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Tracking Rodent Social Interactions Using Machine Learning

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Introduction

We have developed a video-annotation pipeline that can be used to automatically track the movement of particularly social rodents (Degus) during interactive behavior.

Octodon degus, a highly social rodent from central Chile,

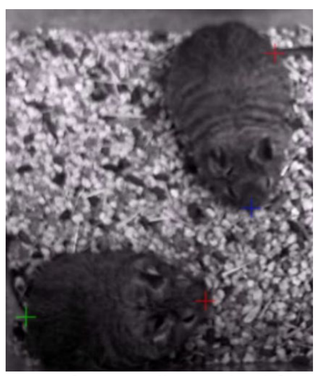
This tracking work is the first phase in a larger effort to automatically classify and label behaviors observed in video recordings of Degu interactions. Such behavioral annotation will influence our understanding of social behavior in general, with possible long-term impacts on diagnosis and treatment of autism spectrum disorder and other mental health conditions.

A long-standing approach has been to take videos of moving Degus, then manually label all video frames. Our automated system builds on advances in machine learning methods to reduce the effort required to track Degu movement.

Model Training

Tracking was automated through the use of DeepLabCut, a tracking software that uses deep neural networks to automatically track user defined body parts on animals.

We trained DeepLabCut's neural network by providing 153 manually labeled video frames. Points labeled included the nose and base of the tail for the two Degus in each video.

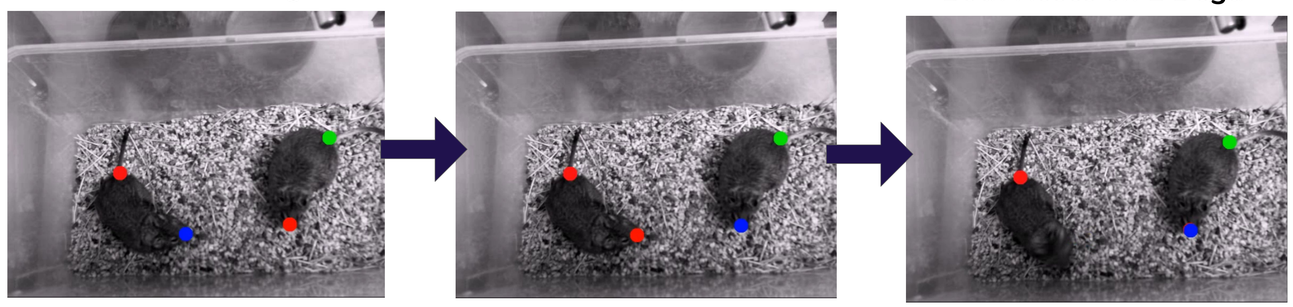


Picture of manually marked frame.

Results

After training, the DeepLabCut model is typically quite good at identifying Degu noses and tails. However, the complexity of tracking two interacting Degus leads to inconsistent labeling, with marked points swapping back and forth between the degus. DeepLabCut treats each frame as a distinct image, so retains no continuity between frames.

Correct Labeling | **Noses Swapped** | **Both Noses on 1 Degu**

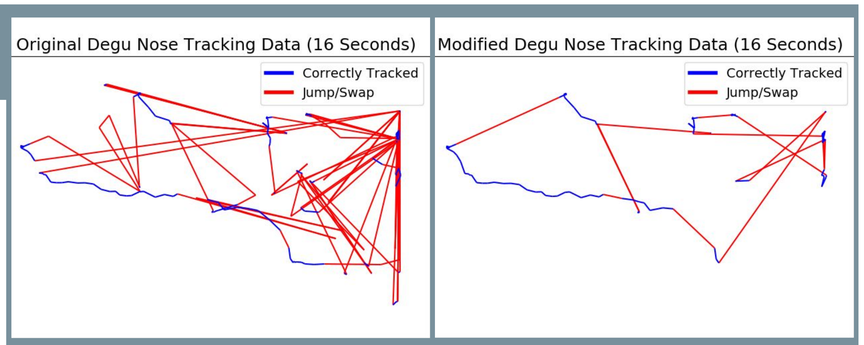


Cure for Jumping Labels?

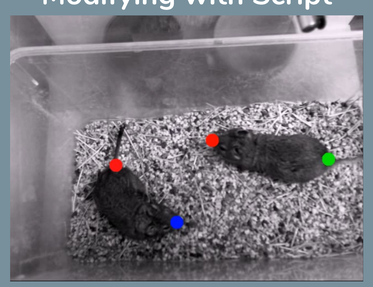
A script was written to take labeled point data from DeepLabCut. Whenever a point traveled greater than 25 pixels between frames, the point would be dragged back to its original location. The output of DeepLabCut was then modified using the script.

Results

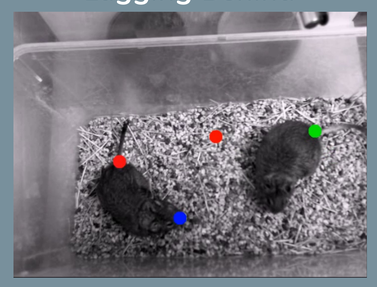
Although the script removed some of the swapping and jumps within the videos, points would noticeably lag behind when a swap lasted a longer duration.



Correct Labeling After Modifying with Script



Example of Point Lagging Behind



Future Cure for Jumping Labels

Our proposed approach for overcoming label teleportation is to extract the per-pixel label probabilities produced by DeepLabCut's neural network, and apply a new algorithm that will probabilistically maintain positional continuity, so that predictions for prior frames inform current-frame predictions.