

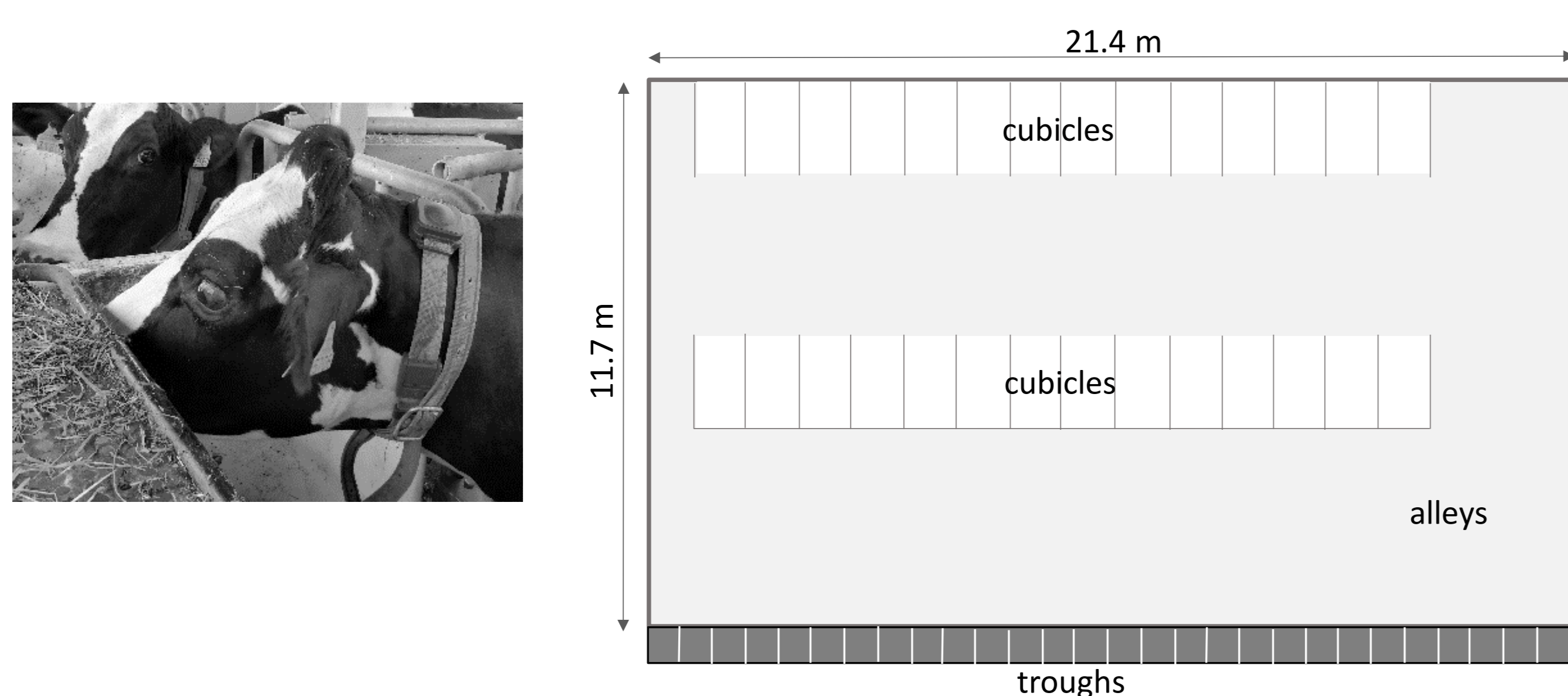
# Definition of indicators of activity from data provided by wearable sensors in dairy cattle

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The use of animal sensors offers the opportunity to continuously monitor and record specific behavioral or other biological/physiological measures in livestock species, including dairy or beef cattle. The sensors provide continuous dynamic signals that can be analyzed and modelled to obtain quantitative characteristics as possible novel biomarkers for phenotyping cows. These biomarkers vary in time and between animals and might have predictive value with respect to the ability of the animal to respond to disturbances. We investigated ways to acquire quantitative metrics describing dairy cow phenotypes from their behavior recorded with the use of sensors

## Methods

We examined ways to visualize data (e.g. so-called actogram), as well as basic mathematical operators (sum, average, weighted sum) and statistical methods (variance, RMSSD, autocorrelation, multivariate analyses). More sophisticated modelling approaches were used such as Fast Fourier Transformation, and several ad-hoc operators were developed. These calculations were applied to data from accelerometers (Nedap Smarttags) and a position system (GEA CowView).



**Figure 1.** GEA Cowview tag on the cow collar (left) and virtual partitioning of the pens to distinguish activities (right)



**Figure 2.** Nedap SmartTag Neck



**Figure 3.** Nedap SmartTag Leg



**Figure 4.** In- and Outdoor acquisition

## Results

**Table 1.** Examples of possible new descriptors for phenotyping cows with the use of sensor data

Descriptor	Definition	Purpose
Actogram	A graphical representation of an animal's phases of activity and rest over the course of a day [1]	Insight in circadian rhythm
Non-Periodicity	Indicator for the regularity of behaviour according to a known pattern [2]	Insight in deviations of a rhythmic pattern
Synchrony (animal level)	The tendency of an animal to follow the herds' behaviour	Indication in the synchrony of an animal related to the activity of the herd.
Synchrony (herd level)	Homogeneity of activity across animals from the same group	Similarity of activity across animals from the same group
Fractioning of the activity	The extent to which the activity of an animal is distributed in small bouts of given activities [3]	Insight in how often activities are changed
Fast Fourier Transformation	A measure of the regularity of behavior for once, twice, three times or four times a day [4]	Insight in circadian patterns of behavior
Dynamic indicators of resilience	Variance, Autocorrelation, recovery time [5]	Insight in micro-recoveries after perturbations

## Conclusions

- We proposed descriptors for the time budget of cows, the activity level, the distribution of activities or their level within days and across days (i.e. diurnal rhythm, the extent to which an animal performs the same behavior at the same times from one day to the next), and between animals (synchrony).
- We further explored the links between these descriptors and complex aspects such as health disorders or welfare state (oral presentation: DETECTION OF COMPLEX ANIMAL TRAITS FROM DATA PROVIDED BY ACTIVITY SENSORS, Veissier et al.)

## References

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