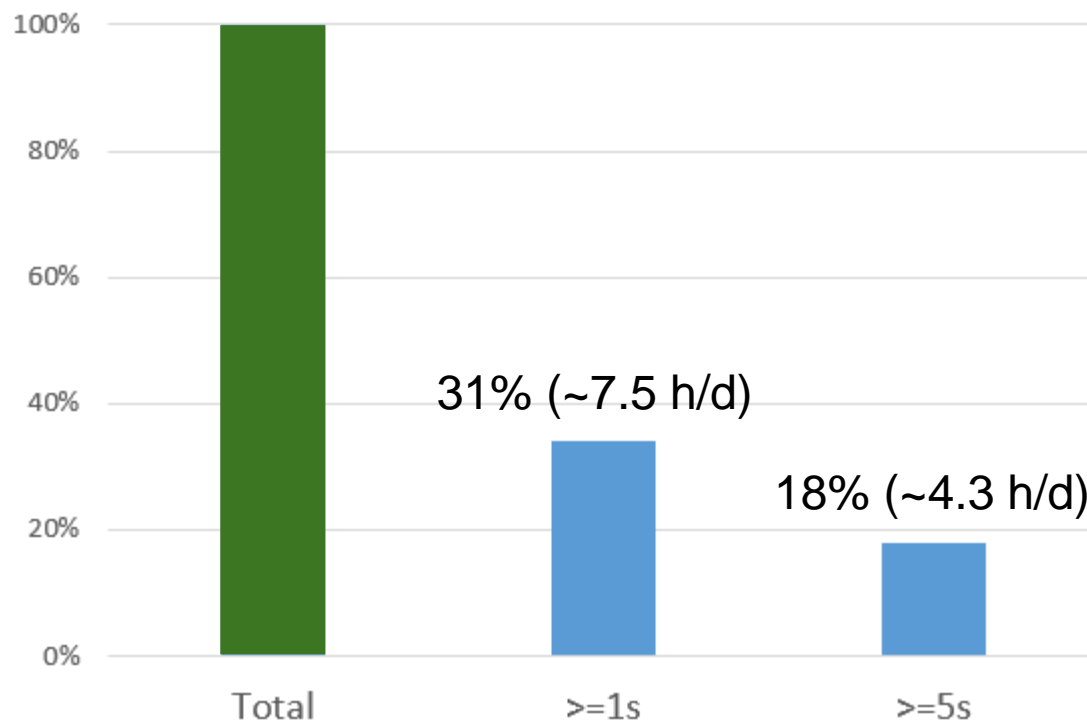
Real-time Location System



Data manipulation

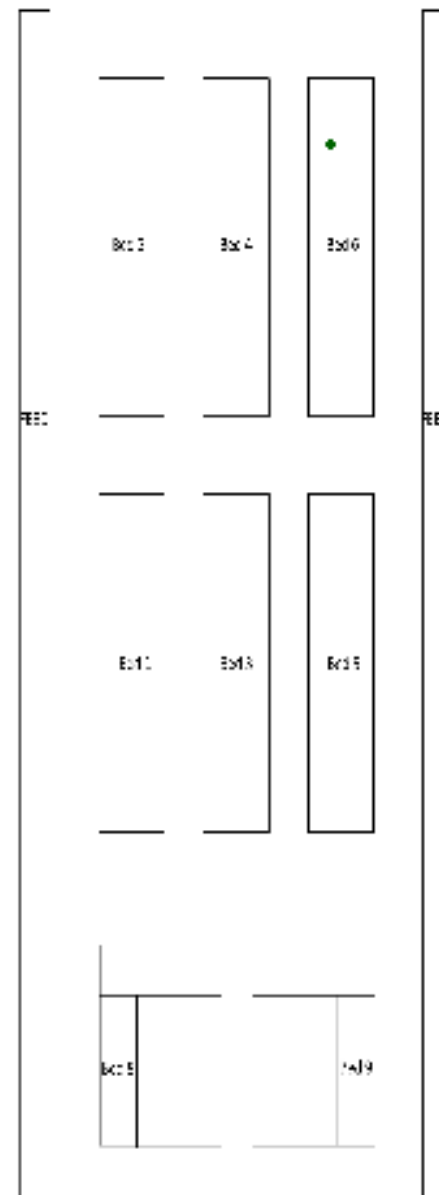


Interpolation methods



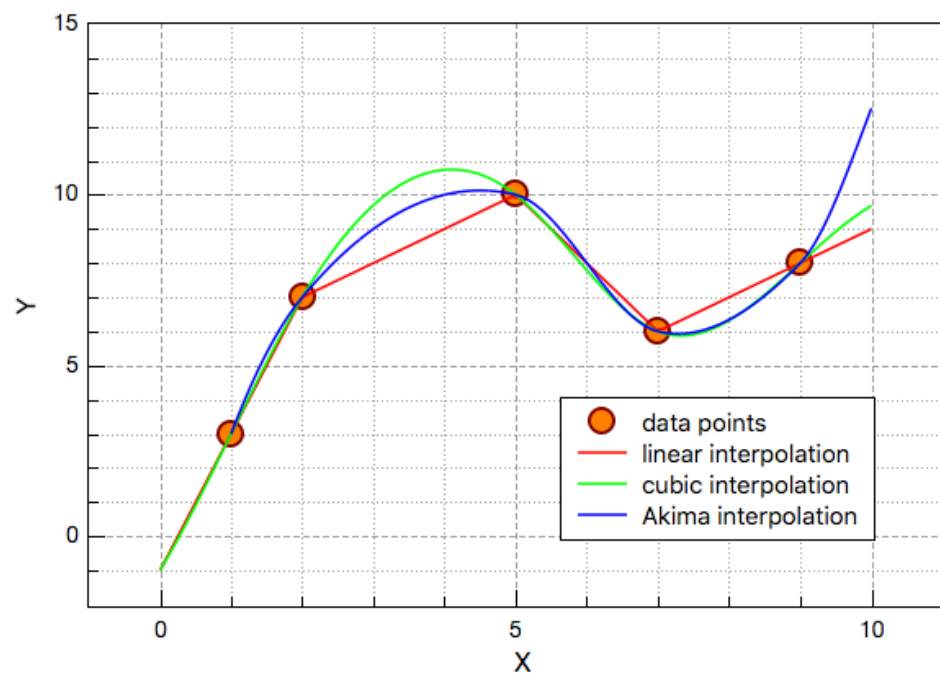
(Ren et al., 2021)

