# Toward novel phenotypes in dairy cattle breeding via video surveillance

**Oroz M.[1], Oroz M.[1], Raguz N.[1], Bobic T. [1], Shihabi M.[2], Curik I.[2], Spehar M.[3], Bilandžija K.[4], Nyarko K.[5], Lukic B.[1*]**

[1]Faculty of Agrobiotechnical Sciences Osijek, University of J.J. Strossmayer in Osijek, V. Preloga 1, 31000 Osijek, Croatia,
[2]Faculty of Agriculture, University of Zagreb, Svetošimunska cesta 25, 10000 Zagreb, Croatia,
[3]Centre for Livestock Breeding, Department for Genetic Evaluation, Svetošimunska cesta 25, 10000 Zagreb, Croatia
[4]Belje plus d.o.o, Svetog Ivana Krstitelja 1a, 31326 Darda, Croatia
[5]Faculty of Electrical Engineering, Computer Science and Information Technology Osijek, Department of Computer Engineering and Automation, Kneza Trpimira 2b, 31000 Osijek, Croatia
[*]Corresponding author: blukic@fazos.hr

## ABSTRACT

Defining novel phenotypes is essential to advance genetic improvement and animal welfare in dairy production. In this study, we focus on video-based monitoring of Holstein cattle as a source of continuous, non-invasive behavioral traits such as lying, standing, and locomotion time. To process video data, we developed a multi-modal computer vision system that integrates object detection (YOLOv8 fine-tuned on our dataset with attention mechanisms), multi-object tracking (BoT-SORT/ByteTrack), and re-identification (deep metric learning with ResNet backbone). This pipeline enables reliable detection, tracking, and identification of cows across complex farm environments, and provides individual-level behavioral profiles suitable for genomic analysis. These behavioral records were combined with genomic data from 800 Holstein cows genotyped with the 700K HD SNP chip to estimate genetic parameters and explore the genetic architecture of these traits. Using SNP-based analyses, we focus on heritabilities and genetic correlations for traits such as lying time and activity levels with health-related traits, including susceptibility to lameness and mastitis. Our preliminary findings demonstrate the potential of video-derived phenotypes to expand the scope of selection beyond traditional production traits, incorporating indicators of robustness, welfare, and efficiency. By integrating digital phenotyping with dense genomic information, this project contributes to the development of management tools that allow both early health monitoring and genomic selection for resilience traits. Ultimately, the combination of video surveillance and genomics paves the way toward farm management prototypes where sensor data and genomic predictions are merged, supporting sustainable breeding strategies in modern dairy farming.

**Keywords:** video phenotyping, dairy cattle behaviour, genomic evaluation, computer vision, precision livestock farming.

**Acknowledgement**: This research was funded by European Union - NextGenerationEU within the project "NEXT GENERATION ANIMAL PRODUCTION" (grant number NPOO.C3.2.R3-I1.04.0141) and supported by PhenoGeno project - IP-2022-10-6914 of Croatian Science Foundation.