Accelerometer-Based Machine Learning Classifier Using Wireless Implantable Devices to Understand Animal Behavioral States

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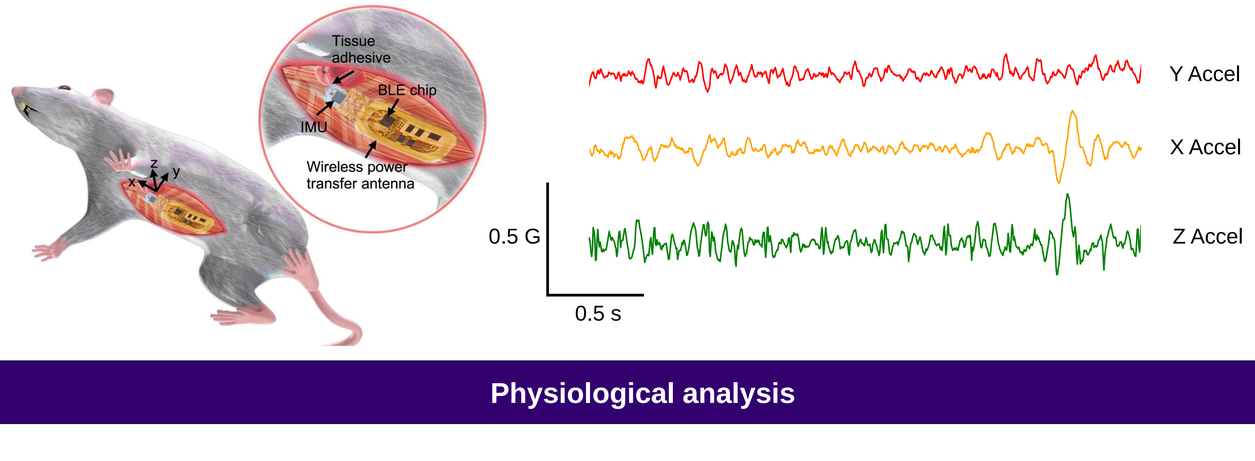
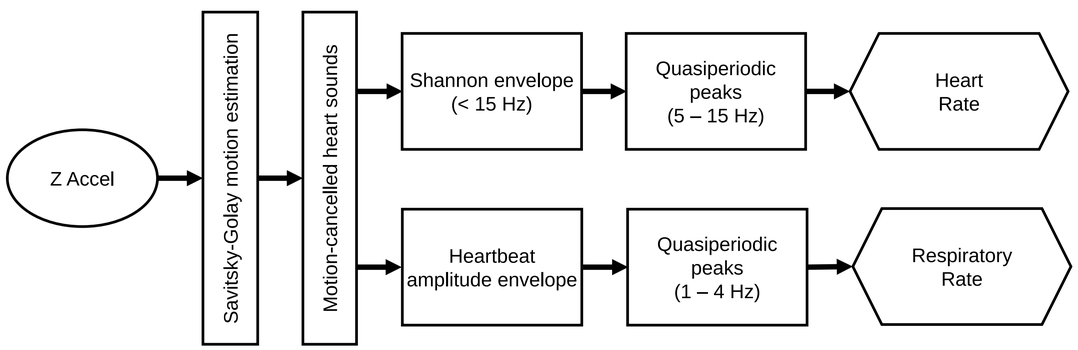
Background

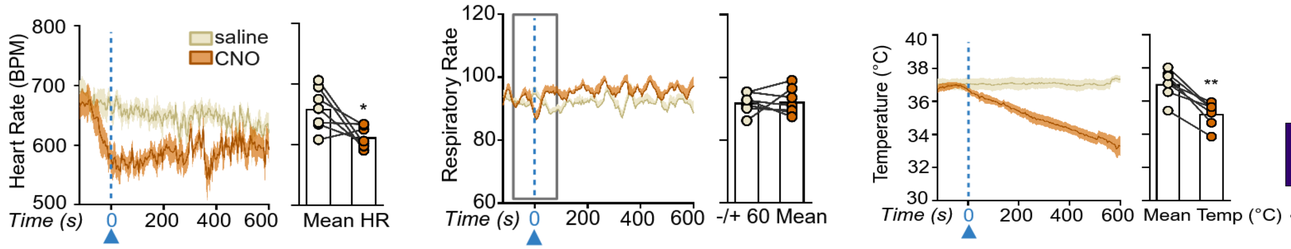
- Traditional physiological recording methods in mice require cable tethers, restricting normal movement and social behavior
- Manually annotating animal behavior is time-intensive and introduces subjectivity
- We recently published two pipelines that independently overcome these confounds: (1) mechano-acoustic devices that provide wireless, minimally invasive peripheral recording based on finely-tuned accelerometers, and (2) a computer vision-based machine learning package (Simple Behavioral Analysis, SimBA) for supervised behavioral classification from recorded videos

