

Running Wheel

Continuously Monitor Animal Wheel Running Activity

VIUM®

INTRODUCTION

The Vium Digital Vivarium Platform offers two different types of activity biomarkers, which allow researchers to dissociate overall physical activity and voluntary activity: Vium Motion and Vium Percentage (%) Time Running on Wheel. Vium Motion measures overall activity, which is comprised of both voluntary and involuntary motor movements, including wheel running, as well as a wide range of complex behaviors, such as eating drinking and grooming. These behaviors contribute to background activity levels, especially during the light cycle when animals are less active. In contrast, Vium % Time Running on Wheel specifically captures free running on the wheel, which accounts for voluntary activity. A number of factors are known to differentially alter overall physical activity and voluntary wheel running activity (1,2).

Running wheels are commonly employed in rodent research not only to provide animal enrichment, but to measure physical activity and circadian rhythm patterns (1). Wheel running provides valuable information on many aspects of an animal's well-being and physiology, including motor function, energy balance, cognition, as well as stress-, anxiety, and depression-like behaviors (2,3). Wheel running activity has also been reliably used as a gold standard for measuring circadian rhythm patterns, therefore becoming an invaluable tool for phenotyping and investigating a number of disease models, including aging, metabolic, psychiatric, and neurological diseases (4-6).

PERCENTAGE TIME RUNNING ON WHEEL

This determines whether a mouse is running on the wheel on a frame-by-frame basis and reports the percentage (%) of time spent running on the wheel. To derive this biomarker, computer vision algorithms locate animals in the wheel zone of the home cage and determine if they are running on the wheel (Fig. 1). The result is reported as a binary output: 1 for animal running on the wheel and 0 for animal not running on the wheel. These outputs are then aggregated into time bins (ex. 60-sec, 600-sec, or 3600-sec bins), wherein each bin represents the percentage time the animal spent running on the wheel (total number of instances running / total number of frames * 100).

Preclinical Researchers Use This Biomarker to:

- Continuously and automatically monitor percentage time animal spent running on wheel with both low and high resolution time bins
- Complement overall and spontaneous physical activity (Vium Motion Biomarker)
- Measure short- and long-term changes in animal behavior, physiology, and well-being
- Assess circadian rhythm patterns
- Evaluate therapeutic interventions in animal models of disease

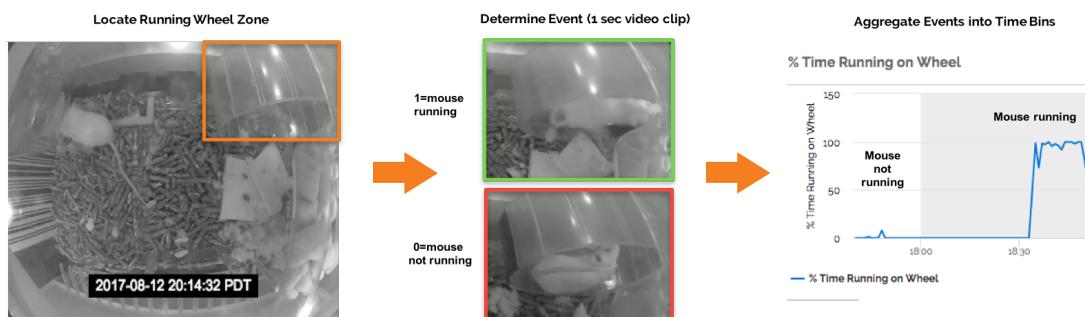


Figure 1. Schematic depicting generation of percentage (%) time running on wheel.

Computer vision algorithms locate running wheel zone then detect binary event (1=mouse is running on wheel for full 1-sec video clip, 0=mouse is not running on the wheel for full 1-sec video clip). Events are aggregated into time bins and can be visualized for individual subjects or as group averages in the online Research Suite.

DISCUSSION

Here we show that Vium Percentage (%) Time Running on Wheel provides automated, continuous, and accurate determination whether an animal is running on the wheel. Depending on the goals of the experiment, low and high-resolution time bins can be investigated for individual subjects or as group averages on the online Research Suite.

We also demonstrate the capability of this digital biomarker to investigate mouse models of disease. In a cuprizone mouse model of Multiple Sclerosis (MS), a representative subject showed periods of attenuated wheel running activity, which may indicate periods of decreased gross motor function resulting from demyelination (7). In conjunction with spontaneous physical activity, wheel running can be used not only to detect changes in overall activity, energy homeostasis, cognition, and social behaviors, but also to acquire more sensitive measurements of circadian rhythm patterns over short and long-term periods of time (2-5). Vium % Time Running on Wheel can be used as a direct readout for the evaluation of compound therapeutic efficacy and investigation of animal models of aging and disease (5,6).

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