PhD Position F/M IA-based automated detection and behavior analysis among piglets

**Contract type**: Fixed-term contract

**Level of qualifications required**: Graduate degree or equivalent

**Function**: PhD Position

**Level of experience**: Recently graduated

About the research centre or Inria department

The Inria Centre at Rennes University is one of Inria's eight centres and has more than thirty research teams. The Inria Centre is a major and recognized player in the field of digital sciences. It is at the heart of a rich R&D and innovation ecosystem: highly innovative PMEs, large industrial groups, competitiveness clusters, research and higher education players, laboratories of excellence, technological research institute, etc.

Context

The proposed subject is part of the PEPR project WAIT4 on animal welfare, which goal is to use Artificial Intelligence and new technologies for tracking behavioral or physiological indicators of welfare in farm animals facing challenges of the agro-ecological transition. Animal welfare is a key agro-ecological process to be optimized for livestock production. The subject focuses on Automated behavior analysis (ABA, also called computational ethology) which is the use of technology to detect and observe the behavior of animals in ways that require minimal human labor. It results from a collaboration between INRIA, for the computer science aspects, and the INRAE Brittany-Normandy centre which is a major player in the development of agricultural and agrifood systems in the Grand Ouest region and will provide data and expertise in animal behavior analysis.

Assignment

Context

Behavior monitoring is crucial for the assessment of the welfare and emotional states of farm animals, such as pigs and cattle. Particularly, social behaviors, which are strongly influenced by husbandry practices, are considered a major determinant of animal welfare on farm. For example, in pigs, social mixing at weaning is often associated with increased levels of aggression, which can induce stress and lead to severe injuries. Conversely, social play occurs mainly when optimal housing and social conditions are met, and is thus considered a behavioral indicator of positive affective states in juvenile pigs.

In line with the development of precision livestock farming, modern farms are often equipped with video cameras which allow to continuously monitor behavior of animals. However, manual observations of animal behavior on video images, and social behavior in particular, is time-consuming and labor-intensive, and thus difficult or impossible to apply on farms. Consequently, in the recent years, several computer-vision automatic systems have been developed to automatically detect a wide range of behaviors, including body postures, locomotion or social behavior, of farm animals such as pigs and cattle (see [10] for a review).

The primary objective of animal behavior analysis is to identify every instance of a specific behavior within a video and determine its precise spatial and temporal localization. Over the last few years, there has been a surge in deep learning approaches for behavioral analysis, including segmentation, identification, and pose estimation [2]. Multiple Object Tracking techniques are also used, which enable the tracking and analysis of individual animals within a group. However, when used for animal behavior analysis, these methods face several challenges and issues. Interactions and group dynamics further complicate the tracking process. Animals' behaviors and movements within a group are often complex and dynamic, making it challenging to identify and track individual animals. This complexity can result in incomplete or inaccurate tracking data.

Despite the progress of these computer vision techniques, the direct recognition of behavior itself, has been more rarely addressed. Classifying animal behavior has lagged behind that of humans. Animal behavior inference tends to be harder because human actions are more recognizable, and most challenges in the human domain focus on classifying short videos rather than long-running recordings as in animal observation. Another limiting factor is the limited number of publicly available animal observation datasets and the high cost associated with obtaining a large number of labeled datasets.
Mission

The PhD objective is to measure the social interactions and the occurrence of fights vs positive social contacts, such as social play, between piglets before and after weaning to assess emotional states of piglets, based on video recordings of piglets provided by INRAE. The proposed methods will rely on computer vision and machine learning fields. This requires solving a number of problems.

* Behavior characterization. In most current computational tools for behavioral quantification, identifying a given behavior relies largely on tracking a few “high-level” properties such as the position of body parts in space (poses) and their speed of motion. Thus, data-rich videos and complex movements are simplified to skeletons and relative positions in space of body parts. While tracking these high-level properties is useful, relying on them to identify a given behavior has its limitations. Firstly, the limited number of high-level properties does not necessarily represent the information needed to capture the complexity of animal behavior. The use of high-level properties is likely to result in a significant loss of information, making the identification of behavior less precise. The aim is therefore to study which properties can be extracted or learned to define and discriminate a behavior.

