Neural algorithms for reinforcement learning in continuous action spaces

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Our brain has a remarkable capacity for learning new movements. We often take it for granted that, given enough time and practice, we can learn almost any skill, such serving a tennis ball or playing the sitar. Yet, from a computational perspective, learning a new skill is a very difficult challenge. This is because it requires the brain to search through very large high-dimensional and continuous motor spaces to determine the “correct” movement parameters, while receiving very simple (typically binary “yes” or “no”) feedback on the outcome of its actions.

This project seeks to understand the learning algorithms employed by the brain to learn in continuous motor spaces and to investigate how these algorithms are implemented in neural circuits. We will acquire large datasets from rodents solving complex motor learning tasks using high-throughput, automated methods of behavioural training. We will analyse these behavioural datasets through the computational lens of reinforcement learning theory to infer the algorithms used by the brain to learn in a continuous motor space. To understand how these algorithms are embedded in the brain, we will record and manipulate activity in brain areas such as motor cortex and basal ganglia using techniques such as electrophysiology and optogenetics. We will compare these neural datasets to parameters of the best fitting reinforcement learning models. This project involves close collaboration between the experimental field of systems neuroscience and the machine learning field of reinforcement learning. We are looking for a candidate who desires to become an expert in both areas.