Sensorimotor adaptation is a crucial process necessary for the proper adaptation to changes and perturbations in the environment. Although research in humans and non-human primates has provided some insight into the mechanisms underlying this process, it is not yet fully described and a comprehensive understanding requires a focus on rodent studies.

This research project aims to investigate the mechanism of sensorimotor adaptation in a trial-and-error process of adjusting the movements to new demands. Throughout the project, we will study the role of the somatosensory (S1) and motor (M1) cortices. The M1 is essential for motor learning, while the S1 provides vital sensory information that is transmitted to the M1, potentially influencing somatosensory adaptation. We will perform experiments on awake, headfixed mice trained to pull the joystick to get the reward and forced to adapt to movement trajectory perturbations, caused by a magnetic force field presented during the task. To determine the causal relationship between cortical neuronal activity, adaptation process, and its possible mechanism, we will perform real-time calcium imaging with the use of a fiber photometry system, genetically encoded calcium indicator (jRGECO) (as the change in calcium level correlates with the change in neuronal activity) as well as glutamate and gamma-aminobutyric acid (GABA). Further, we will use optogenetics to inhibit both S1 and M1, as well as the connectivity between them, in order to investigate their involvement in sensorimotor adaptation. All behavioral experiments will be video recorded, and extensive analysis will be conducted on the animals' actions during the motor task to obtain various movement parameters such as direction, amplitude, and speed.

We believe that our experiments will make a significant contribution to the current knowledge of sensorimotor adaptation. Furthermore, impairment of this process often manifests as a symptom of neurological disorders or as a consequence of stroke. We hope that the results of our experiments will contribute to the development of novel and more effective therapies for patients suffering from such disorders.