Dairy Australia

Australian Government
Department of Agriculture

VIRTUAL HERDING RESEARCH UPDATE

ISSUE 07 | JULY 2019

'Enhancing the profitability and productivity of livestock farming through virtual herding technology' is a four–year project that began in July, 2016 to evaluate the application of virtual herding (VH) technology across different production systems and examine the responses of different livestock (dairy cattle, beef cattle, sheep) to various cues and stimuli to improve productivity and profitability in the livestock industries.

The project

The project received $2.6 million from the Australian Government through its Rural R&D for Profit program. A further $1.365 million has been provided by a number of Rural Research and Development Corporations and R&D providers. The R&D providers include, CSIRO, the University of Sydney, University of New England, the Tasmanian Institute of Agriculture, University of Melbourne and Agersens Pty Ltd, with additional contributions from Dairy Australia, Meat and Livestock Australia, Australian Wool Innovation and Australian Pork Limited.

Using VH, the research team will investigate the potential to constrain animals to certain areas (better grazing management and environmental outcomes), autonomously herd animals, or move individual or groups of animals in a herd differently to the rest of that herd. Fundamental research involving behavioural observations and physiological measurements will be critical to ensure that the technology does not compromise animal welfare.

Update on sub-program activities

Sub-program 3 Determine best Sub-Herd and Individual animal management for Dairy and Beef

Dr. Sabrina Lomax and A/Prof Cameron Clark, alongside PhD candidate Patricia Colusso have recently completed experiments assessing how individual cows learn a virtual fence in a grazing environment, and the role that hunger plays in dairy cow response to virtual fence cues.

To evaluate learning of a virtual fence (VF) in a strip grazing environment, twelve Holstein Friesian dry cows were fitted with an experimental prototype of the Agersen's eShepherd collars. Cows were allowed access to ⅓ of a one hectare paddock for three days using a VF, which was then moved to provide access to ⅔ of the paddock for days four to six. We evaluated where the cows spent their time in reference to the VF, and the number and type of stimuli delivered.

The VF contained cows within the predetermined grazing areas for 99 per cent of time. Initially, cows spent less time near the VF but over time, more time was spent near the VF as pasture was depleted. Cows were able to learn to associate the electrical pulse (EP) with the audio tone (AT) as demonstrated by a significant reduction in the ratio of EP:AT, from 29 per cent on day one to 9 per cent on day six. The number of electrical pulses delivered to individuals ranged from one to six. Further work should focus on this individual variation, including measures of welfare. This work has been submitted to 'Animals' for publication.

Dairy cows were trained to a VF in a 1 ha paddock. The VF was successful at containing cows in the inclusion zone. Cows spent more time near the VF as feed depleted.

We evaluated the effect of hunger on cow response to a virtual fence. Thirty-six Holstein Friesian cows were used in the experiment which was repeated across three blocks of time. Cows were trained in groups of 12 to a VF for six days prior to the experiment. Cows were then allocated to one of two feed treatments (six cows per treatment)

- a maintenance ration of lucerne/oaten cubes, or
- ad libitum consumption of the cubes.

Cow response to the VF was tested in a mown paddock (100m x 15m), using lucerne cubes as the feed attractant. A VF was set halfway down the paddock, and cows were allowed 30min to attempt to access the feed in their treatment groups. The test was repeated four times over three days. Overall it was clear that there was an effect of hunger, with only maintenance-fed cows crossing the VF to reach the feed. Across the 12 tests, maintenance cows attempted to reach the feed across the VF 12.5 per cent of the time. None of the ad libitum cows crossed the VF line. There was evidence that individuals were motivated by the behaviour of the herd, as it was noted that if one animal crossed the VF to reach the feed, others would follow.

