Detecting Lameness Before It Becomes Obvious

Using automated monitoring to identify early changes in cow mobility.

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Lameness remains one of the most persistent challenges affecting dairy cow well-being, productivity, and longevity. Although severely lame cows are recognizable, changes in mobility often develop gradually, making early identification difficult, particularly in large herds where individual observations are limited by labor availability and competing management priorities. Periodic locomotion scoring provides useful information, but it may miss changes occurring between assessments.

Automated camera systems offer another approach by collecting repeated measurements as cows move through designated areas of the dairy. Rather than relying exclusively on occasional visual assessments, these systems can track changes in posture and locomotion over time, summarize mobility patterns across management groups, and identify animals requiring closer examination. The practical opportunity lies not simply in generating more locomotion scores, but in converting repeated observations into information that supports timely management decisions.

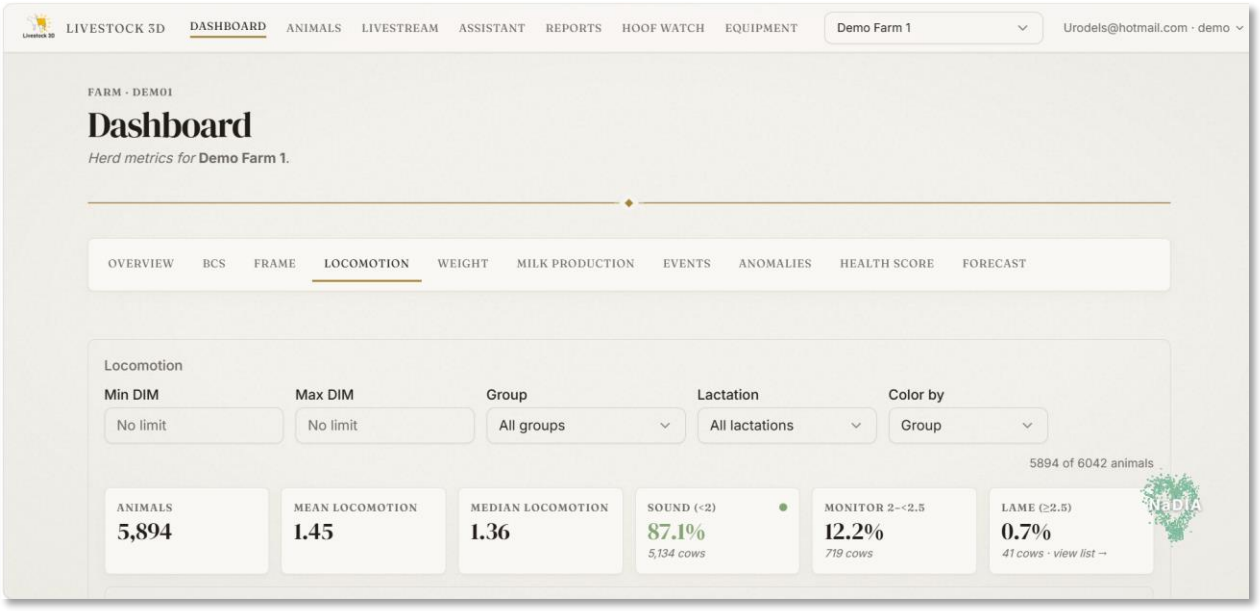
From individual observations to a herd-level picture

Automated locomotion monitoring provides a herd-level perspective that is difficult to obtain through periodic visual assessments alone. By collecting repeated measurements as cows pass beneath cameras, these systems can summarize mobility patterns across large populations and identify animals requiring closer attention. Figure 1 illustrates this approach using actual herd data collected with the Livestock 3D camera system.

Of the herd's 6,042 animals, 5,894 were included in the locomotion assessment. The mean locomotion score was 1.45, with a median of 1.36, on a scale from 1 to 5, where lower values indicate better locomotion. The automated scores are based on a five-point locomotion scale adapted from Sprecher et al. (1997), although the camera-generated measurements and classification thresholds are specific to the monitoring system. Most assessed cows (87.1%) were classified as sound, with locomotion scores below 2.0. Another 12.2% fell into the monitoring category, with scores from 2.0 to below 2.5, while 0.7% were classified as lame, with scores of 2.5 or higher, according to the system's thresholds. The ability to examine these results by days in milk, lactation number, and management group adds practical value. An increase in locomotion scores concentrated within a particular group or stage of lactation may indicate conditions requiring investigation, including flooring, hoof health, or cow comfort.

These patterns do not establish a diagnosis, but they can help managers direct their attention toward animals and groups where further examination may be justified.