01:00:00



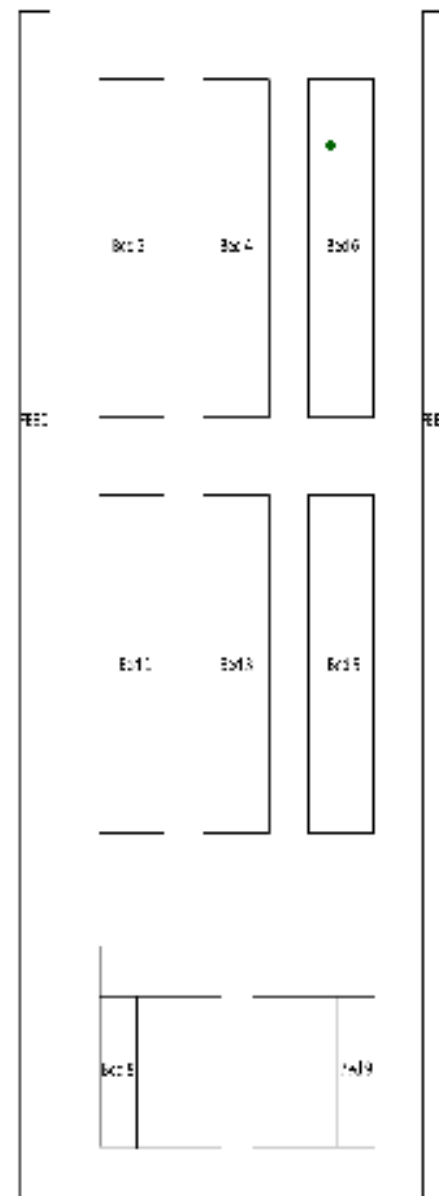
Interpolation methods

- Maximising the information

