Guide to automated heat detection technologies

This guide is designed to help you to understand the automated heat detection technologies currently available in Australia. It outlines why you would consider using such technologies, how they work and what key features could impact your choice of the best system to adopt.

Before purchasing an automated heat detection system, you should consult your veterinarian or herd reproduction advisor to ensure that the technology is appropriate for your herd management practices.

Why use automated heat detection technologies?

Detecting cows on heat has become increasingly difficult as:
Herd sizes have increased.
The availability of skilled labour has decreased.
Cows are having shorter heats of lower intensity.

An increasing number of Australian dairy farmers have adopted automated heat detection technologies to save labour and improve heat detection efficiency.

Automated heat detection systems are an aid to heat detection as they do not directly diagnose cows in heat. Cows that are flagged as being on heat require further investigation to determine if they are in fact in heat, so it is essential that your stock people are properly trained.

Automated heat detection systems may benefit herds with poor fertility as the technology is designed to more accurately identify animals in heat, which should increase submission and insemination rates. Herds with high submission rates and conception rates are unlikely to see reproductive benefits but there may be savings in medication and labour costs.

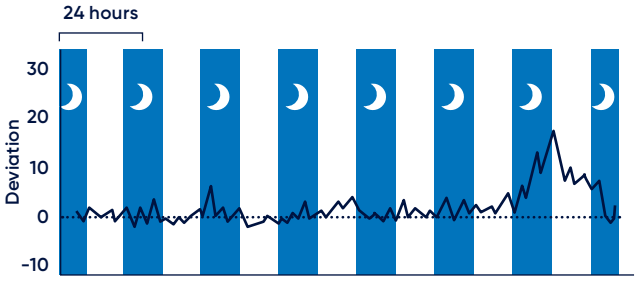
Dairy Australia has a network of specialised Repro Right fertility advisors (herd fertility advisors) who can investigate, troubleshoot and assist dairy farmers to develop tailored solutions that fit their farm business. For more information, visit **dairyaustralia.com.au/animals/fertility/find-a-herd-fertility-advisor**.

How do they work?

The central piece of technology is a monitoring device available as either a bolus or that is attached to the cow by an ear tag, leg strap or neck collar. The monitoring device contains sensors that are embedded inside a waterproof housing that also includes a battery, a miniature data processor, temporary data storage (24 hours or more) and a data transmitter.

Most automated heat detection systems work by using one or more sensors to monitor parameters that can be related to a cow's heat cycle or health. For example, time spent walking, lying, grazing, ruminating or changes in body temperature. The system develops a baseline level of activity for each cow and then monitors changes to this baseline over time. When a cow is in heat, she becomes increasingly restless. The changes in each cow's activity over several hours provides an indication of the optimal time for insemination.

Delivering for Dairy



In many systems, the monitoring device uses radio frequency to transmit the results to a receiver either in the milking parlour or out in the paddocks. Once the receiver picks up the data it is then transferred to a base computer via cable or wirelessly via Bluetooth, mobile data or Wi-Fi. Some systems can transmit from the receiver directly to an internet-based cloud application using mobile data or a local Wi-Fi network.

Once the activity data has been received, it is stored, processed and can then be retrieved for reporting on individual cows or the herd. The data is processed using proprietary algorithms (formulas) to compare each of their activity periods against their baseline and in some cases also against the whole herd's activity. In some systems this algorithm can become more accurate by learning from your own data.

An individual cow's relative activity is usually displayed in a graph with alerts and warnings indicating that the cow may be on heat. If automated drafting facilities are available, the system may then create auto drafting lists of cows for insemination. Extreme reductions in cow activity can also be noted, providing you with alerts of cows with changes in their activity that may indicate illness or lameness or that the calving process has begun.

How good are they?

Over the last few decades advances in technology have resulted in large improvements in the performance of this technology. In practice, most commercially available products use similar sensors, have little variation in their performance and their ability to detect cows on heat is more than adequate.

When measuring the performance of a system to select cows for Artificial Insemination (AI) there are two key areas; firstly the ability to detect cows on heat, and secondly the ability to determine the best time to AI.

Detecting cows on heat

These systems can detect a high proportion of cows actually on heat (heat detection rate) but in doing so they sometimes select cows not on heat (false positives). Raising the activity threshold required for an alert will decrease the heat detection rate but improve the accuracy (fewer false positives).