Figure 1. ***Herd-level locomotion assessment using automated 3D camera monitoring.*** *Locomotion scores from 5,894 cows illustrate the distribution of animals classified as sound (87.1%), requiring monitoring (12.2%), or lame (0.7%), according to the system's scoring thresholds. Filters for days in milk, lactation number, and management group allow managers to investigate mobility patterns within the herd. Source: Livestock 3D.*



Looking beyond the herd averages

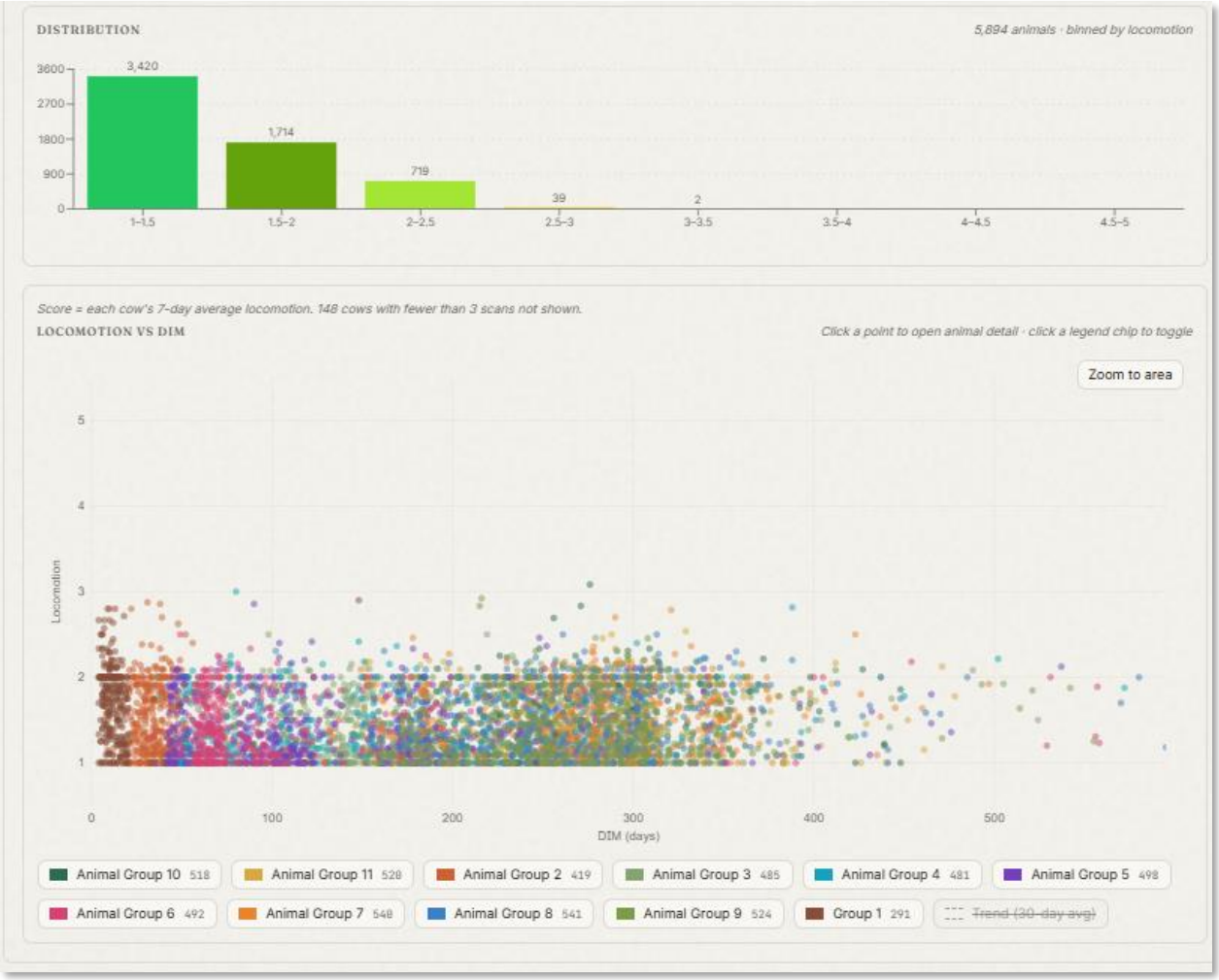
Herd averages provide a useful starting point for evaluating locomotion, but they can conceal differences among individual cows and management groups. Examining the distribution of locomotion scores reveals how many animals fall within different mobility categories, while relating those scores to days in milk (DIM) helps identify patterns associated with stages of lactation. Figure 2 illustrates these complementary perspectives using automated measurements collected from individual cows.