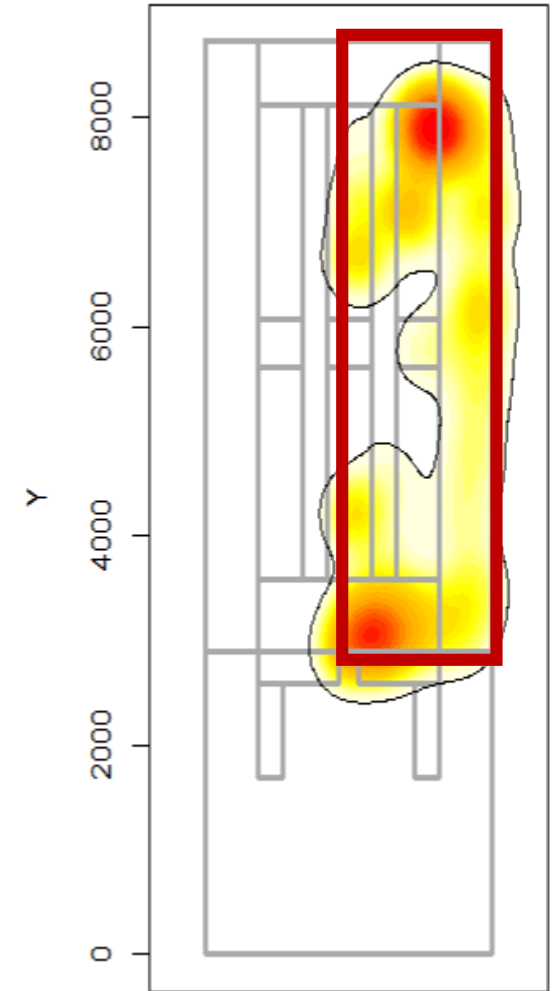
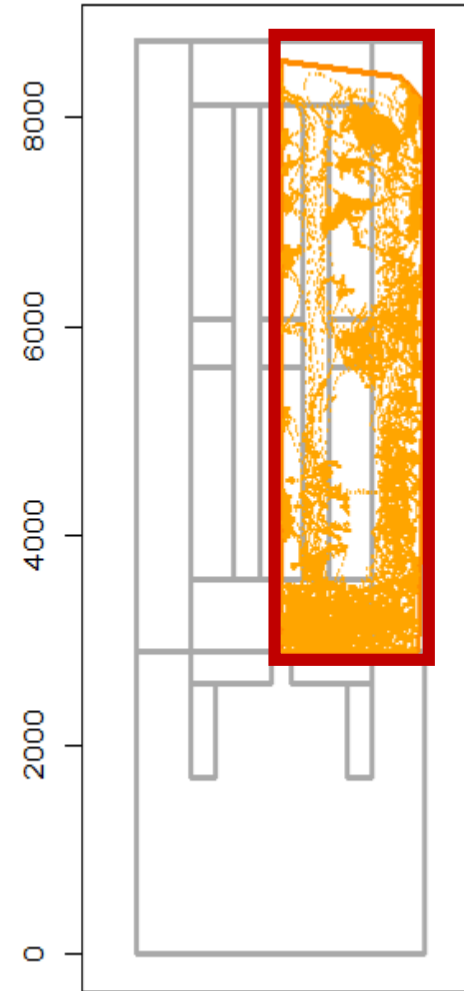
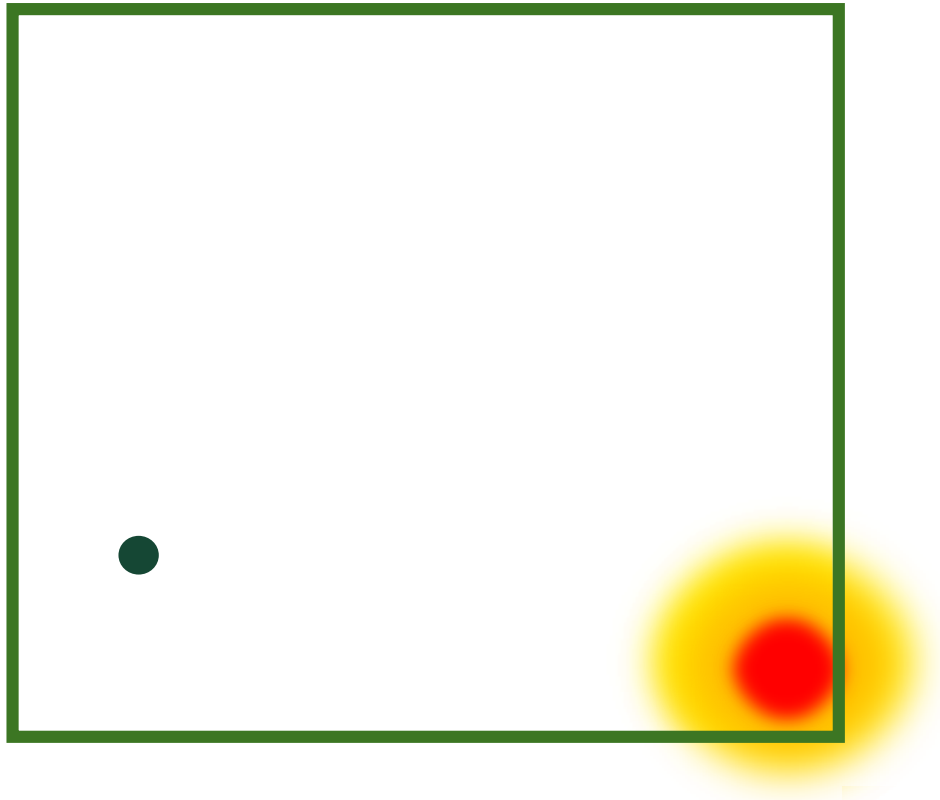


