Unraveling animal behavior through decoding of non-invasive, continuous measurements

Sujet proposé par

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M2 Research project title

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Keywords

behavior, monitoring, machine-learning, decoding

Description of the project

Animals interact with the world through freely expressed behaviors which reflect sensory information, prior experience and internal state. The brain composes these complex patterns of action by concatenating stereotyped motifs of movements into meaningful sequences. The goal of this project is to develop a continuous, non-invasive method that can discover modules of behavior (e.g., rearing, running, grooming, etc.) and can characterize how that structure is altered by experimental interventions such as genetic mutations, drug treatments, or in animal models of human diseases. For that purpose, we propose to develop machine learning techniques for automated categorization of behavioral modules of continuous actimeter measurements from the home cage. Our goal is to develop easily scalable tools which enable uninterrupted and non-invasive decoding of behavior including social interactions, which will present a significant and wide-reaching advance in behavioral studies, animal monitoring and phenotyping. The project inscribes itself in the emerging field of computational behavioral analysis—the use of modern methods from computer science and engineering to quantitatively measure animal behavior. Using continuous, non-invasive actimeter measurements to infer animal movements has not been used before to study refined animal behavioral motifs (e.g., rearing, running, and grooming) in their typical habitat - the home cage. This innovative approach will provide unbiased behavioral measures which can be used to address a large range of scientific questions, i.e., characterization of the behavioral consequence of any type of intervention, early onset detection of behavioral phenotypes, social interaction studies, behavior monitoring, characterization of individual biases, etc. The low cost, versatility and scalability of the measurements provides the potential that actimeter-enabled behavioral monitoring takes a central role in animal research. This innovative implementation can provide insights which will not only be crucial for animal monitoring but also be insightful for a more refined and comprehensive characterization of animal disease models used to study human disorders.

Methods and techniques

We propose to use continuous actimeter measurements and develop tools to infer animal behavior and social interactions through advanced machine learning approaches. The actimeter measurements are based on a combined gyroscope and accelerometer unit attached to the animal's cage in the animal facility. This system has been put in place and the continuous data-streaming and storage are running. Our main objective is to create decoding tools allowing us to use these non-invasive, continuous, low dimensional actimeter measurements to infer behavioral modules including social interactions. We will first generate a ground truth data-set which consists of combined actimeter measurements with video recordings of the animals in the cage. This combined data-set will be used to train and test machine learning-based decoding methods aimed at inferring behavior from the actimeter measurements. Together the project aims at providing a tool for assessing animal behavior based on low-cost, large-scale, non-invasive actimeter readings providing a far-reaching advance in behavioral studies, animal

monitoring and phenotyping.

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