Virtual fencing and cyber herding

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Abstract. Virtual fencing is a means of containing stock either inside or outside of areas delineated by some form of transmitted signal which is received by a device located on each animal. The device controls the animal's movements through electrical, sound or other stimuli. Cyber Herding allows stock to be controlled from a remote location by transmitting movement signals to these on-animal devices. Cyber Herding can be effective over very remote distances opening up the potential for stock to be moved hundreds or even thousands of kilometres in search of the best foraging or grazing conditions.

Introduction

Thanks to Nicole, the Kidman name is a household word in Australia today. A century ago her namesake Sidney was equally well known and respected. Sidney Kidman earned fame and fortune as a cattle drover and station owner during the early settlement of South Australia. The Kidman family eventually owned stations covering a huge area around Birdsville and extending as far as Broken Hill in the south-east to near Alice Springs in the north-west. Not bad for a boy who left home at age 13 with his life savings of 5 shillings (50 cents today) and his faithful one eyed horse Cyclops.

Sidney Kidman was a shrewd businessman and an expert cattleman. He initially made his money by buying cattle on remote inland stations and droving them to the Adelaide markets. His droving routes and his droving seasons were selected to ensure that there was a good supply of feed throughout his journey. His droving routes and journey times were not fixed but followed the local weather patterns – chasing storm activity so that his cattle would arrive at a feeding site about 2 weeks after heavy storm rain and be able to feed off the rapidly growing natural grasses. These strategies allowed him time and again to arrive in Adelaide with prime beef, which he was able to sell for top dollar. Later with his vast chain of family properties he was able to move his cattle around to maximise feed opportunities.

We don't see this level of droving and cattle movement today. The vast areas that Kidman covered have been divided and fenced. Cattle stay on one property until sold and trucked out. Fine in a good season, but expensive in a drought.

Imagine returning to the droving days of Kidman and moving numerous herds of cattle around Australia's massive grasslands and rangelands with the drovers selecting the best grazing locations on a daily basis.

While Kidman did this and did it well, 10,000 Kidmans each vying for the best grazing areas would be chaotic. Also the cost of 10,000 groups of drovers paid to be on the road for 12 to 24 months at a time would be very expensive compared with paying fencing contractors to set up boundary fences and paddocks where the same cattle could be left unattended for most of the time.

Fences themselves are expensive and need continual maintenance while the boundaries they create are artificial in relation to nature. For example a storm will not start and stop between boundary fences of a property even though the owner of a drought stricken property may often be convinced that his neighbour always gets all the rain.

The days of turning out cattle into large paddocks and letting them fend for themselves until the paddock has been completely grazed are numbered. Cell grazing is one method of utilising the grazing environment, but requires more control of the cattle and much more fencing. This paper describes technology that is available to graziers in the way of virtual fencing and "Herd Masters". It also suggests future technology and applications of technology.

Virtual fencing

The cost of fencing can be reduced very effectively by the use of electric fences, however, we are now in a position to take this concept one significant step further and essentially make each individual animal carry its own personal electric fence. This concept has been called virtual fencing since it does not involve a real fence but the animal can receive the equivalent of an electric fence shock if it strays beyond a boundary defined by some form of radio transmitted signal. A similar concept has been used effectively for the last 20 years to keep pet dogs from straying outside a defined boundary around the owner's house. Research has shown that it can work just as effectively with cattle and possibly all other species of grazing animals.

Of course a virtual fence would appear to be a different type of fence to an animal then would a normal electric fence. The animal can see an electric fence and also probably sense the presence of the electric pulses well before it makes contact with the fence so it learns to stay away from the fence after receiving a small number of aversive shocks. With a virtual fence there would be no visual cues as to the boundary, the animal simply receiving a shock "out of the blue" if it tried to cross this imaginary boundary. This would be enough to make any animal paranoid about moving anywhere so additional cues such as warning sounds must be emitted from the device well before the boundary is reached and the animal must be trained to understand and respond to these cues. We know that about 95% of cattle can be readily trained to respond to these cues. With selective breeding for trainability and early herd conditioning we would expect this figure to improve rapidly over time. The other important aspect of grazing animals is their herding instinct. If you concentrate on training the herd leaders then the rest of the herd will simply follow them.

Cyber herding

This brings us to the concept of a latter day Kidman but instead of a drover with his dogs we can imagine a "Herd Master" capable of leading the herd to the best grazing areas and returning the herd to a safe camping and watering area each evening. The Herd Master is a motorised robot, a bit like the Rovers that are currently exploring Mars but more the size and construction of an ag bike. The Herd Master navigates by satellite GPS and can take the herd out along predefined grazing routes and even move the herd between camping grounds just as Kidman did. But the Herd Master does not need to have Kidman's instinct for finding the best grazing areas as other satellites can now provide this information with a speed and accuracy that Kidman could not have imagined in his wildest dreams.

