

# Acuity Testing in Rodents with use of RatCAVE Virtual Reality System



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## Introduction

Animals used for spacial learning experiments include visual perception in their assessment of the situation. Perhaps, especially in artificially created laboratory environment, in case of which a lot of alternative stimuli are restricted. With that in mind RatCAVE was created. This setup is a part of a Cognition and Neural Plasticity Group, making creation of 3D experiments simple and accessible.

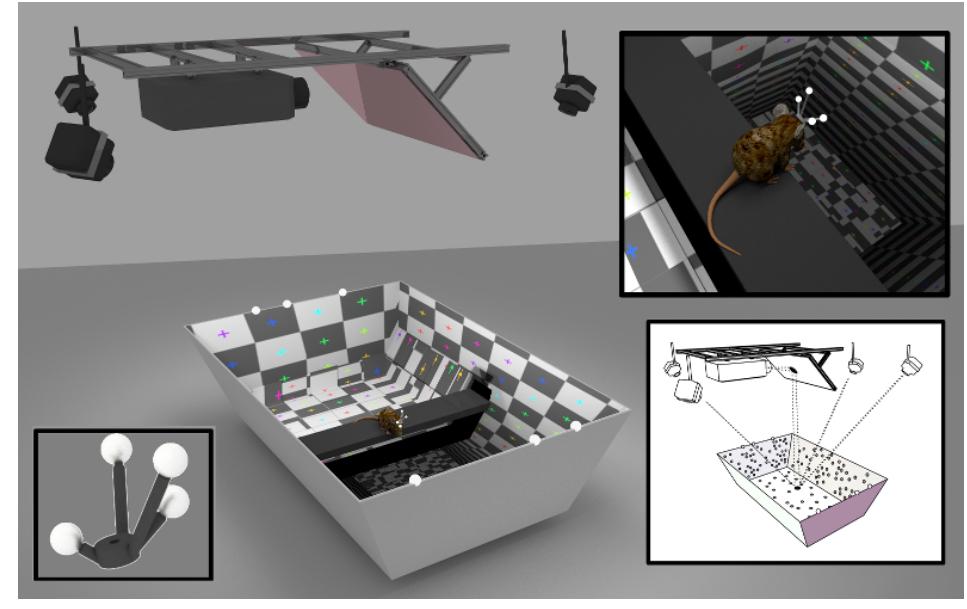


Figure: RatCAVE arena.

Following research was conducted to ensure that animals that take part in experiments have appropriate eyesight. With that in mind an appropriate

protocol for testing the acuity of the animals needs to be developed. We analysed the recorded data to look for such protocol.

## Experiments

- 8 recorded experiments
- 7 rats
- 2 days in July 2017
- Duration: 11 minutes
- 4 stimulus velocities: [0, 7, 14, 28]