(Ren et al., 2022)

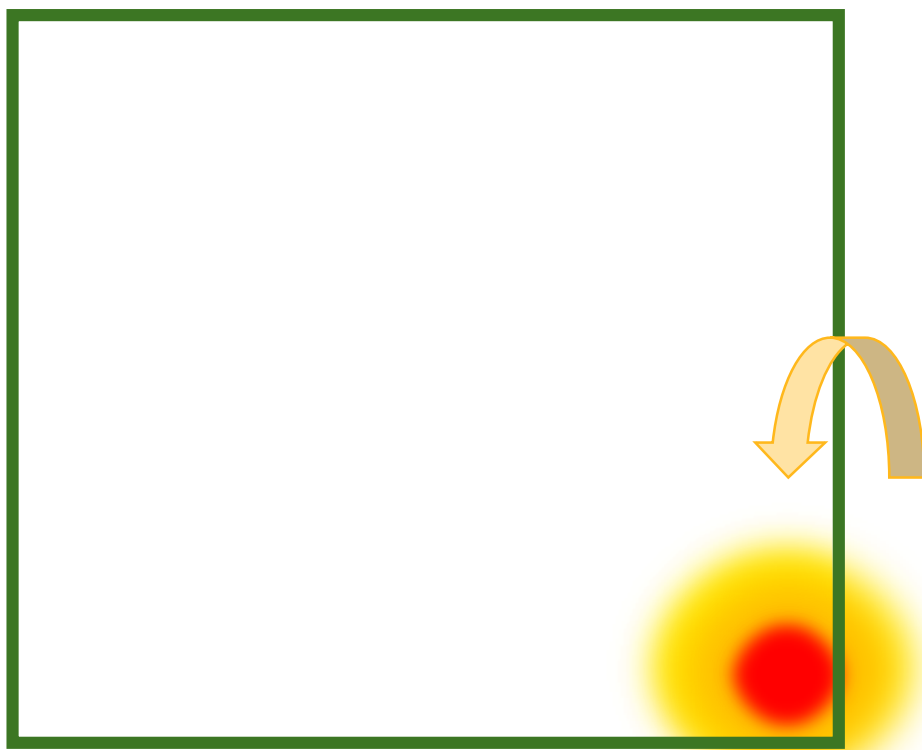
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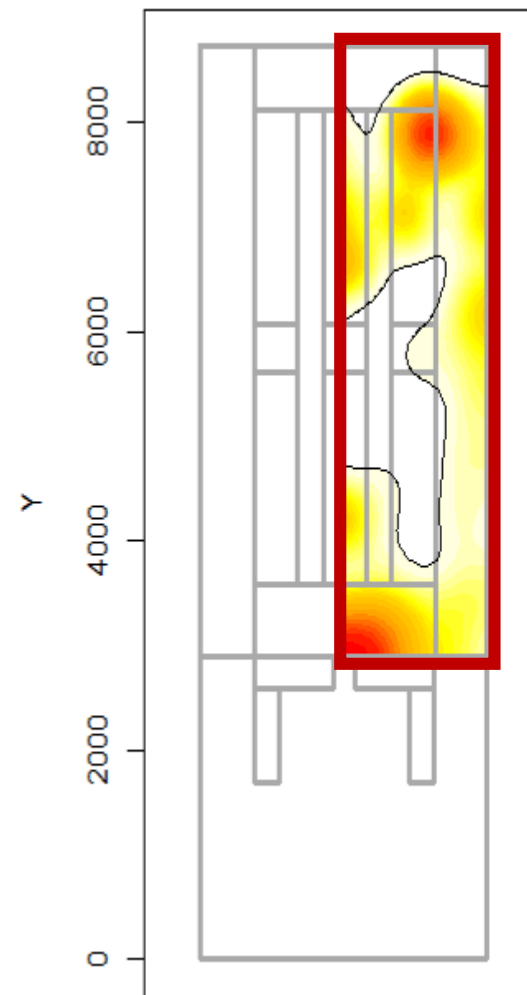
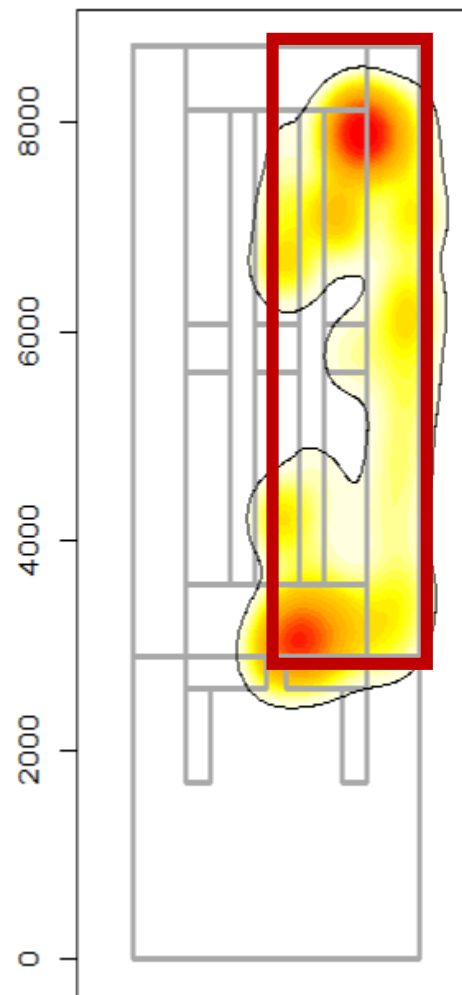
Boundaries



