March 24, 2024

Tracking poultry locomotion with AI technology

Lilong Chai

Department of Poultry Science, University of Georgia

Poultry locomotion is an important indicator of animal health, welfare, and productivity. Traditional methodologies such as manual observation or the use of wearable devices, encounter significant challenges, including potential stress induction and behavioral alteration in animals. For instance, locomotion speed can be used to predict poultry gait score (an indicator of animal walking status) or lameness. In a commercial broiler house (20,000 – 30,000 birds), cage-free layer house (50,000 birds), or broiler breeder house (10,000 birds), it's hard to detect individual birds' locomotion manually. An automated monitoring system will be valuable for track individual birds and analyze their locomotion.

To develop an efficient tracking tool, researchers at the University of Georgia collected poultry videos and tested different models for tracking poultry locomotion speed. The dataset was obtained from two different experimental chicken houses (i.e., broilers and layers houses) in the Poultry Research Center at the University of Georgia (UGA), USA. Chickens were subjected to dyeing to assess the detection differences between dyed and undyed samples. Broilers were dyed with specific colors (green, red, and blue), and laying hens with another set (green, red, and black). Figure 1 illustrates the experimental chicken houses alongside their dyed counterparts. HD cameras (PRO-1080MSFB, Swann Communications, CA, USA) were affixed at a 3 m height on ceilings and walls in each room, capturing chicken behavior at 18 frame per second (FPS) with a 1440x1080 resolution. Lens maintenance involved weekly cleaning for clarity. Image data was first saved on Swann video recorders and subsequently transferred to HDDs (Western Digital Corporation, CA, USA) at UGA's Department of Poultry Science. Chickens were first subjected to a random selection process to determine which individuals would be used for the experiment. Once chosen, these chickens were dyed using the all-weather Quick Shot dye (LA-CO INDUSTRIES, INC, IL, USA). The application process required a coordinated effort from a two-person team: while one individual gently held and restrained the bird to ensure its safety and ease of application, the other expertly applied the spray dye to the specific targeted areas on the chicken's body, ensuring consistent and even coverage. This methodology was designed to minimize stress to the chickens while achieving a uniform application of the dye. In the current study, UGA researchers utilized the track anything model (TAM) (Figure 2) to monitor chicken locomotion.

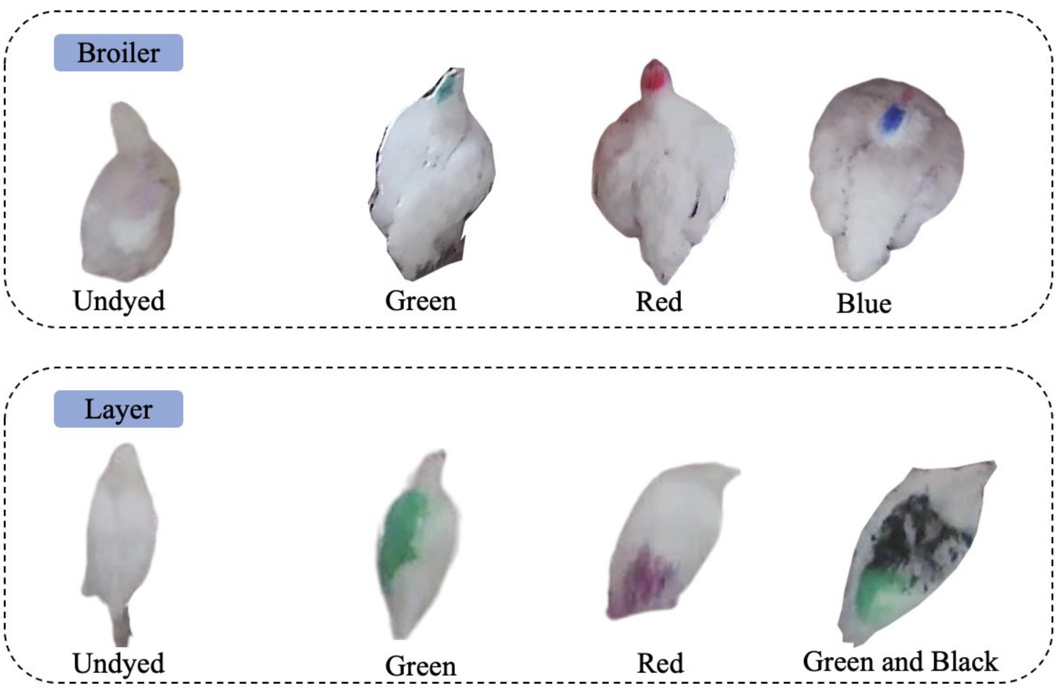

Figure 1. Contrast of dyed and undyed broilers and layers in experimental settings.