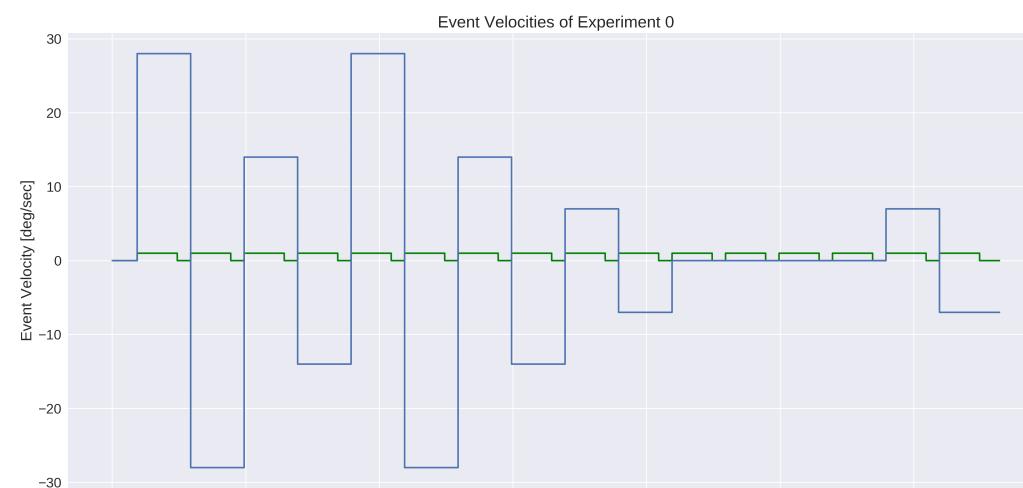
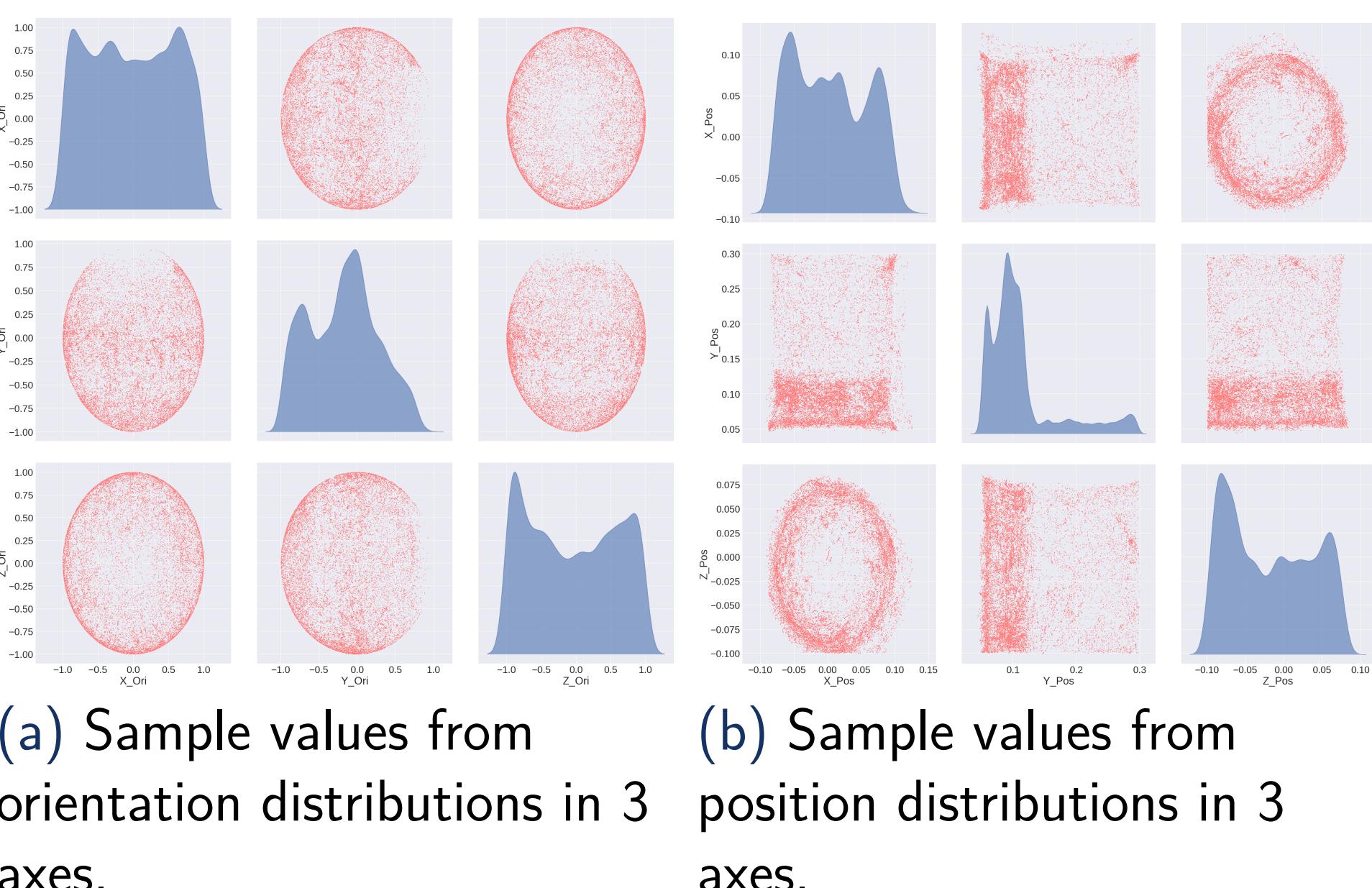


Figure: Example visualization of an experiment time series, view of different velocities and directions of the stimuli.

