

論文の内容の要旨

論文題目

CUBIC-Cloud: An Integrative Computational Framework Towards Community-driven Whole-Mouse-Brain Mapping

(CUBIC-Cloud: 分散型マウス全脳マッピングのためのクラウド解析システム)

氏 名 真野 智之

Recent advancements in tissue clearing technologies have offered unparalleled opportunities for researchers to explore the whole mouse brain at cellular resolution.

With the expansion of this experimental technique, however, a scalable computational framework is in demand to effectively analyze and integrate whole-brain mapping datasets collected by the research community.

To that end, here I present CUBIC-Cloud, a cloud-based framework to quantify, visualize and share whole mouse brain data.

In chapter 1, I will review the previous whole mouse brain mapping projects, and explain how tissue clearing and light-sheet microscopy imaging method is bringing a new breakthrough in this landscape.

Based on these observations, I will outline the software challenges that needs to be addressed to achieve more scalable and efficient whole brain mapping.

Chapter 2 describes the experimental methods and software implementation details.

In chapter 3, I will explain the CUBIC-Cloud framework and describe the front-facing functionalities to allow researchers to upload, analyze and publish the whole brain mapping data.

Because CUBIC-Cloud is constructed with serverless architecture, the system is able to dynamically scale its computational power depending on the load by the user.

In chapter 4, using CUBIC-Cloud framework, I will present some novel whole mouse brain mapping results to demonstrate the usability of the proposed framework.

First, I investigated the brain-wide distribution of various cell types, including

PV, SST, ChAT, Th and Iba1 expressing cells.

Second, I analyzed the $A\beta$ plaque deposition in AD model mouse brains.

Third, I reconstructed neuronal activity profile under pharmacological perturbation using c-Fos immunostaining.

Forth, a brain-wide connectivity mapping by pseudo-typed Rabies virus will be demonstrated.

Together, CUBIC-Cloud provides an integrative platform to advance scalable and collaborative whole-brain mapping.