The upper graph shows the distribution of locomotion scores across the herd, with most cows concentrated at the lower end of the scale Although few cows exceeded the system's lameness threshold, the distribution reveals a larger population with intermediate scores that may warrant closer observation. The lower graph plots each cow's seven-day average locomotion score against DIM, with colors distinguishing management groups. This makes it possible to examine whether elevated scores are concentrated during particular stages of lactation or

within specific groups. For example, a concentration of higher scores among fresh cows could justify examining transition management, flooring conditions, hoof health, and cow comfort.

These patterns do not necessarily indicate a common cause or confirm clinical lameness. However, they provide a basis for directing further investigation toward particular groups or stages of production. Individual observations can then be examined more closely, allowing managers to move from recognizing herd-level patterns to identifying cows that may require clinical evaluation.

Figure 2. Locomotion patterns across lactation. *The upper graph shows the distribution of locomotion scores across the herd, while the lower graph relates individual cows' seven-day average scores to days in milk, with colors identifying management groups. Together, these views help managers identify differences in mobility among groups and stages of lactation that may warrant further investigation. Source: Livestock 3D.*



From locomotion scores to cows requiring attention

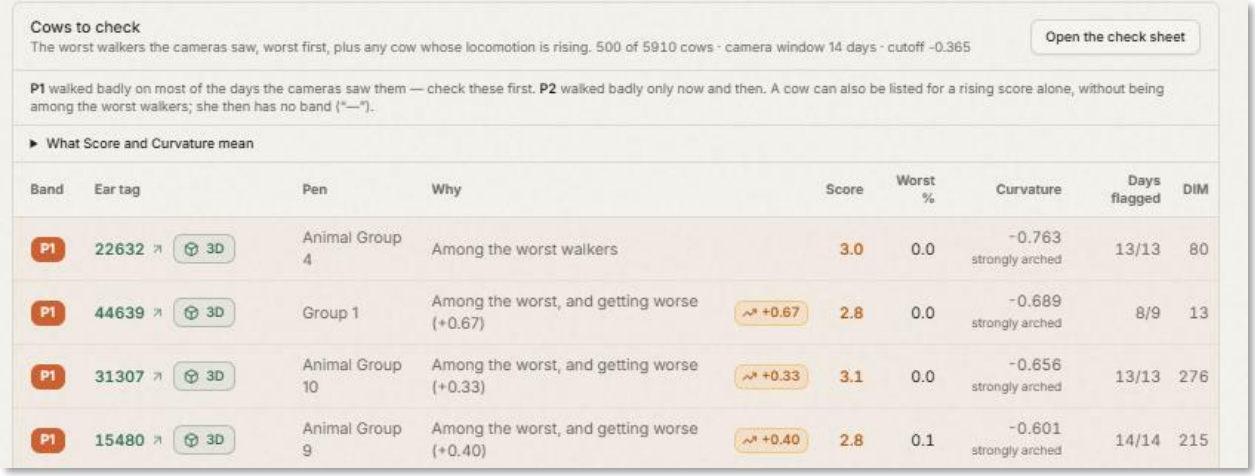
The practical value of continuous locomotion monitoring becomes particularly evident when repeated measurements are used to identify cows requiring closer examination. In large herds, reviewing individual locomotion records is impractical, making it important to distinguish animals with persistently poor mobility from those showing progressive deterioration. Automated monitoring can support this process by organizing cows according to the severity, persistence, and direction of changes in their locomotion scores (Figure 3).

Two patterns are particularly relevant. Some cows consistently exhibit poor locomotion across repeated observations, suggesting an ongoing problem that warrants clinical evaluation. Others show less consistent abnormalities or increasing locomotion scores over time. The latter may be especially important because a cow's mobility can deteriorate before she reaches the threshold used to classify her as lame. Considering both the current score and its recent trajectory provides a more complete picture than relying on a single measurement.

The example in Figure 3 illustrates these distinctions. Cow 44639, at 13 days in milk, had a locomotion score of 2.8 following an increase of 0.67 points, while cow 31307, at 276 days in milk, had a score of 3.1 and an increase of 0.33 points. Both animals were identified as high priorities for examination, although their stages of lactation and patterns of deterioration provide different clinical contexts. Additional information, including back curvature, the frequency of poor locomotion observations, and the number of days flagged, can help farm personnel determine which animals deserve immediate attention.

These measurements do not establish the cause of impaired mobility or replace hoof examination and veterinary judgment. Their principal contribution is to help organize clinical assessments, identify cows whose locomotion is worsening, and make more effective use of the time available for herd health management.

