

Video Analysis for Accurate Locomotor and Behavior Measures for Home-cage Housed Mice

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Abstract

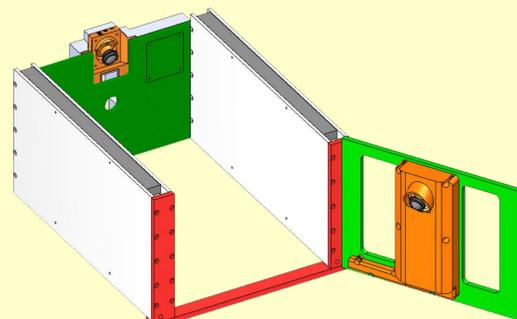
The System for Continuous Observation of Rodents in Home-cage Environment (SCORHE) was developed to quantify activity levels and behavior patterns for mice housed within a commercial ventilated cage rack. The SCORHE in-rack design provides daytime and night-time monitoring with the stability and consistency of the home-cage environment. The dual-video camera custom hardware design makes efficient use of space, does not require home-cage modification, and is animal facility user-friendly. Given the system's low cost and suitability for use in existing vivariums without modification to animal husbandry procedures or housing setup, SCORHE opens up the potential for wider use of automated video monitoring in animal facilities. SCORHE potential uses include day-to-day health monitoring, as well as advanced behavioral screening and ethology experiments, ranging from assessing short- and long-term circadian rhythm studies to evaluation of mouse models. When used for phenotyping and animal model studies, SCORHE aims to eliminate concerns often associated with many mouse monitoring methods, such as circadian rhythm disruption, acclimation periods, lack of nighttime measurements, and short monitoring periods. Video analysis methods have been developed to accurately track the head and tail position of the mouse. The algorithms also automatically detect the following nine distinct behaviors: eating, drinking, grooming, foraging, climbing, walking, resting, supported rearing, and unsupported rearing. Preliminary results comparing day/night activity and behavior profiles for C57BL wild-type mouse are presented.

Objectives

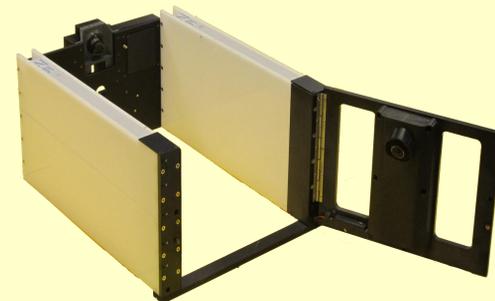
Video-Based Mouse Monitoring

- Long term** Multiple full diurnal cycles, possibly months
- Scalable** Simultaneous monitoring of a large number of cages
- Space efficient** No customization of cages and/or racks. No requirement for extra real-estate.
- Analyzed automatically** Detailed time-resolved mouse behavior profiles
- User friendly** Easy to setup and use both by scientists and animal care staff
- Non-invasive** Requires no special marking of mice to facilitate tracking

Method



Fisheye Lens, Near-IR LED bars, Front Door, Support Plates, Lens Holder, Diffuser Plates, Camera Cover, Back Plate



Designed and Built

A 3-D computer aided design (CAD) model (top image) designed to meet investigator and animal facility requirements. The 3-D CAD model was then used to build in-house SCORHE prototypes (bottom image).



Maintain Diurnal Cycle

Cage is illuminated with near-IR emitters to avoid disruption of the day/night cycles for the mouse. While inside the SCORHE unit, the cage-internal ambient lighting will follow the vivarium room light levels due to the window cutouts of the front door.



Easy Cage Access

Mouse cages can be easily inserted to and removed from the rack. Researchers and animal care staff can visually inspect the mice while located in the SCORHE unit without disrupting the automated monitoring.



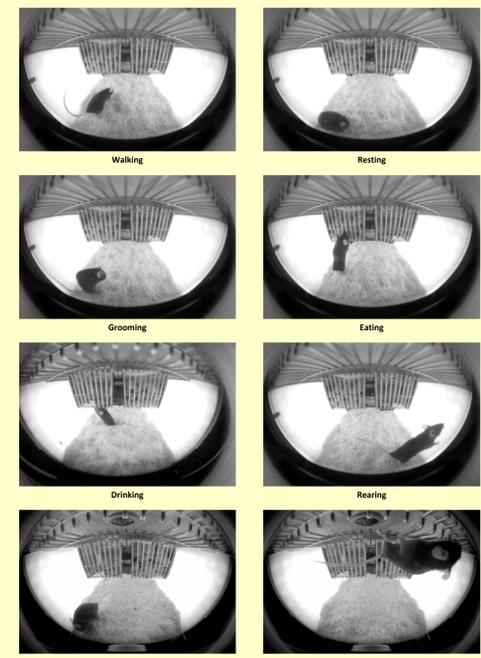
Space Efficient

Even with adjacent rack slots occupied, SCORHE units fit seamlessly in the rack and require no additional space.