## Data

Data-set was recorded thanks to the infrared sensor placed on the hear of the rat. Thanks to that following information could be decoded:

- Position - 3D coordinates of rat's position
- Orientation - Unit Vector in 3D: X, Y, Z



(a) Sample values from orientation distributions in 3 axes. (b) Sample values from position distributions in 3 axes.

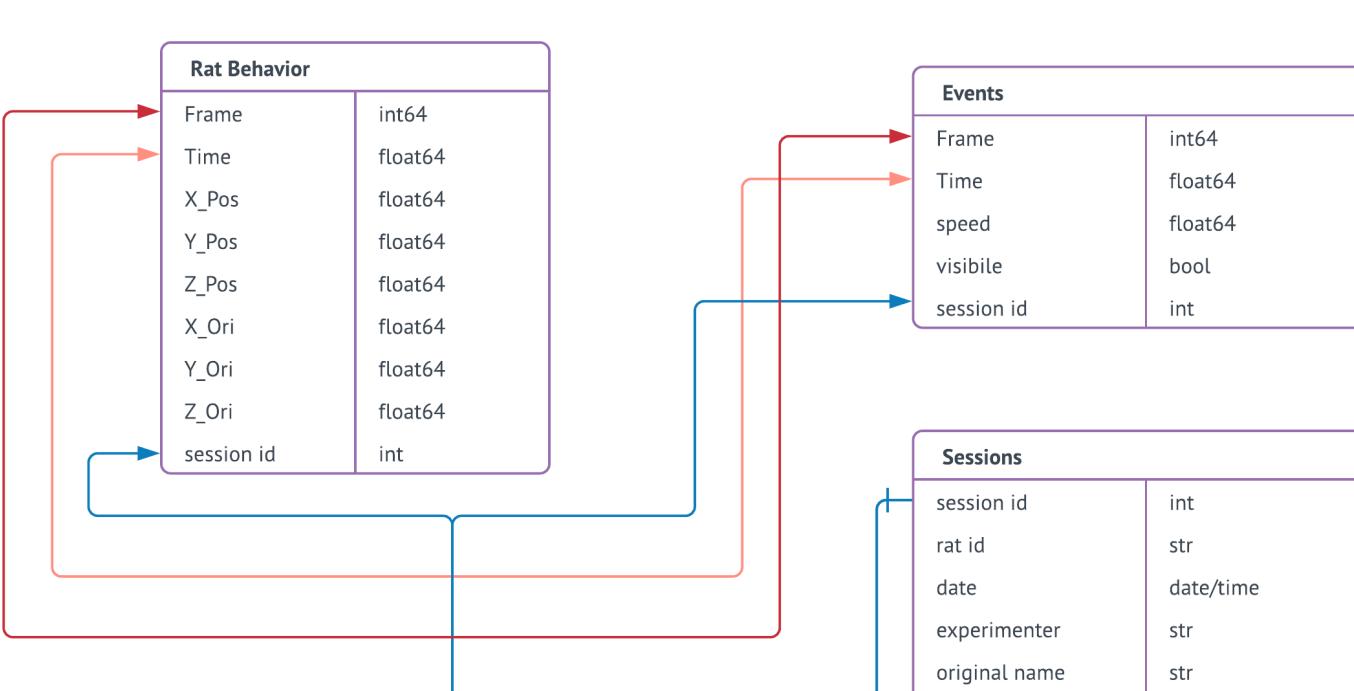
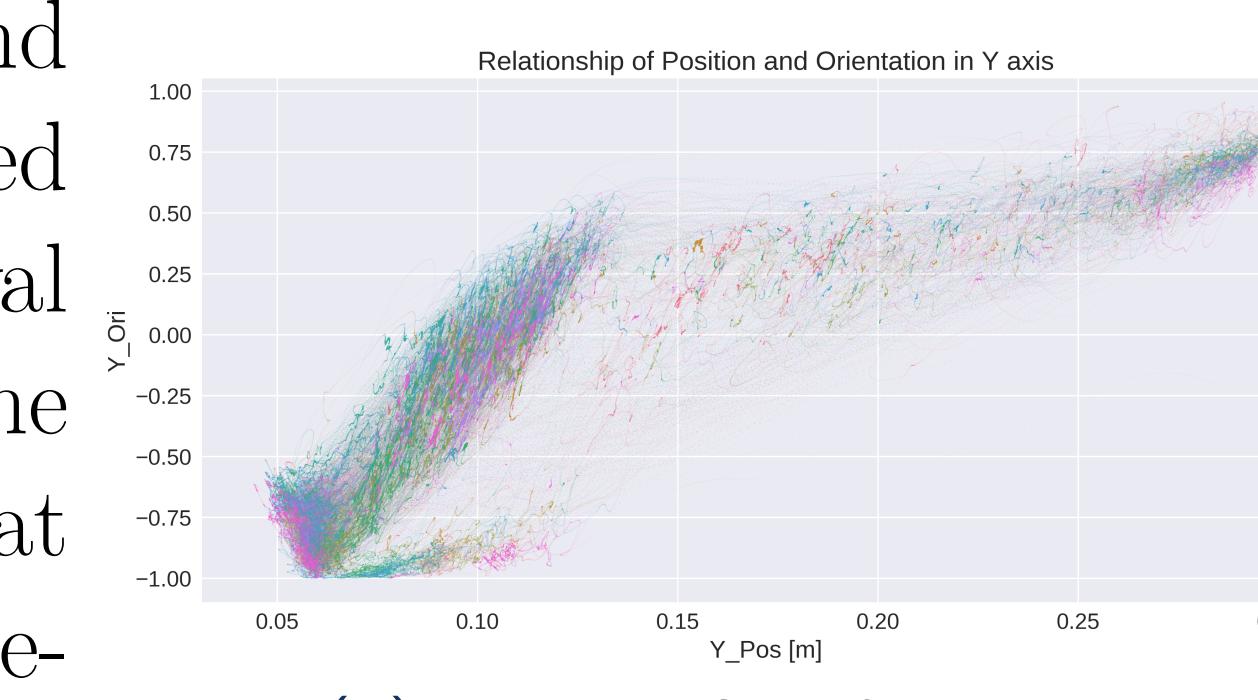