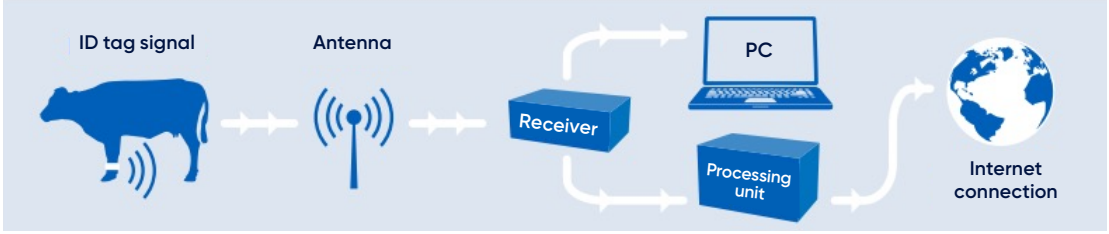
Alternatively, reducing the threshold will increase the heat detection rate but decrease the accuracy (more false positives).

- A typical result would be a heat detection rate of around 85 per cent with up to 20 per cent of alerts being false positives. This means that for every 12 cows actually on heat, ten will be detected and two will be missed. For every ten cows the system detects, eight will actually be on heat and two will not.
- Activity alerts can be combined with other information such as the last time the cow was recorded on heat and visual observations by an experienced stockperson or AI technician. This will help improve heat detection accuracy without substantially reducing the detection rate.
- Combining activity data with rumination monitoring also improves heat detection performance as rumination often decreases during heat.

Using onset of increased activity for timing of AI

Timing AI for best conception rates is all about co-ordinating the arrival of sperm in the oviduct with the time of ovulation. Inseminations as close to but before ovulation have been shown to give the best conception rates. Onset of increased cow activity has been shown to be a good predictor of timing of pending ovulation and thus a good indicator of best time to AI.

- The average interval from onset of increased cow activity to ovulation is approximately 30 hours. The reported best time to inseminate cows following the onset of increased cow activity varies between studies with ranges from 6-24 hours, with a 12-16 hour interval as the target.
- In practice, the best time to AI based on onset of increased cow activity will vary between systems due to the different definitions and algorithms used. It will always be best to refer to the advice provided by the manufacturer as they will have results from their own system using large amounts of data.
- Best timing will also vary depending on the quality and quantity of semen in each straw. The higher the quality and quantity the longer the time from AI that viable sperm is likely to be present when the egg arrives in the oviduct following ovulation. Thus, the optimal window of time for insemination with conventional semen is usually wider and several hours earlier than for sexed semen.
- Again, it will be best to take specific advice from the manufacturer of the system about the best time to inseminate when using the different types of semen.



Herd reproductive performance

- Research trials in year-round herds have shown that using activity meter systems to select cows for AI can achieve InCalf rates as good as or better than the use of routine timed AI programs.
- Manufacturers claim that significant improvements in reproductive performance may be observed within the first few years of installation.
- Reductions in the average number of days open (calving to conception interval) of approximately 20-30 days have been reported.
- The proportion of cows pregnant at pregnancy test have been reported to improve from around 70 per cent to 90 per cent.

What is the cost and time to set them up?

Automated heat detection systems now have a wide array of features and purchasing models available, including buying outright or using a lease/subscription model. The costs are impacted by the brand, features, purchasing model, length of expected life, warranty, the number of monitoring devices and receivers required, the need for additional software or hardware updates and future compatibility.

Indicative device costs

- Standard Heat Detection and Animal Health – equivalent to approx. $30 to $60/cow/year.
- Including Virtual Fencing – additional $100 to $150/cow/year.

Buying a system outright may reduce device costs/cow/year however it is important to assess the full financial impact relative to other purchasing models. Setup costs can also be offset by technology grants so before making a purchase, review what grants or other support may be available.

In general, most herds can install a system in one full day however they may also split the installation over multiple phases to manage costs and the impact on farming operations. Set up will involve:

1 Applying the devices to cows.

2 Installing antennas, receivers and connecting to solar or mains power.

3 Installing software on a computer located near the dairy and connecting the computer to the internet. Some systems can use a custom data terminal avoiding the need for a computer and software.

Consideration will need to be given to the available labour, Occupational Health and Safety (OH&S) risks, and facilities required for handling cows to attach sensor devices. If power is not already available at the site of the receivers, then this may need to be arranged prior to installation. A suitable computer, internet connection and office area may need to be set up near the dairy if one does not already exist.