* Modelling interaction. The behaviors studied in this thesis are not the behaviors of a single animal, but result from the interaction between several animals, which adds complexity. In addition, multiple animals may perform different behaviors. It is obvious that when modeling social dynamics, observations must necessarily involve several individuals. The method developed should be able to perform an automated classification of the behavior of individual piglets and not just the behavior of the group as a whole, as in most research. The key problem here is to identify individuals, capture the temporal aspect of the individual's behavior, and model interaction and interdependence with its companions.

* Data scarcity. The scarcity of available labeled data poses significant challenge. Not only are training data few but behavior events are short-lasting and occur sporadically. Most likely, the approach will rely on models developed in other contexts (involving humans or other animals) and propose effective methods for knowledge transfer and few-shot learning.

* Multimodality. An original aspect of the proposed approach will be to take into account the audio information available in the video recording. The aim is to study whether vocalizations can be associated with behaviors, and whether sound characteristics can help visual analysis. The difficulty lies in the fact that sound is recorded globally, and it is difficult to associate it with a particular animal or activity, if several different behaviors are taking place simultaneously. This also requires the development of a multi-modal architecture.

References

Bibliography study on existing methods for Automated behavior analysis based on visual data
Analyze and process video recordings of piglets to extract relevant information for an interaction model
Develop an IA-based method for piglet behavior classification based on raw video frames
Expand the approach in a multi-modal setting that integrate audio information
Scientific publications, present the work to various scientific community

Skills
- Master in Computer Sciences, with proficiency in python and its libraries for deep learning
- General background in computer vision and machine learning
- Understanding of deep learning methodologies and techniques;
- Proficiency in data handling, particularly in video processing
- Good communication skills in oral and written English

Benefits package
- Subsidized meals
- Partial reimbursement of public transport costs
- Possibility of teleworking (90 days per year) and flexible organization of working hours
- Partial payment of insurance costs

Remuneration
Monthly gross salary amounting to 2100 euros for the first and second years and 2190 euros for the third year

General Information
- Theme/Domain: Vision, perception and multimedia interpretation
  Scientific computing (BAP E)
- Town/city: Rennes
- Inria Center: Centre Inria de l'Université de Rennes
- Starting date: 2024-09-01
- Duration of contract: 3 years
- Deadline to apply: 2024-05-31

Contacts
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- PhD Supervisor: Kijak Ewa / Ewa.Kijak@irisa.fr

About Inria
Inria is the French national research institute dedicated to digital science and technology. It employs 2,600 people. Its 200 agile project teams, generally run jointly with academic partners, include more than 3,500 scientists and engineers working to meet the challenges of digital technology, often at the interface with other disciplines. The Institute also employs numerous talents in over forty different professions. 900 research support staff contribute to the preparation and development of scientific and entrepreneurial projects that have a worldwide impact.

The keys to success
Application
Candidates are invited to submit a clear CV together with:
- a letter detailing their education, career path, experience (internships, etc.), and explaining how they match the profile sought
- their Master's transcripts (list of marks, even preliminary)
- recommendation letters are an asset

Warning: you must enter your e-mail address in order to save your application to Inria. Applications must be submitted online on the Inria website. Processing of applications sent from other channels is not guaranteed.

Instruction to apply
Please submit online: your resume, cover letter and letters of recommendation eventually
Defence Security:
This position is likely to be situated in a restricted area (ZRR), as defined in Decree No. 2011-1425 relating to the protection of national scientific and technical potential (PPST). Authorisation to enter an area is granted by the director of the unit, following a favourable Ministerial decision, as defined in the decree of 3 July 2012 relating to the PPST. An unfavourable Ministerial decision in respect of a position situated in a ZRR would result in the cancellation of the appointment.

Recruitment Policy:
As part of its diversity policy, all Inria positions are accessible to people with disabilities.