Figure: Visualization of interconnected DataFrame used for the experiment.

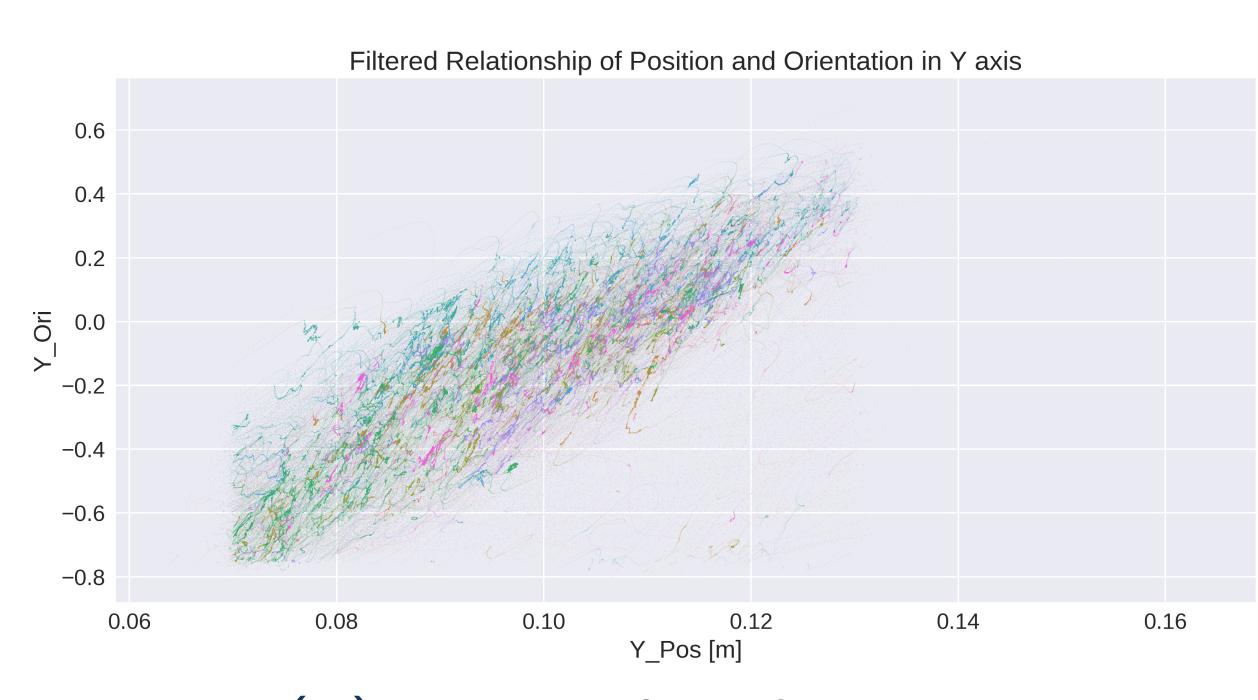
## Data Pre-processing

Due to the parameters of the hardware and signal acquisition recorded data required pre-processing. That involved first removal of invalid values and faulty parts of the recording. After that we concluded that data consists of four types of Animal Behaviors: **Tracking, Free movement, Rearing, Cleaning**.

**Rearing, Cleaning.** Additional filtering had to be conducted to eliminate the recordings representing both cleaning and rearing, both behaviors resulted in characteristic shape in distributions of position and orientation.



(a) Data before filtering.