Figure 3. Individual cows prioritized for locomotion assessment. *The Livestock 3D "Cows to check" screen identifies animals with consistently poor locomotion or worsening scores. Priority classifications, individual scores, changes in locomotion, back curvature, days flagged, and days in milk help operators determine which cows require closer examination.*



Following an individual cow over time

Identifying cows with deteriorating locomotion is only the first step. Understanding when those changes occurred and how they relate to other indicators of health can provide valuable context for clinical examination and subsequent management decisions. Repeated camera measurements allow locomotion scores to be evaluated over time rather than as isolated observations, while integration with herd management records can help establish whether changes coincide with important physiological or clinical events.

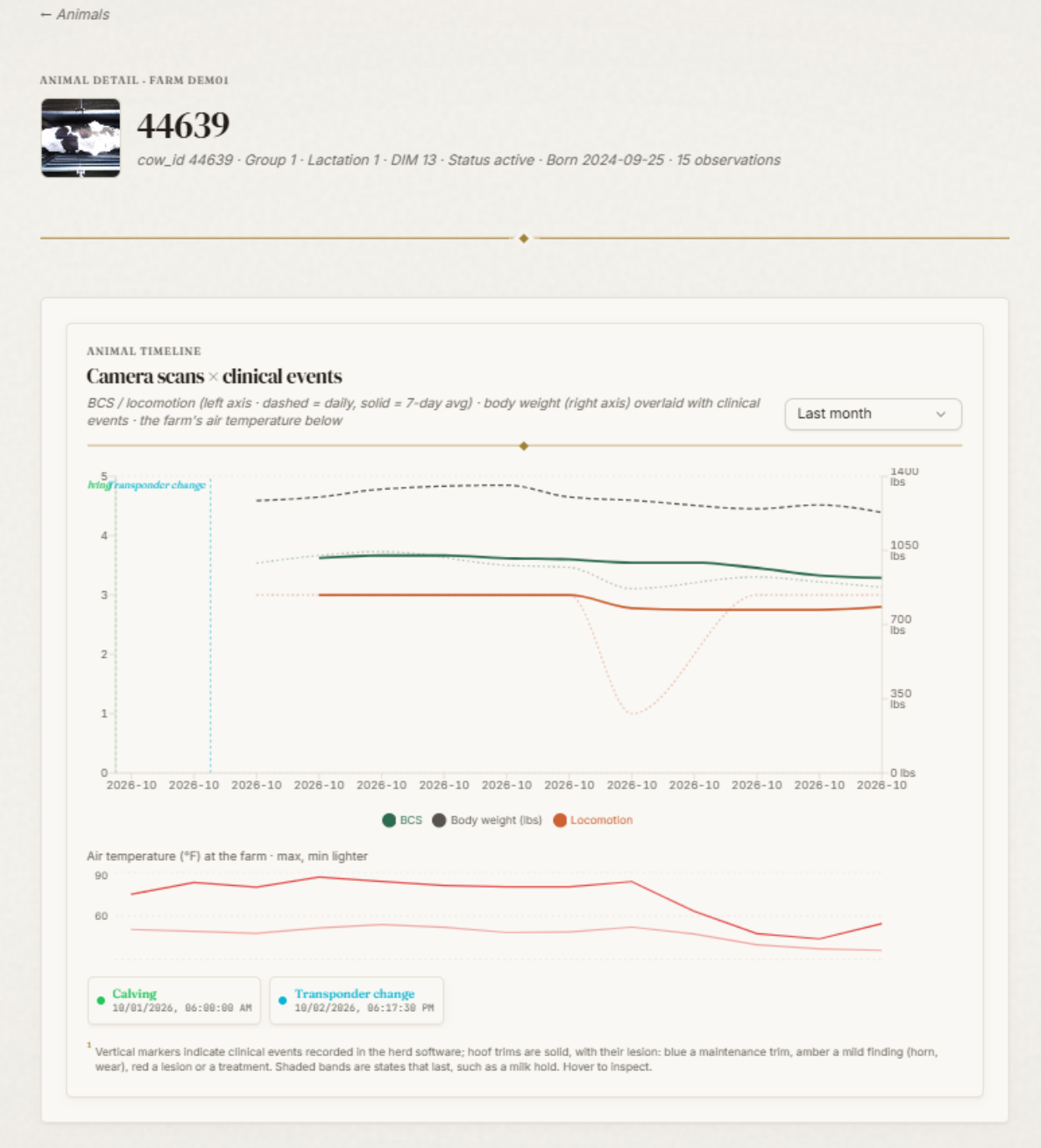
Cow 44639 provides an example of this approach (Figure 4). This first-lactation cow, at 13 days in milk, had a locomotion score of 2.8 following an increase of 0.67 points. The change warranted closer examination, particularly during early lactation, when cows undergo substantial physiological and metabolic adjustments. Her individual monitoring record allows locomotion measurements to be examined alongside body condition scores, body weight, and recorded clinical events, providing a broader perspective on her condition.