The artificial test context in the above study limits interpretation of the results, therefore the next experiment will investigate the effects of the response to hunger in cows that are on pasture, to determine if it is possible to hold cows off fresh pasture allocations. For this experiment, 12 dry cows will be trained to the VF in a group for six days. Cows will be allocated a fresh 20m wide strip of annual ryegrass each day for four days, however on the 5th day they will be held for an additional 24h on the post-grazed pasture to test the response to hunger. This will be repeated across another five days, with behaviour and collar data (number and type of stimuli) evaluated.

The same cows will be used in a follow up experiment to evaluate the ability of the technology to keep two small groups of cows separated on pasture. This will help us understand the effect of herd and social motivations on cow response to the VF.

Sub-program 4 Identify opportunities for labour savings through the application of VF in sheep wool and meat enterprises.

Researchers at the University of New England and the CSIRO in Armidale, have conducted further sheep research to investigate the impact of virtual fencing on animal welfare and the use of virtual fencing to improve pasture utilisation.

Drs Danila Marini, Caroline Lee and Fran Cowley, investigated the use of virtual fencing for intensive grazing methods similar to techno-grazing. In this study, a virtual fencing treatment was compared to conventional electric fencing. Please note that the virtual fence treatment was achieved by using manual collars specifically developed for sheep, which limits the number of animals that can be studied in this type of research.

Sheep were allowed to graze small grazing plots for four hours and pasture measures were taken before and after grazing. Preliminary analysis of the results show that the amount of pasture consumed did not differ between the virtual fence and electric fence group. Furthermore, sheep in the virtual fence group were successfully contained within the allocated plots throughout the grazing period. These preliminary findings indicate that pasture utilisation in sheep is not adversely impacted by virtual fencing and is similar to conventional electric fencing systems.

Sheep confined to the grazing area by a virtual fence at Armidale)

Earlier this year, PhD student Tellisa Kearton conducted further research looking at the welfare impacts of virtual fencing on sheep. For her second study, Tellisa investigated the stress responses of sheep that were trained to the virtual fence using correct training techniques, compared to poor training techniques. When sheep are correctly trained to the virtual fence they learn to react to the audio warning and avoid receiving the subsequent electrical stimulus. This provides predictability (the audio warning) and controllability (avoiding the electrical stimulus by stopping or turning around) of their interaction with the virtual fence. Having good predictability and controllability is an important aspect of virtual fencing that ensures acceptable welfare status of the animals is maintained. Analysis of the results is currently being conducted.

Further work is planned for August this year that will look at using virtual fencing to herd or move a small group of sheep across a paddock.

Sub-program 5: Challenges for integration and adoption of virtual herding.

Ms Nikki Reichelt, a Research Fellow at The University of Melbourne leads this Subprogram and summarises some outcomes from this Sub-program below.

So what has been happening in Subprogram 5 over the past year?

Our program is developing an adoption pathway(s) for virtual herding technology (VHT) to be completed in 2020 based on two main research activities:

- a participatory technology assessment, and
- a cost benefit analysis of three case study farms.

In terms of the participatory technology assessment we have been engaging with a range of stakeholders in workshops and meetings to understand from their perspectives what the key considerations are for them to adopt or support the adoption of VHT. So far we have engaged livestock producers, natural resource managers, agricultural advisers, state public servants and food companies. We will also meet with meat and dairy food processors and try to gauge the likely response of the general public to the technology to complete our stakeholder engagement at a supply chain scale.

What have we found out so far?

We now have a set of key considerations for adopting virtual herding technology that have been confirmed and reinforced during our workshops and meetings. (see table below)

Overall, our stakeholder engagements have been highly informative experiences for both participants and project members. In one case, it has resulted in additional project work with project team members and a regional natural resources management organisation to trial the use of VHT for water quality management.

'Participants at the Agricultural Advisor Workshop held in 2018'

What have we got planned?

