

## Behavioral assessment in dairy calves using video-based deep learning approach

Po-Lin Chen<sup>1</sup>, Jih-Tay Hsu<sup>2</sup>, Ta-Te Lin<sup>1\*</sup>

<sup>1</sup> Department of Biomechatronics Engineering, National Taiwan University, Taipei, Taiwan, ROC

<sup>2</sup> Department of Animal Science and Technology, National Taiwan University, Taipei, Taiwan, ROC

\* Corresponding author. Email: m456@ntu.edu.tw

### Abstract

Behavioral assessment is crucial for evaluating the health status in dairy cattle. Variations in behavioral patterns frequently reflect health issues, making it essential for efficient management and welfare optimization in dairy farming. Because traditional observation methods relying on human supervision are ineffective, some recent studies employ sensor-equipped devices for monitoring dairy cattle behaviors, while their usage is mainly limited to adult cattle to avoid potential impacts on newborn dairy calves.

Accordingly, our objective is to develop a non-contact, video-based deep learning approach for comprehensive behavioral assessment in dairy calves. The state-of-the-art *VideoMAEv2* model, redesigned for recognizing seven distinct behaviors from 32 consecutive video frames, is optimized to achieve an overall F1-score of 0.93 on the independent testing dataset. In addition, the daily assessment performance on unseen calves has improved. The accuracy has increased from 0.85 to 0.90 through fine-tuning for adapting new instances, and it has reached 0.87 with behavioral sequence refinement using bidirectional-LSTM and local attention mechanisms. Furthermore, long-term monitoring at the National Taiwan University's experimental dairy farm is conducted for behavioral analysis in dairy calves. This research has yielded insights into the behavioral trends in maturing dairy calves, as well as the discernible differences among individuals. The behavioral assessment approach developed in this study demonstrates accurate recognition of dairy calf behaviors and in-depth analysis in a real-world dairy farming environment, providing insights for dairy farm management and welfare optimization practices for dairy calves.

**Keywords:** Pattern Recognition, Behavioral Analysis, Machine Learning, Deep Learning