Boundaries

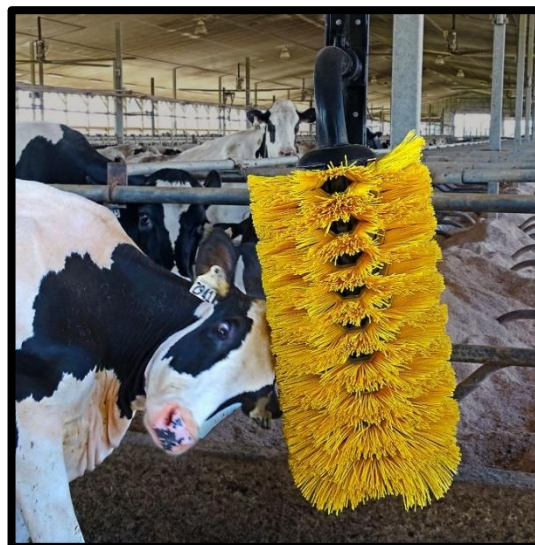


(Benhamou and Cornélis, 2010)

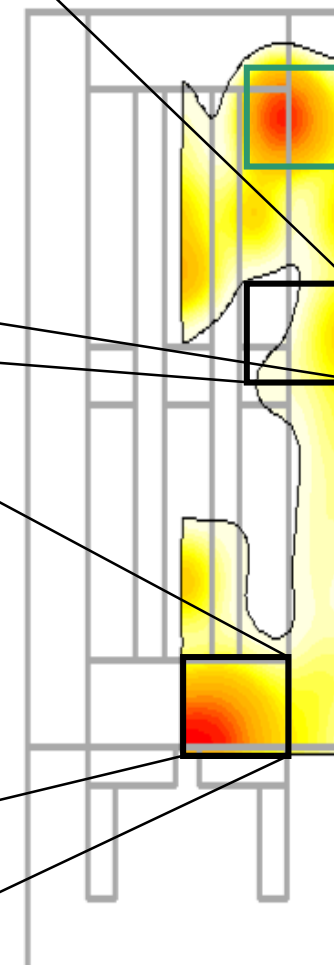


Utility of indoor home ranges

- Area usage of the animals
 - Cubical preference
 - Feed bunk preference
- Locate high density areas



