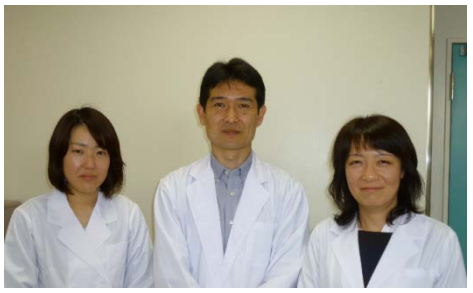
東海大学創造科学技術研究機構
TOKAI UNIVERSITY INSTITUTE OF INNOVATIVE SCIENCE AND TECHNOLOGY

Systems Neuroscience KATOH LAB
加藤研究室



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Analyses of mechanisms for motor control and learning and characterization of eye movements as diagnostic indices for diseases

Keywords: Vestibulo-ocular reflex, Disease-model animals, Neural circuits, Optogenetics

Background and Motivation

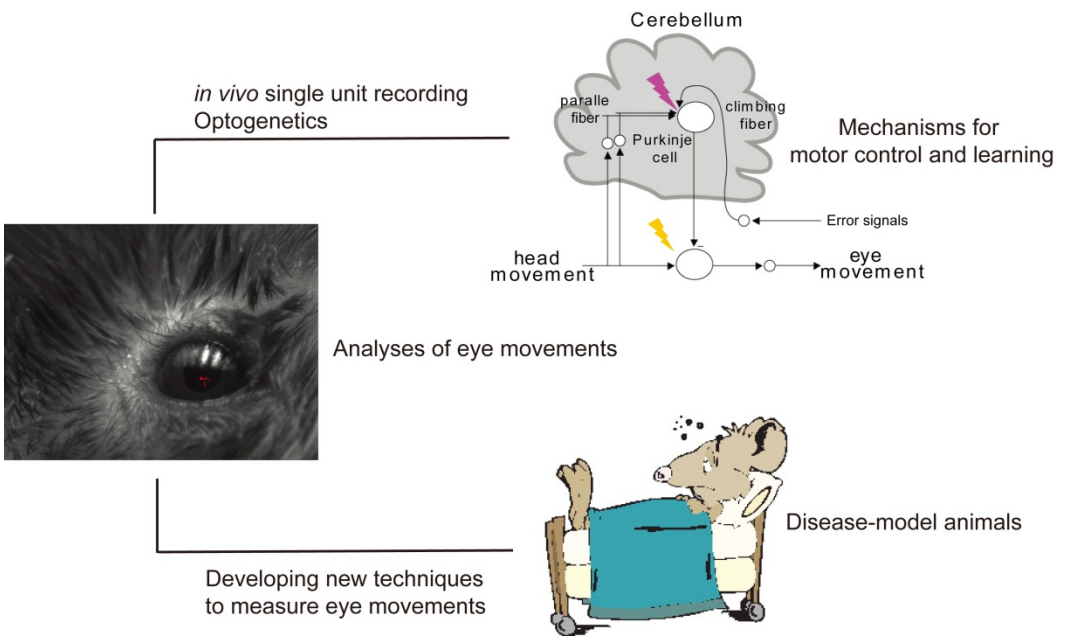
Motor learning is the process by which movements become smooth and accurate through practice and depends on brain regions called the cerebellum and brainstem. We will focus on eye movements in rodents to understand mechanisms of motor control and learning systematically from genes through neural circuits and behavior. We utilize two complementary methods, 'recording' and 'stimulation' in alert animals, which would help to elucidate mechanisms for motor control and learning at the level of neural circuits in the cerebellum/brainstem. In addition, we try to develop new techniques to measure eye movements precisely in rodents, and characterize eye movements in disease-model animals as diagnostic indices for human diseases.

Originality

Two basic and complementary approaches for analyzing neural circuits are recording and stimulation. I have developed *in vivo* unit recording system from a single cell in the cerebellum in mice during training that changes the motor output of eye movements. Using this technique and a new molecular-genetic tool, Optogenetics, which uses light-activated molecules to rapidly depolarize or hyperpolarize only a subset of neurons in the related neural circuit when they are exposed to light of specific wave length, is a novel approach to reveal the role of the cerebellum/brainstem for motor control and learning and to elucidate mechanisms at the level of neural circuits. This approach combined with precise and less invasive measurements of reflexive eye movements in rodents will also be helpful to discover and characterize disease-model animals.

Impact and Perspective

Our research will lay the groundwork for using eye movements in rodents as a model system for examining the neural mechanisms by which the brain controls motor output and motor learning in the eye movements, resulting in the development of better treatments for neurological disorders. Although there has been a few works which apply both *in vivo* unit recording and Optogenetics to awake animals, a better understanding of how neural circuits work by using these powerful tools will aid the development of better treatments for a wide variety of neurological disorders affecting motor functions. Moreover, the general principles we uncover about how neural circuits work could influence all areas of neurology, and could even influence our approach to normal aging. It is also important to develop the new experimental systems to analyze neural functions for a broad contribution to the alliance of medical engineering in Tokai University.



■ For more information:

www.u-tokai.ac.jp/tuiist/english/tt/announcement_katou.html

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