Lightweight wireless implantable device captures mechano-acoustic signals

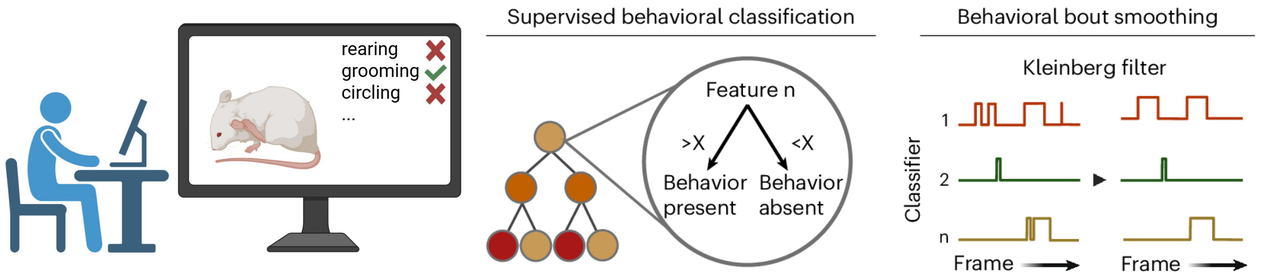


Physiological analysis

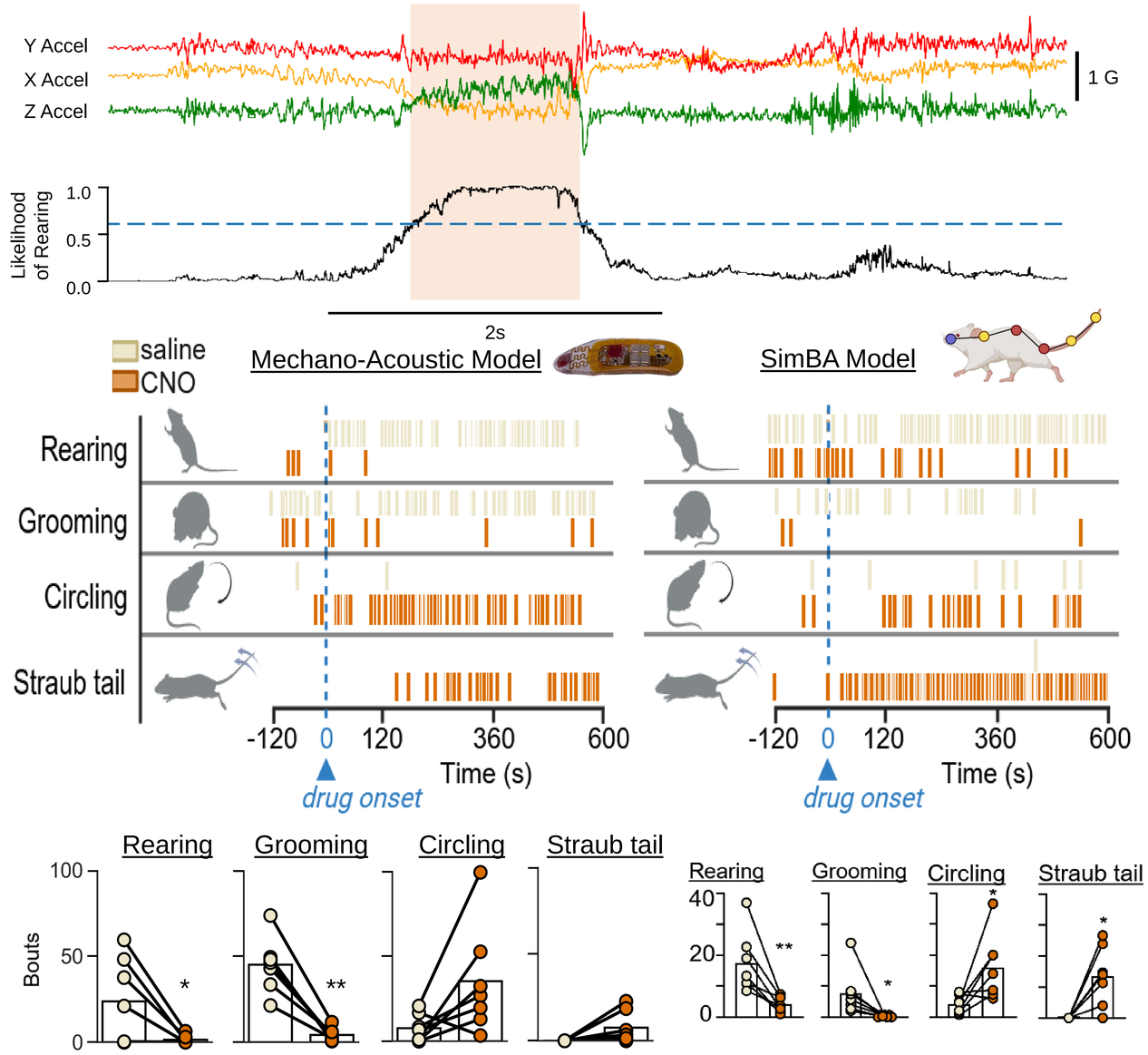




Random forest behavior classification



Behavioral analysis of chemogenetically reactivating anesthesia-circuit



Conclusions

- We developed a comprehensive machine learning model to classify mouse behavioral states using wireless, implanted accelerometer data
- We test this model by analyzing the effect of consciousness-altering drugs on behavior and comparing our results with SimBA's computer vision analysis
- Future goals include building closed-loop and unsupervised applications
- This work contributes to the growing field of bio-signal processing, offers a new approach to automated behavior classification, and provides the groundwork for answering many diverse questions in neuroscience and related fields

Acknowledgements

- Devices and physiological analysis pipeline from Ouyang, Wei et al., 2024 (PMID 38537641);
- Physiology figures and classifier diagrams from Goodwin, Nastacia et al., 2024 (PMID 38778146);