SCORHE in the Vivarium

The SCORHE design emphasizes compatibility with the animal facility equipment and procedures. Several SCORHE validation studies, as well as investigator studies, have been conducted.

Automated Behavior Detection

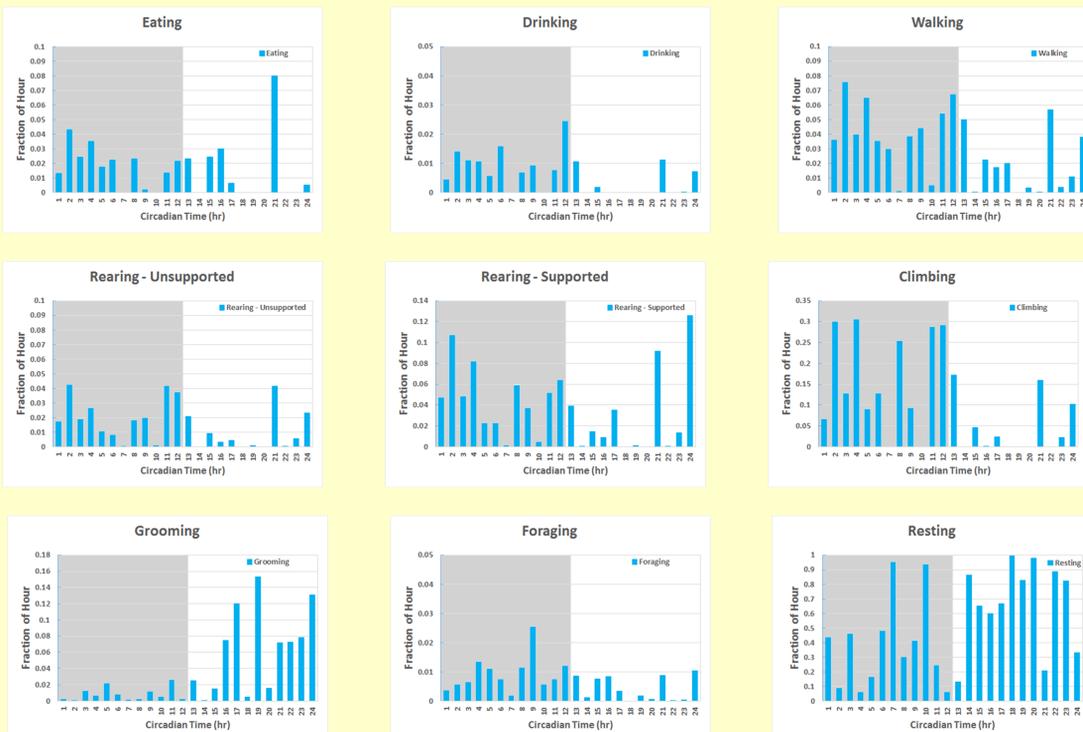


Video Processing

Custom software algorithms were developed to process both camera video streams and extract activity measures. Reported activity measures include automatic identification of about 9 different behaviors: eating, drinking, walking, grooming, foraging, rearing—supported, rearing—unsupported, climbing, and resting.

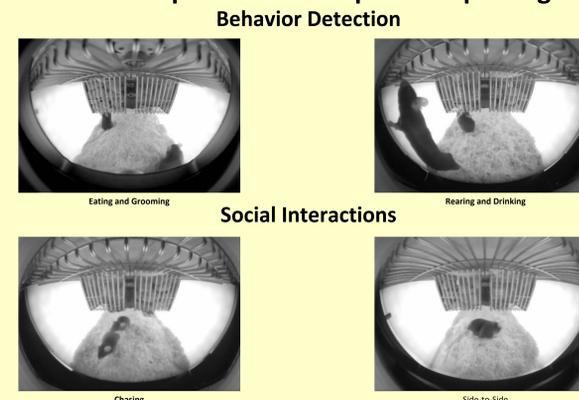
Results

Automated Behavior Detection Solitary Housed WT Mouse Full 24hr Circadian Cycle Profiles



Future Work

- Thorough validation of behavior detection
- Accurate 3-D construction of mouse head/tail
- Extension of methods to different mouse coat colors
- Extend development to multiple mice per cage



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Collaboration/Contact

scorhe.nih.gov