DANISH TECHNOLOGICAL INSTITUTE

Project proposal – Danish Technological Institute (DTI)

Self-supervised learning for re-identification of pigs

Development of automatic surveillance systems to improve welfare and breeding for healthier animals. A common problem is re-identification of animals.

The objective is to develop (parts of) a self-learning AI system capable of reliably re-identifying individual pigs within video footage from commercial pig barns containing approximately 40–100 animals in each group. The complete system should provide a confidence score for each re-identification in every video-clip and should be able to assess whether pigs appearing in two different video recordings are likely to be the same individual. The ground truth for animal ID is today provided using coded ear tags visible in a video-clip. However, this ID is not visible in all video clips. Therefore, the proposed AI system will, in its final form, bridge video segments where pig IDs are unknown with those where ground-truth IDs are available.

The system should autonomously learn and extract visual patterns from the pigs without relying on predefined templates such as anatomical keypoints. These distinguishing features may include anatomical traits (such as body size, ear tag position, or overall anatomy), patterns of movement, and temporary markings like colored stripes applied for farm management purposes. Such color marks are unique for short periods but may fade or be applied inconsistently across pigs.

To achieve robust identification, the AI must leverage both stable features—such as anatomy, size, and the position of permanent ear tags—and labile features that may appear or change over time (like color marks). For instance, when a pig receives a green stripe along its back, this transient characteristic can facilitate more confident identification; however, the system must also detect when such marks disappear or substantially change and update the pig's feature profile accordingly.

Desired final functionality (selection of focus points will be discussed with the students):

- Autonomous discovery and adaptation to both stable (permanent) and labile (fleeting) features.
- The ability to link new, previously unseen features (e.g., a fresh color stripe) with existing profiles of known pigs.
- Dynamic feature matching that increases the confidence in individual identification even as some features fade or change across time.
- No strict dependence on a fixed set of known patterns; the AI should learn, evaluate, and fuse a variety of discriminative cues from image and video input.
- Specific design for handling feature evolution over time, as labile visual characteristics (e.g., coloration) slowly decrease in prominence or disappear entirely.

The system is intended to advance beyond static template matching, employing advanced machine learning approaches to fuse visual cues of different persistence and origin, enabling robust, scalable pig re-identification, real-world environments. We have ongoing projects involving commercial companies ensuring an urge to implement the developed models.

Data

We estimate that we will have video clips available with ground truth on animal ID for approximately 100 different animals present in at least 5 different video clips. We continuously collect data so we may have significantly more when the project starts. We have >1,000 video clips without ground truth on animal ID.

Working with Danish Technological Institute (DTI)

DTI is a well known research and technology organization (RTO) founded in 1906 working with advances science and technology. DTI employs approx. 1,100 experts in many different fields – for example robotics and AI development, big science (using eg. hadron colliders for research), printable electronics etc. We serve as both a research institution, but we also aid the industry with commercial services.

Our department has specialized in developing AI for industrial purposes. We have several projects relating to characterizing animal biometrics and industrial measurements using AI and have significant expertise in AI development and implementation. We have had several students in our department and also employ student workers for smaller tasks. We are located in Taastrup, just outside of Copenhagen. We will be able to allocate an industry supervisor along with the university supervisor for this project.

Should you choose DTI for an intern project, we can provide office space, PC etc. for students taking on a project with DTI. The department has free (good) coffee and a canteen with discounted prices for employees (as well as students).

Key papers (for inspiration)

- ***Review of Computer Vision for Livestock Biometrics**:*
  Livestock biometrics identification using computer vision approaches: a review (2025)
  Covers pig/cattle biometrics, keypoints, self-supervised techniques, and practical system architectures.
- ***Temporal Tracking & Deep Learning**:*
  Individual Cattle Identification Using a Deep Learning Based Framework (2019)
  Proposes combining CNN and LSTM for improved temporal recognition, applicable to labile features.
- ***AI-Enhanced Real-Time Identification**:*
  AI-enhanced real-time cattle identification system through tracking across various environments (2024)
  Employs multi-modal (appearance + gait) identification, including temporal modeling of labile features.
- ***Multi-camera Re-identification & Self-supervised Learning**:*
  MultiCamCows2024 Dataset and Framework (2024)
  Dataset and models for self/supervised cow re-ID, but concepts directly transfer to pigs.
- ***Pig Behavior and Identity Monitoring**:*
  Research Progress of Vision-Based Artificial Intelligence in Pig Farming (2022)

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