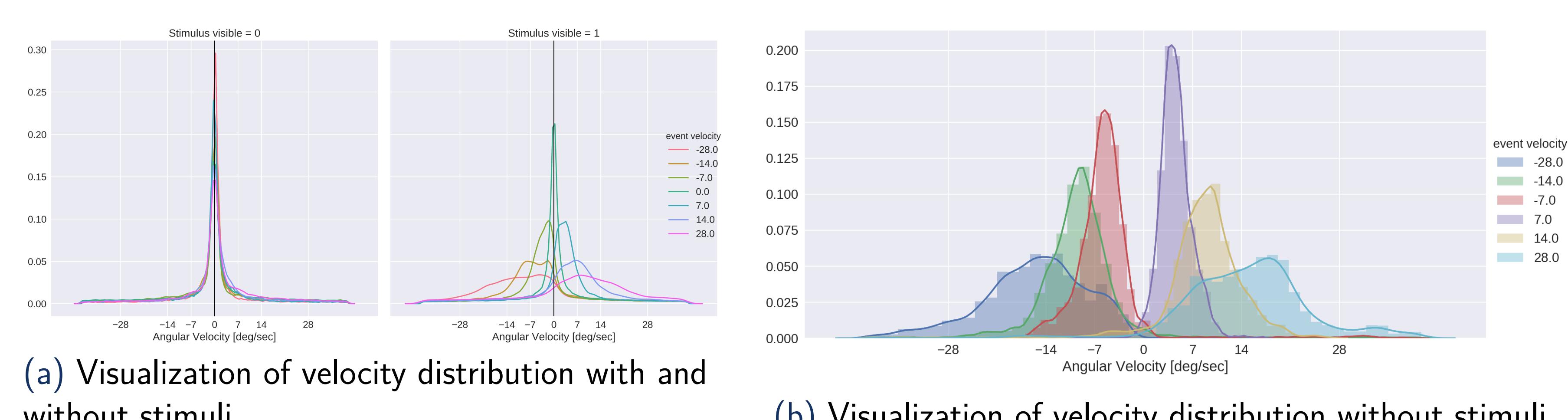
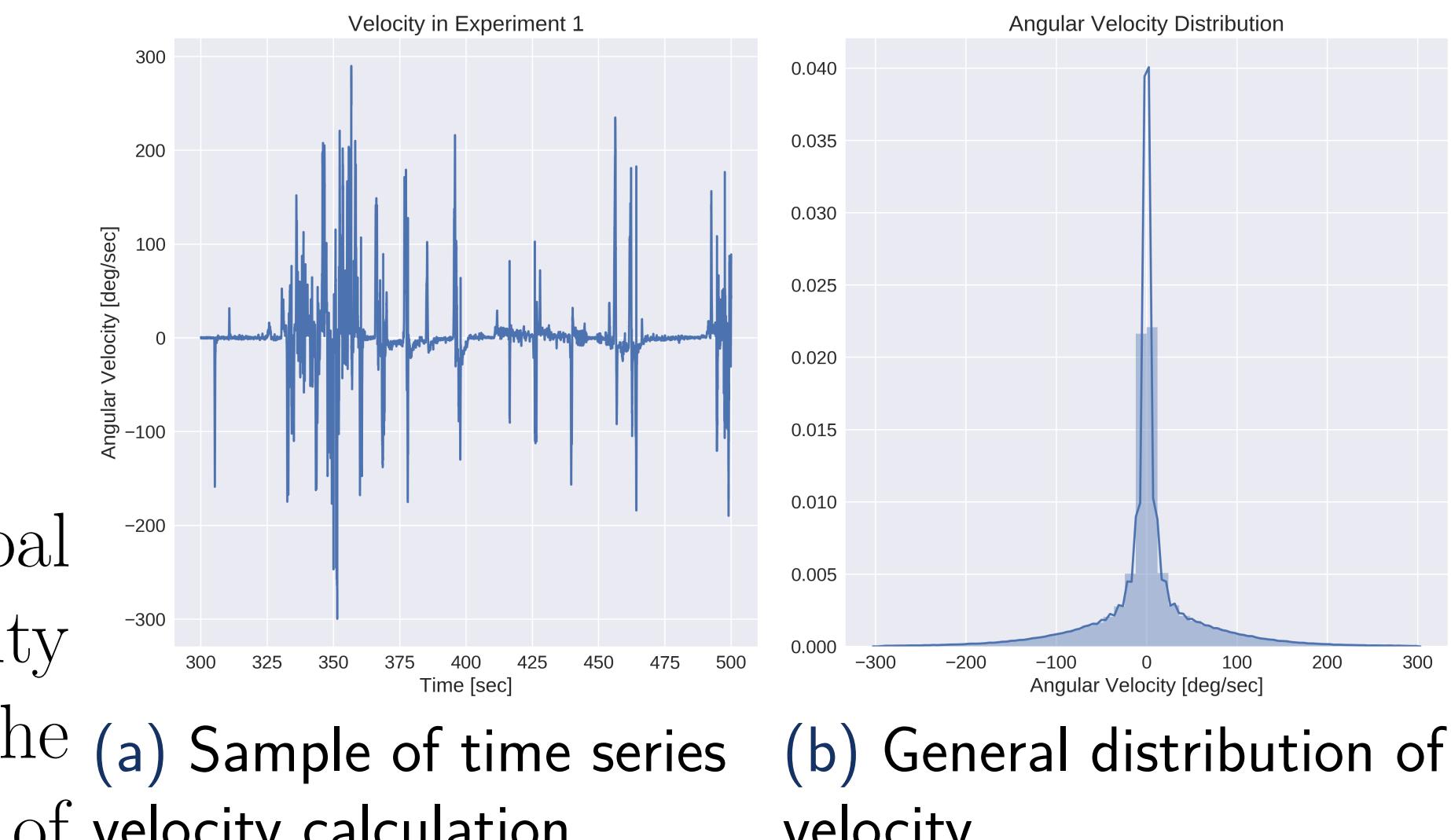
(b) Data after filtering

