Scaling Thermal Behavioral Ecology: DeepLabCut Machine Learning Models for Detecting Avian Thermoregulatory Responses

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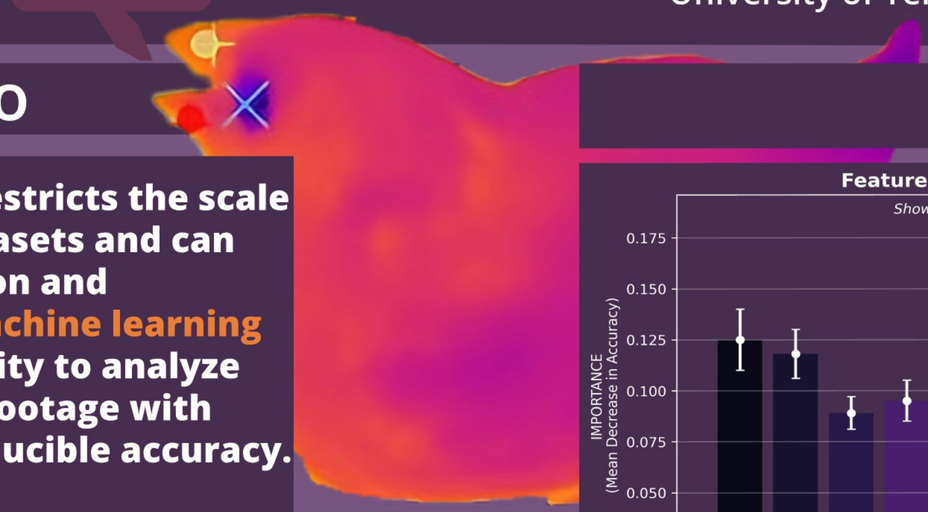
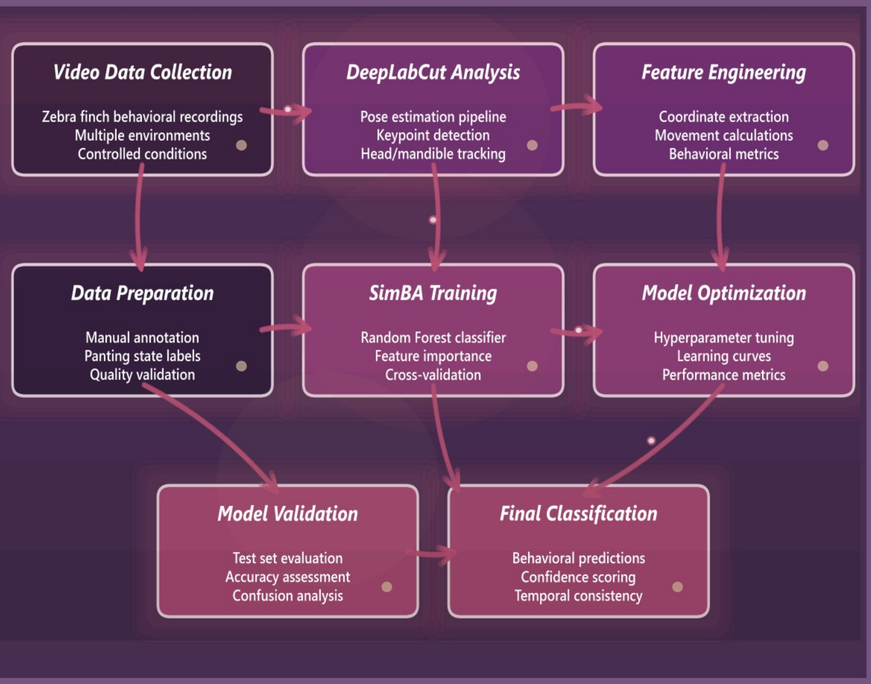