Automated heat detection systems deliver the most value when the herd manager is motivated to make the system succeed. Farms need to invest in training and allow staff time to actively manage the technology and correctly interpret the data.

Successful automated heat detection systems require:

Support

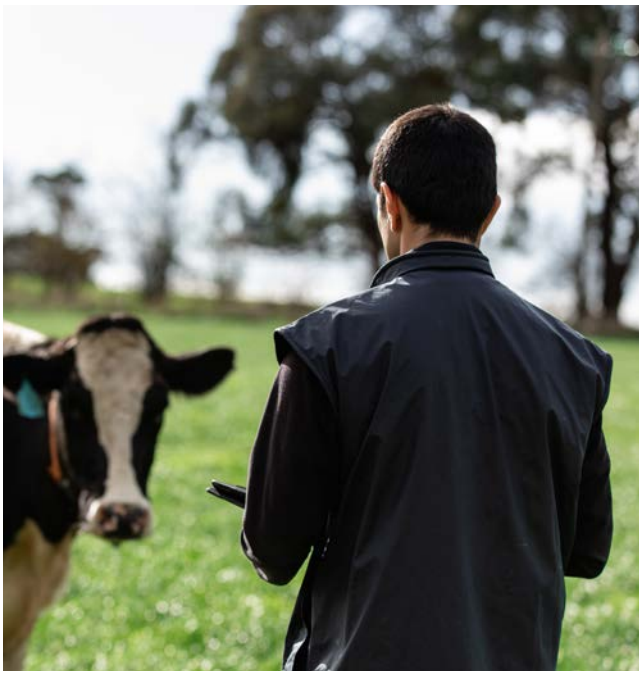
Be confident in the availability of locally-based and skilled support for technical issues, operating the system and interpreting the data.

Integration

Most heat detection technology is designed so it can be operated standalone, however if it can be integrated with the current farm management platform this will minimise the need for multiple data entry and allow reporting and list creation from one single integrated system.

Be easy to use

Having a user-friendly interface will improve adoption, accuracy and efficiency. The mobile and desktop processes for data entry, viewing reports and making target animal lists need to match staff requirements.



What other factors are important when choosing a system?

- Battery life and replacement:
  - The expected battery life of different devices ranges from two to 10 years.
  - If batteries cannot be replaced, then device life is limited to the battery life.
  - If batteries can be changed, then consider the extra time and labour required.
  - Battery saving features may be available, such as the ability to turn on and off when not in use and the ability to change how often the data is transferred.
- Warranty:
  - Full replacement warranty ranges from one year to five years.
  - Some systems have a full warranty period followed by a pro-rata warranty.
  - Extended warranty can be purchased in some systems.
- Monitoring device format (Ear, Leg, Neck, Bolus):
  - Consider the ease of applying and removing devices from cows if you plan to change them from cow to cow to reduce the level of investment.
  - Straps may be difficult to undo after some time.
  - Review the impact of your feeding, watering, housing and handling facilities and OH&S involved (may differ for cows and heifers).
  - Consider cow comfort and device durability in wet muddy conditions.

Additional features:

  - Rumination monitoring may improve heat detection capability, transition management and provide early detection of sick cows and other changes in cow feeding patterns.
  - Tri-axial accelerometer sensors may provide other useful information such as identifying at-risk cows including lame cows, downer cows and grazing or other feeding or drinking behaviours.
  - Individual cow identification and positioning data to allow real time location of individuals or groups of cows and heat mapping for pasture management processes.
  - Virtual fencing using audible and physical cues to direct cow movement.

What are the benefits?

The greatest benefits will occur in herds with previously high medication and labour costs and poor reproductive performance. Many manufacturers have used their own case study herds to calculate a payback period and return on investment. Reported pay back periods range from one to three years and depend on the assumptions and figures used.

The typical benefits of an automated heat detection system include:

- Improved reproductive performance through increased submission rates and conception rates.
- Increased revenue from improved reproductive performance including increased milk production and more replacement cows being available.
- Reduced labour costs from less time spent on observing heats, administering medications, identifying and drafting cows for AI and pregnancy testing.
- Reduced direct costs for reproductive treatments, pregnancy diagnosis and semen

For more information, visit dairyaustralia.com.au, email enquiries@dairyaustralia.com.au or call 1800 004 377.

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