# The evaluation of a computationally simple algorithm for monitoring mounting activity in rams

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The introduction of on-animal sensors to agricultural research has garnered growing interest from Australian sheep producers to make such technology commercially available. This is especially true for a sensor that could monitor the mating activity of rams, as sources of reproductive wastage are often imperceptible in extensively managed animals (Alhamada, Debus and Bocquier, 2017). Such a device would allow producers to identify infertile, sub-fertile and low libido individuals as well as to facilitate better management of artificial breeding programs and lambing. However, commercial sensors must strike a balance between performance, affordability and robustness, particularly in an extensive environment. Machine learning methods traditionally used to analyse animal behaviour patterns in accelerometer data are computationally expensive and place a large load on battery (Valletta *et al.*, 2017). Due to these constraints, simpler predictive models are required in a commercial setting.

The primary objective of this research was to compare the performance of a random forest model against a single-feature algorithm in the detection of mounting activity in rams. The attachment point of accelerometers on the rams was also evaluated.

Tri-axial accelerometers (wGT3X-BT; Actigraph, Florida USA) were fitted to necks and withers of Merino rams (n=15) via a collar and harness prior to their individual introduction to a ewe in a pen. Each ram was allowed three minutes to interact with the ewe, twice over the course of a day. Signal annotation of the accelerometer data occurred post factum using video footage recorded continuously over the trial. Behaviours labelled included: running, walking, standing, courting and mounting. Following signal annotation, two types of algorithms were applied to the data to detect mounting events: a computationally expensive random forest (RF) model and a single-feature Moving Average Convergence-Divergence (MACD) algorithm of the z-axis. Precision, sensitivity and F1 score (the weighted average of precision and sensitivity) were used to evaluate the performance of each algorithm for both collar and harness data.

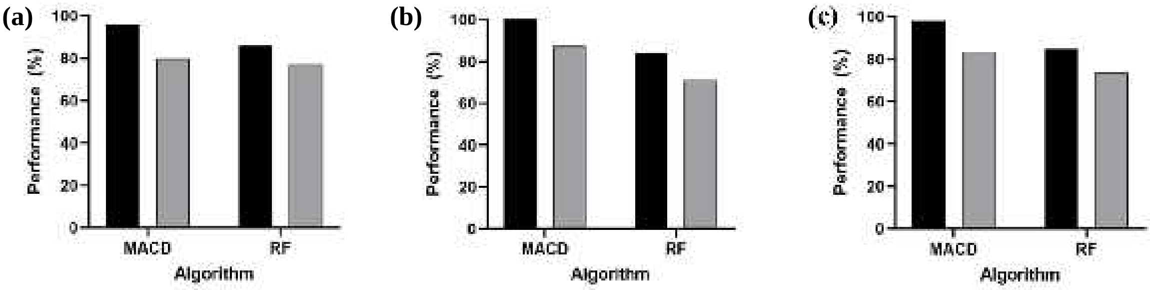


**Figure 1. The (a) precision, (b) sensitivity, and (c) F1 score of the MACD and random forest (RF) algorithms for the prediction of mounting events in harness (black) and collar (grey) mounted accelerometers.**

The MACD algorithm identified mounting events in harness data with extremely high precision (96%), sensitivity (100%) and F1 score (98%). The random forest model performed worse on the same set of data, identifying mounting behaviour with a precision of 86%, a sensitivity of 84% and an F1 score of 85%. The performance of both algorithms on the collar-retrieved data was lower overall compared to the harness data.

This research has demonstrated that behaviours such as mounting, computationally simple algorithms can outperform complex machine-learning models. Although it is unlikely that they could classify an extensive suite of behaviours, single-feature algorithms are advantageous for monitoring target behaviours. Future studies will focus on the evaluation of this algorithm in sensors developed for commercial application and the integration of Bluetooth technology to determine the identity of the ewe being mated.

## References

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Valletta JJ, Torney C, Kings M, Thornton A, Madden J (2017) *Animal Behaviour* **124**, 203–220.

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