## Analysis

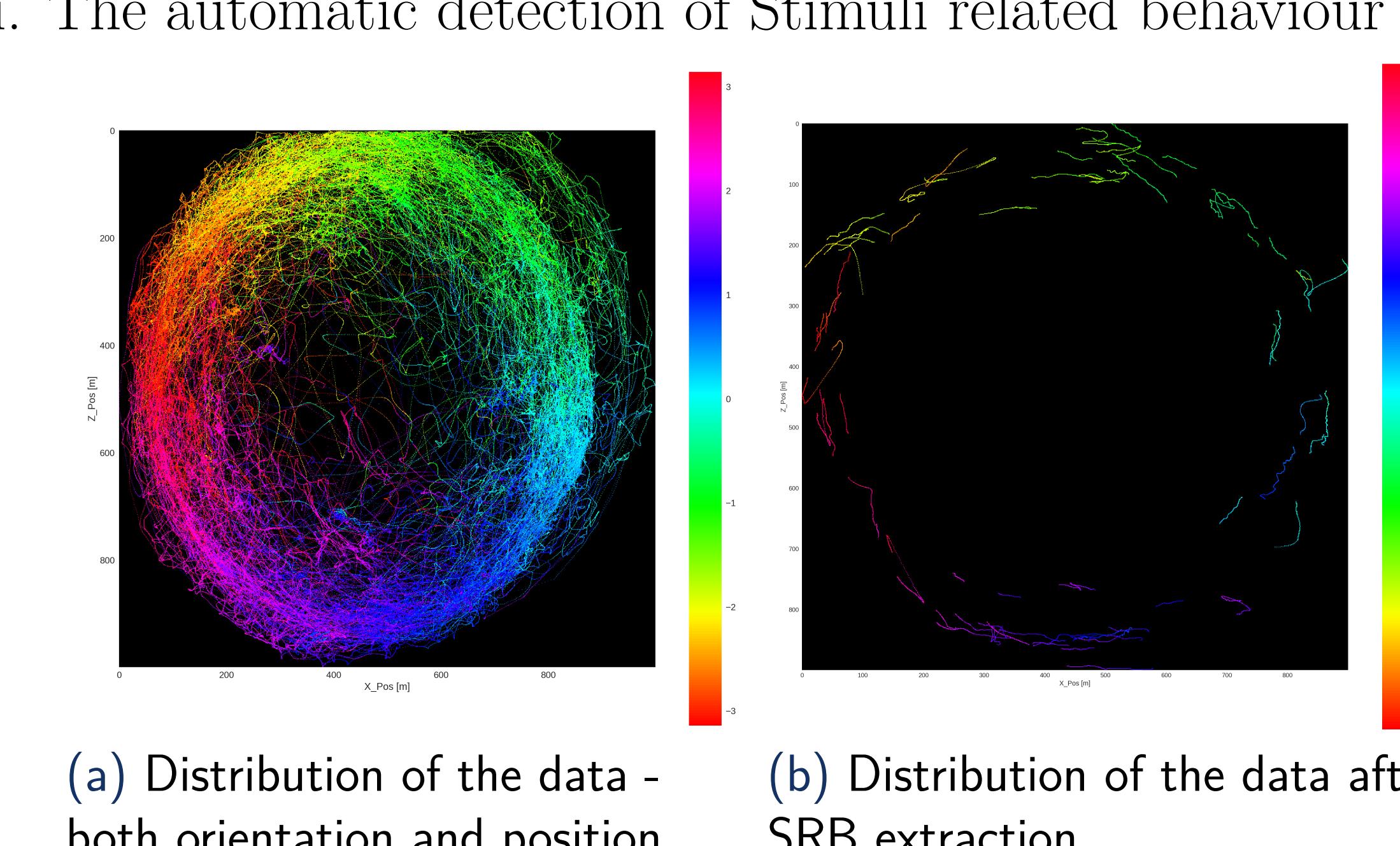
All time series have been analysed with following approach:

- The orientation vector has been flattened down to represent only XZ axes.
- **Angular velocity** has been calculated in the new dimensions.

Finding **Stimulus related behavior(SRB)** was the goal of the experiment. It could only be evaluated in the velocity domain. After appropriate transformations, we compared the velocities of the stimuli with the velocities of the rat in search of velocity calculation. correlation. Automatic Detection of the events is based no set of features: *velocity range, duration, variance*. Procedure involved comparison of angular velocity of the animal with the event speed. Elimination of too short correlations and merging shortly interrupted events - indicating movement of the head in the opposite direction.



## Results



(a) Distribution of the data - both orientation and position . (b) Distribution of the data after SRB extraction.

## References

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- [2] V. Kretschmer F. Kretschmer, Sz. Sajgo and T. C. Badea. A system to measure the optokinetic and optomotor response in mice, [2015].
- [3] Ouagazzal A. Rousseau S Romand R. Auwerx J. Sahel J. Chambon P. Picaud S. Jellali A., Meziane H. The optomotor response: A robust first-line visual screening method for mice[2004].