The chaos of having 10,000 Kidmans can now be replaced by 10,000 robotic Herd Masters each following well planned routes to optimise the grazing of each herd. This maximises the use of available feed and also allows grazing to be used as a form of environmental control in both grasslands and rangelands, such as skirting around environmentally sensitive regions while heavily grazing grasses which would otherwise encroach onto these areas. Basically, this is what a good grazier would do but on a much larger scale than any individual farmer could ever cope with.

While the Herd Master is capable of producing aversive electric shocks in straying animals, this would not be its prime mode of herd control. Just as with a natural herd leader the Herd Master would be seen by the herd as the one that leads them to good feed, shelter and water and keeps them free of danger. Rewards in the form of salt licks and molasses based supplements can be associated with the presence of the Herd Master. The Herd Master can be used to gather the herd at an evening campsite in such a way that each animal can be routinely weighed and identified. Information gathered by the Herd Master can then be transmitted back by satellite to the Herd Control Station allowing real time monitoring of the growth and health status of the herd. On demand the Herd Master can also move the herd to mustering yards where they can be processed, medicated and drafted. Since all of this can be managed and controlled by a computer located basically anywhere in the world the name Cyber Herding has been coined.

A unique feature of Cyber Herding is that several herds can be combined into one large herd and then drafted into several different herds again without human interference or the use of drafting yards. This can be done because each animal is receiving its own personal signals for movement control. One Herd Master can take control of part of another Herd Master's mob at any time. If 2 or more mobs are brought together by their Herd Masters, a simple cyber space reassignment of cattle between the Herd

Masters can then send each Herd Master off with a different group of animals. Or if for example 2 extra Herd Masters are introduced to a single mob then the mob can be drafted 3 ways by assigning selected cattle to each of the Herd Masters.

Cyber herding is not only for rangelands grazing where mobs of cattle are being controlled from remote locations and may be moved over vast distances – maybe even thousands of kilometres. Cyber herding is totally applicable to all grazing situations including intensive grass finishing and dairy farming.

For instance, a dairy herd can be controlled by a Herd Master to strip graze irrigated pasture. In this case, a Herd Master can take control of the dairy herd immediately after milking, take the herd out to its assigned pasture and then return the herd to the milking shed. In principal, a dairy farm could be run without the need for a single paddock fence and the dairy farmer would only be involved with handling the cows at the milking shed. Herd Masters for control of dairy herds would not have to control cattle over as large a distance as would be needed in rangelands grazing, would not have to be so robustly built and would only need to travel several kilometres a day. The Herd Master for a dairy herd would therefore be a much smaller and cheaper device than its rangelands equivalent.

An enormous advantage of Cyber Herding is the ability to remove physical restrictions on where a herd can be located. For example, a herd does not have to be relegated to a single property, but can be assigned to move and graze across a range of properties. This means that feed utilisation can be managed over massive areas. Therefore, when combined with rainfall and pasture quality information, herds can be continually moved to areas of maximum feed potential. Currently, in a drought situation we see properties in the worst affected areas completely denuded of feed because stock have been held as long as possible in the hope that drought conditions may break. In Cyber Herding this situation does not need to arise. With proper forecasting and planning, areas can be classified as having lesser or greater grazing potential and stock progressively moved to better grazing areas if drought conditions start to build up in one location. The result would be that by the time an area was in severe drought all grazing livestock would have already been moved to areas with better conditions – even if that meant having moved them halfway across the state. This does not mean relocating thousands of animals out of a drought region but potentially relocating millions of animals. Therefore the expenses associated with selling stock including rounding up the cattle, offering them for sale, getting a good sale in a highly depressed market, transporting them to a new location, which in a drought may itself be a thousand kilometre trip, would no longer exist. This is because the stock relocation would just be part of the normal daily management procedure.

Cyber Herding at this level would change the way individual producers would need the think about ownership of cattle. The cattle they owned would not necessarily reside on their property while the cattle that were grazing their property could be owned by a multitude of people. Each grazier would be responsible for maintaining his property to a level capable of producing good grazing in good conditions and for the general welfare of the cattle on the property, such as the provision and maintenance of watering sites and holding yards. The cattle themselves would become a more general trading commodity then they are now, anybody could "own" them but would be paying each grazier for the right to utilize his feed, water and facilities.

Conclusion

The technologies required to implement this form of stock management are certainly available. While the ability to control stock by using "on-animal" electronic devices has now been researched for a number of years I believe that there remains much room for improvement in the way these control devices work. The effectiveness of these devices is ultimately tied to an animal's herding instinct and a much fuller understanding of animal behaviour is essential if the potential of these devices is to be fully exploited.

Wireless fencing can be implemented in a number of ways including fixed point transmitters and extended wire transmitters which are preferably strung several metres above the ground in order not to hinder vehicle and native animal movements. It is also conceptually possible to have GPS receivers built into the on-animal devices which would then allow direct control of each animal by satellite. The Herd Master concept described in this paper is but one facet of wireless fencing. Fixed transmitters and transmitting wires will also play their part along with conventional fencing.