In addition to the stakeholder engagement, three cost-benefit analyses (CBA) of the implementation of VH on farms will be conducted, one each of dairy, extensive beef and sheep/cropping enterprises. This work will be conducted by Brendan Cullen and Nikki Reichelt from the University of Melbourne) and Dan Armstrong from D-ARM Consulting. A partial budgeting approach will be used to estimate the return on investment from adopting VHT using real case-study farm data. The CBAs will draw on the findings of the other sub-programs in the Project to inform the applications and benefits of VHT. However, as uncertainty may exist about the magnitude of the benefits that can be achieved, a 'sensitivity approach' will be adopted (eg high, medium or low expected benefits). Environmental benefits will also be documented in these case studies.

Table 1 Key considerations for adopting virtual herding technology

Keep in mind
End users being able to anticipate multiple benefits from adopting VHT for whole farm systems management
Transforming the proof of concept into a clear and customised value proposition per industry and farm
Using VHT to manage livestock health and wellbeing alongside accurate messaging to the wider society about VHT
Developing a data governance system for VHT data: ownership, access, security, privacy, sharing protocols and integration
Provision of a comprehensive adoption support service from awareness raising to strategic decision making
Moving towards a regulatory sensibility to ensure VHT is used effectively for productivity, profitability and sustainability

Latest news

- Dana Campbell will be discussing animal welfare in the beef industry at the Northern Beef Research Update Conference between 19 and 22 August in Brisbane.
- Sabrina Lomax has been selected to take part in the Sydney University Womens Mentoring Program in 2019. Sabrina will be assigned a mentor to support her through this experience of personal and professional development.
- Congratulations are in order for Dr Sabrina Lomax, who, in collaboration with Dr Lachlan Ingram, has recently been awarded $400K from the John and Betty Casey Trust for their project, 'Managing Pastures and Cattle for Maximum Productivity'. This project will determine the energetic efficiency of grazing cattle behavior to enable better selection of productive, efficient animals in a changing environment.
- Ms Nikki Reichelt will be visiting Norway in June to present a paper at the European Society for Rural Sociology Conference held in Trondheim. In addition Nikki will meet with the principals of NoFence **translate.google.com/translate?hl=en&sl=no&u=https://nofence.no/&prev=search** to discuss the adoption strategy and pathways for their Virtual Fence technology, which has been developed for goats in Norway.
- Nikki Reichelt, Ray King and Dairy Australia Communications staff have produced a short Virtual herding video. You can access this video through the link **youtu.be/SYLK4qlH2eE**. This six minute video helps explain the virtual herding technology and shows some of the responses of livestock to the cues associated with the technology, that we been observed in several of our experiments in the Project.
- Sub-program Leaders have been busy presenting the results of their work in the Project to industry conferences around Australia. Further details on scientific publications and media articles are available on the respective links on the Project web-pages on the Dairy Australia website **dairyaustralia.com.au/farm/animal-management/technologies/virtual-herding-program.**
- Agersens announced in June that they have successfully completed a capital raising of $14.75 million, having received further support from existing investors, including the Gallagher Group (am.gallagher.com/au). The proceeds from the capital raising will allow Agersens to scale up and prepare to handover marketing and sales of eShepherd to Gallagher in Australia and New Zealand.
- Ian Reilly will transition from CEO to a newly created Ambassador role within Agersens. The new CEO, Jason Chaffey was a co-founder of Agersens and has played an instrumental role in the successful growth of Agersens to where it is today.
- The seventh Milestone Report for the project is being prepared and will be submitted to the Department of Agriculture in August, 2019. The Project has been extended and will now finish at the end of November in 2020.

FOR FURTHER INFORMATION

The website for this project has been established on the Dairy Australia website **dairyaustralia.com.au/farm/animal-management/technologies/virtual-herding-program**. The site contains information about project activities and recent news about the Project, including copies of a number of presentations that members of the Project Team have made to industry over the past few months.

Agersens also have a website at **agersens.com/** where you can keep up to date with the progress of commercialisation of this exciting technology.

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19472 | July 2019

This project is supported by funding from the Australian Government Department of Agriculture as part of its Rural R&D for Profit program.