



Precision Dairy That Pays

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The purpose of precision livestock technologies is real-time monitoring of animals to enhance the “eyes and ears of the farmer” [1]. Precision livestock farming manages a livestock production system according to “the principles and technology of process engineering.” Individual management is especially important for high-value animals, such as sows and dairy cows [2]. Precision technologies designed specifically for dairy applications are called precision dairy technologies [3]. Variables measured by technology can be related to several health, management, well-being, reproduction and production characteristics. However, technology must fill an on-farm need and be economically feasible.

Technologies can be wearable, part of the milking system, a stand-alone system that does a specific task (body condition scoring, automatic weights, etc.) or part of the management software [4]. Technology development stages are divided into four categories: 1) measurement (quantification); 2) interpretation of measurements (classification); 3) a combination of interpretation with other information; and 4) decision support or creation [5]. As technologies become more sophisticated, they should be able to move from a standard report, i.e. number of steps taken, to an alert, i.e. cow is in heat. In the future, technologies may be able to predict

diseases, calving or even optimize an entire farm operation based on individual animals and farm management practices. In order to achieve this, multiple technologies must be able to integrate and analyze data in a familiar platform for the end-user, the dairy farmer.

One of the most commonly available technologies is behavior monitoring systems for heat (estrus) detection that can also extend to health monitoring. These technologies are available from several companies in many forms including leg tags, neck collars and ear tags. Most of the tags use a tri-axial accelerometer which measures movement in three directions (Figure 1.A). Then, the raw information is transferred into something usable like activity (steps per day or neck and ear movement), time spent lying or standing and even rumination and eating time. Figure 1.A may look complicated, but it uses the same type of accelerometer that is used in most smartphones. Think about holding your phone in front of you. As long as the phone is held vertically (Figure 1.B), the screen will remain vertical. Think about this as a cow standing or being vertical. However, if you switch the phone and hold it horizontally (Figure 1.C), the screen will switch and become horizontal. This would be similar to a cow lying down and having a change in how the tag is oriented compared to the ground.

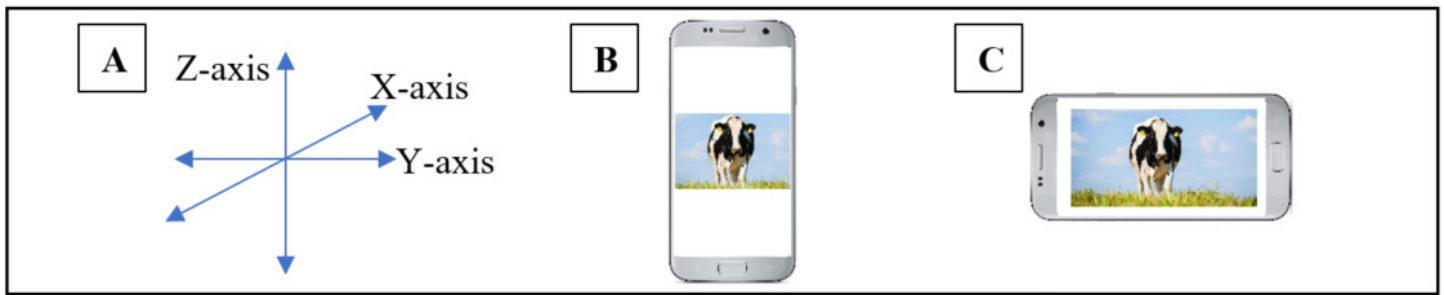


Figure 1. Tri-axial accelerometers measure movement in three directions (A). Examples of a phone held vertically with screen orientation (B) and horizontally with screen orientation (C).

Based on these behaviors, a technology uses algorithms to predict when an event, like estrus, will happen. The technologies send information to a computer and/or smartphone that can generate reports that suggest which cows to breed and when to breed them.

Even though many technologies currently exist, and more are being developed, farmer adoption has been slower than expected. Farmers being unfamiliar with technology, an undesirable (or unknown) cost-to-benefit ratio, information overload, not enough time to spend on technology and lack of perceived economic value [6] are all reasons for this lag. Especially in tough economic times, investment in an additional tool may not make sense. If you are considering investing in a technology, think about the following wish list:

1. Does the technology explain an underlying biological process, i.e. a reason behind a change?
2. Does the technology provide information in a simple and solution focused way?
2. Can the information be translated into a meaningful action?
3. Is the technology cost-effective?
4. Is the technology flexible, robust and reliable?
6. Is the information readily available?

Keep in mind, this is a **wish list**. A technology may provide all, none or some of these wishes.

From a financial standpoint, technologies can pay for themselves in a variety of ways. They may increase milk production, decrease labor costs (fewer employees or fewer hours), improve animal health, improve heat detection or reduce cull rates [7]. From an investment standpoint, consider what the largest need

is on **your** farm. If you have excellent heat detection, investing in a heat detection technology may not be economically feasible. Similarly, if labor is difficult to find or keep, investing in something like an automated feed pusher or automated milking system may make economic sense. Ask your neighbors what technology they have used and how they like it. Consider who has a good service team in your area. An excellent technology with a poor service team will be less beneficial to you than an adequate technology with an exceptional service team. Technologies can and will have issues, and you will want a service team who will be there to help you when those issues happen. Finally, consider if a technology is your best financial option. Can you achieve the same results with tail paint, heat detection patches or by following protocols in the parlor or for your fresh cows? Have clear discussions with all farm partners, and get the opinions of industry experts and Extension agents you trust.

You also need to be very aware of the technology's sensitivity (number of true events correctly identified) and specificity (number of false events correctly identified). Why? Because false positives and false negatives are both costly. If a technology incorrectly tells you a cow is in heat, you will pay for the labor, semen costs and compounded cost to breed a cow that will not become pregnant. Similarly, if technology incorrectly tells you a cow is not in heat, you will miss the opportunity to breed and pay the compounded maintenance cost to keep an open cow until her next heat cycle. Ideally, a technology should be upward of 90 percent sensitive and specific. However, these two measures constantly fight each other and current technology may not be able to meet these demands. This does not make a technology useless or unprofitable, but it should be taken into consideration.

Technology can do amazing things and can be a profitable part of your farm. To make sure it is, keep these things in mind:

- Choose a technology that meets a need on your farm.
- Choose a technology with proven success and a good service team.
- Avoid using technology as a shortcut in place of good management practices.
- Choose a technology that you are willing to use and incorporate into your farm.

If you have any questions, please contact your **local Extension agent** or Liz Eckelkamp at 865-974-8167 or eeckelka@utk.edu.

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