When available, records of calving, hoof trimming, and treatment can be examined alongside subsequent locomotion measurements to evaluate whether mobility improves, remains unchanged, or continues to deteriorate. Although changes in locomotion scores cannot establish a diagnosis or demonstrate treatment effectiveness on their own, they provide additional information that can support clinical follow-up. The value of continuous monitoring therefore extends beyond identifying cows requiring attention to documenting their subsequent progress and helping managers determine when further intervention may be necessary.

As with other automated monitoring technologies, the reliability of locomotion measurements depends on consistent data collection and appropriate interpretation. Camera placement, animal movement, the number of observations, and the algorithms used to

calculate scores can influence the information generated. Consequently, automated classifications should be interpreted as indicators of mobility that warrant attention rather than substitutes for clinical locomotion assessment. Their practical value depends on how accurately they identify meaningful changes and how effectively farm personnel respond.

Figure 4. Repeated camera measurements allow locomotion scores to be examined alongside body condition, body weight, and recorded clinical events. *Cow 44639, a first-lactation animal at 13 days in milk, was flagged following an increase of 0.67 points in her locomotion score, reaching 2.8. The individual record provides context for clinical examination and subsequent monitoring. Source: Livestock 3D.*



Cow Well-Being, Longevity, and Economics

Lameness is more than a locomotion problem. Painful hoof conditions can interfere with normal walking, feeding, resting, and social behavior, compromising cow well-being long before their full consequences become apparent in production records. Earlier recognition creates an opportunity to relieve discomfort, address underlying causes, and prevent mobility problems from progressing to more severe or chronic conditions. Maintaining good mobility

is also essential for productive longevity, particularly in cows expected to remain in the herd for several lactations.

The financial consequences are substantial. A bioeconomic modeling study published in the Journal of Dairy Science estimated an average annual cost of $357 per lame cow and $454 per cow affected by digital dermatitis. Each additional week a cow remained lame was associated with $14 in additional losses. These costs reflect reduced performance, reproductive consequences, premature culling, and the resources required to manage affected animals (Robcis et al., 2023). Importantly, the study also found that preventive hoof trimming was more effective at reducing lameness prevalence than early detection alone, reinforcing the need to integrate monitoring technologies into established hoof-health management programs.

The economic value of automated monitoring therefore depends on what happens after a mobility problem is identified. Earlier recognition is useful only when it leads to timely examination, appropriate treatment, and management changes that reduce the duration or severity of lameness. Repeated camera observations and prioritized lists can also help farm personnel allocate their time more effectively, particularly in large herds where frequent visual assessment of every cow is difficult. At the herd level, changes in locomotion patterns may direct attention toward flooring, cow comfort, or other management conditions contributing to impaired mobility.

From Detection to Prevention

One of the most valuable contributions of automated locomotion monitoring is the opportunity to identify changes in mobility before they develop into more severe problems. Camera-generated scores cannot establish a clinical diagnosis, and their usefulness depends on measurement reliability, appropriate interpretation, and timely follow-up. Technology cannot replace attentive stockmanship, preventive hoof care, or veterinary judgment, but it can provide information that makes these efforts more consistent and better targeted.

The success of automated monitoring should not be measured by the number of scores collected or alerts generated, but by the outcomes achieved for the cows being monitored. Reducing the duration of painful conditions, preventing severe mobility problems, and helping more cows remain healthy and productive through successive lactations are the objectives that matter. When better cow well-being also translates into fewer treatment costs, reduced production losses, and less premature culling, animal welfare and economic performance become complementary outcomes of effective herd management.

References

1. Robcis, R., et al. 2023. “Cost of Lameness in Dairy Herds: An Integrated Bioeconomic Modeling Approach.” Journal of Dairy Science 106(4): 2519–2534. https://doi.org/10.3168/jds.2022-22446
2. Sprecher, D. J., D. E. Hostetler, and J. B. Kaneene. 1997. “A Lameness Scoring System That Uses Posture and Gait to Predict Dairy Cattle Reproductive Performance.” Theriogenology 47(6): 1179–1187. https://doi.org/10.1016/S0093-691X(97)00098-8