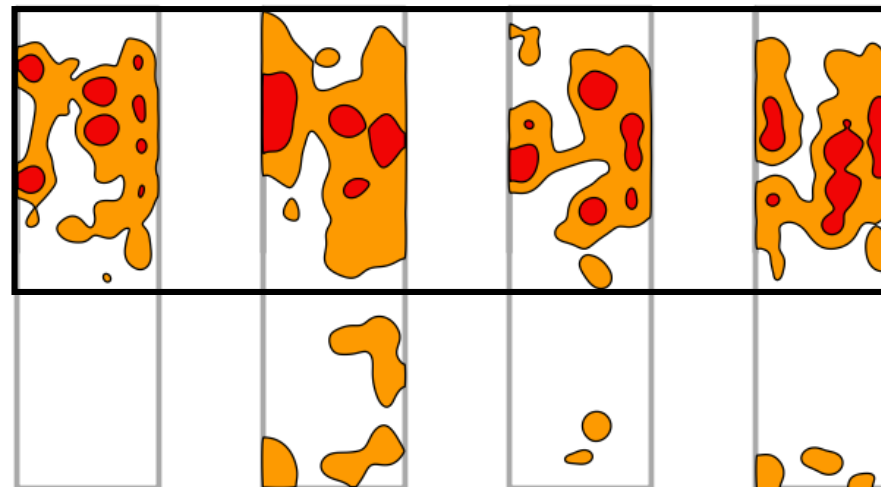
(Churakov et al., 2021)



Utility of indoor home ranges



- Barn area preference



- Detect behaviour changes?



Recommended literature

1. Burt, W. H. (1943). Territoriality and home range concepts as applied to mammals. *Journal of Mammalogy*, **24**, 346–352.
2. Roger A. Powell , Michael S. Mitchell, What is a home range?, *Journal of Mammalogy*, Volume 93, Issue 4, 14 September 2012, Pages 948–958, <https://doi.org/10.1644/11-MAMM-S-177.1>
3. Broekman, M. J. E., Hoeks, S., Freriks, R., Langendoen, M. M., Runge, K. M., Savenco, E., ter Harmsel, R., Huijbregts, M. A. J., & Tucker, M. A. (2023). *HomeRange*: A global database of mammalian home ranges. *Global Ecology and Biogeography*, **32**, 198–205. <https://doi.org/10.1111/geb.13625>
4. Walter, W.D., Onorato, D.P. & Fischer, J.W. Is there a single best estimator? Selection of home range estimators using area-under-the-curve. *Mov Ecol* **3**, 10 (2015). <https://doi.org/10.1186/s40462-015-0039-4>
5. Krysten L. Schuler, Greg M. Schroeder, Jonathan A. Jenks, and John G. Kie "Ad hoc smoothing parameter performance in kernel estimates of GPS-derived home ranges," *Wildlife Biology* 20(5), 259-266, (1 October 2014). <https://doi.org/10.2981/wlb.12117>
6. Ren, K., Nielsen, P.P., Alam, M., Rønnegård, L., 2021. Where do we find missing data in a commercial real-time location system? Evidence from 2 dairy farms. *JDS Commun.* **2**, 345–350. <https://doi.org/10.3168/JDSC.2020-0064>
7. Ren, K., Alam, M., Nielsen, P.P., Gussmann, M., Rønnegård, L., 2022. Interpolation Methods to Improve Data Quality of Indoor Positioning Data for Dairy Cattle. *Front. Anim. Sci.* **0**, 53. <https://doi.org/10.3389/FANIM.2022.896666>
8. Churakov, M., Silvera, A.M., Gussmann, M., Nielsen, P.P., 2021. Parity and days in milk affect cubicle occupancy in dairy cows. *Appl. Anim. Behav. Sci.* **244**, 105494. <https://doi.org/10.1016/J.APPLANIM.2021.105494>
9. Benhamou, S., Cornélis, D., 2010. Incorporating Movement Behavior and Barriers to Improve Kernel Home Range Space Use Estimates. *J. Wildl. Manage.* **74**, 1353–1360. <https://doi.org/10.1111/J.1937-2817.2010.TB01257.X>

hands
on





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