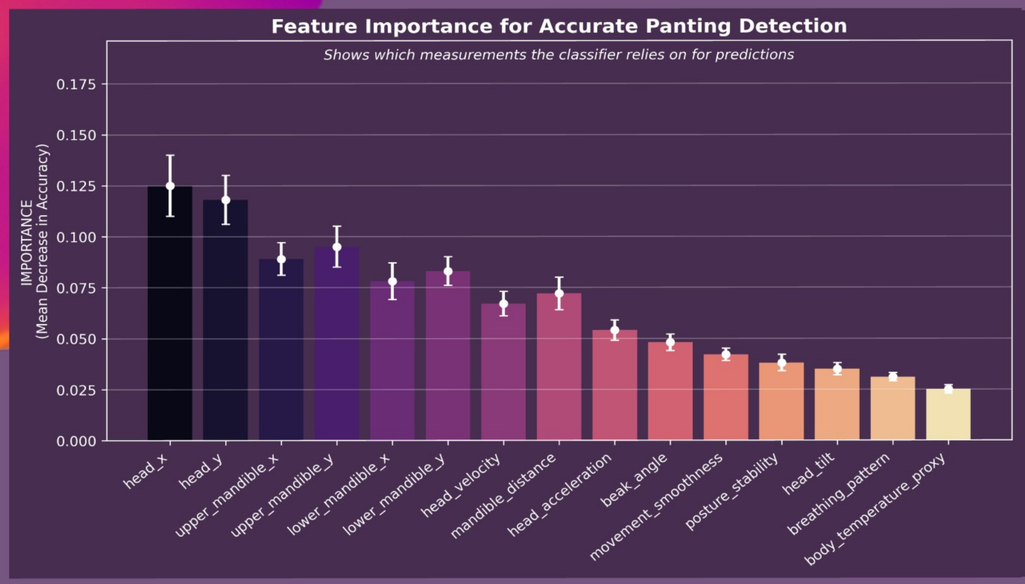
Intro

Manual scoring restricts the scale of behavioral datasets and can introduce variation and inconsistency. Machine learning opens the possibility to analyze large volumes of footage with consistent, reproducible accuracy.

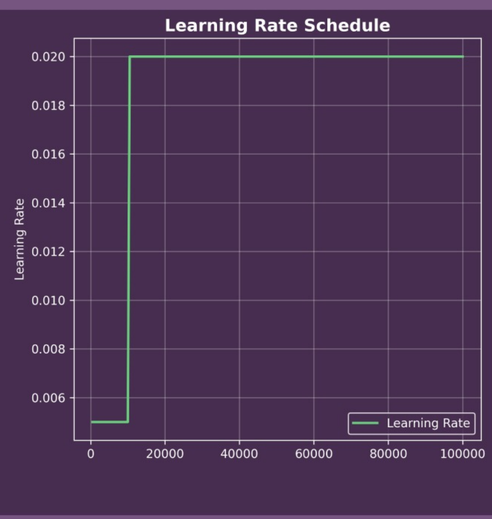
Methods



Results



- **Data: 30 videos, 6–7k labeled frames**
- **Keypoints: head + upper/lower mandible**
- **Training: 100k iters; loss 0.040 0.006 (−84.7%)**
- **p-cutoff error: Test 7.76 px Train 3.78 px (gap ≈ 4.0 px)**



Future Directions

- **Cross-Species Expansion: Already trained on Zebra Finches & Least Terns;adaptable to other birds.**
- **More Behaviors: Extend detection beyond panting/wing-spreading to other thermoregulatory behaviors available to wildbirds, and to non-thermoregulatory behaviors.**

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Acknowledgments and References

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Mathis et al., 2018 Nature Neuroscience; Nath et al., 2019 Nature Protocols; Wittek et al., 2023 Behavior Research Methods; Shaw et al., 2023 Current Biology; Wiltshire et al., 2023 Journal of Animal Ecology; Bohic et al. 2023 Neuron; Popik et al., 2024 Frontiers in Pharmacology