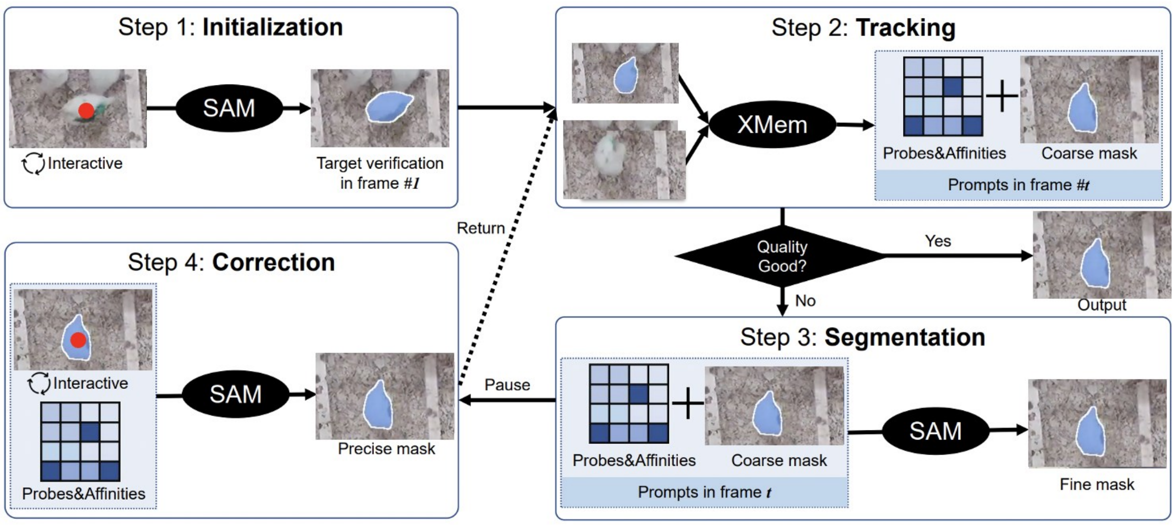

Figure 2. Pipeline of the track anything model (TAM) and segment anything model (SAM) for chicken tracking.

In the meticulous pursuit of accurate and reliable chicken tracking, TAM-*speed* has been subjected to a thorough evaluation, particularly focusing on its capability to accurately detect and quantify the speed of chickens within a controlled environment. In our experiments, where the average speed of the chickens was measured to be 0.05 m/s, the precision with which TAM-*speed* could predict and validate these speed measurements became paramount. Utilizing the RMSE as a pivotal metric to quantify the average discrepancies between the speeds predicted by TAM-*speed* and the actual observed speeds, a comprehensive analysis was conducted. Given that RMSE provides a high penalty for larger errors, it serves as a stringent metric, ensuring that the model's predictions are not only accurate on average but also do not deviate significantly in individual predictions. In our analysis, dyed chickens, with their distinct and consistent coloration, provided a somewhat stable basis for the tracking algorithm to latch onto, potentially minimizing the instances where tracking was lost or inaccurately assigned. The RMSE for dyed chickens was recorded at a laudable 0.02 m/s, indicating a high degree of accuracy in speed detection.

Figure 3. Track and detection speed of broilers (The green number indicates the tracking number, while the black number represents speed).

Further reading:

Yang, X., Bist, R. B., Paneru, B., & Chai, L. (2024). Deep Learning Methods for Tracking the Locomotion of Individual Chickens. *Animals*, *14*(6), 911. **https://doi.org/10.3390/ani14060911**