

Japan-U.S. Brain Research Cooperation Program
Group Joint Study Project Program FY2016_ - FY2017__ : Report

Field: Brain Science

1. Principal Researcher

Name Takuya Hayashi

Title Team Leader

Affiliation RIKEN Center for Life Science Technologies (Currently changed to RIKEN Center for Biosystems Dynamics Research)

2. Project Title:

Dissecting plastic brain of non-human primates with non-invasive neuroimaging

3. Japanese Group

Names, Titles and Affiliations of Principal Researcher and Collaborating Research Members

PI

Takuya Hayashi, Team leader, RIKEN Center for Life Science Technologies, Functional Architecture Imaging Team

Collaborating Research Members

Chihiro Yokoyama, Senior Researcher, RIKEN Center for Life Science Technologies, Functional Architecture Imaging Team

Sayuki Takara, Researcher, RIKEN Center for Life Science Technologies, Functional Architecture Imaging Team

Joonas Autio, Post-doctoral Researcher, RIKEN Center for Life Science Technologies, Functional Architecture Imaging Team

Takayuki Ose, Research Assistant, RIKEN Center for Life Science Technologies, Functional Architecture Imaging Team

4. U.S. Group

PI

Names, Titles and Affiliations of Principal Researcher and Collaborating Research Members

David Van Essen, Emeritus Professor, Department of Anatomy and Neurobiology, Washington University School of Medicine in St. Louis

Collaborating Research Members

Tim Coalson, Programmer analysis, Department of Anatomy and Neurobiology, Washington University School of Medicine in St. Louis

Donna Dierker, Programmer analyst, Department of Anatomy and Neurobiology, Washington University School of Medicine in St. Louis

Timothy B Brown, Programmer analyst, Department of Anatomy and Neurobiology, Washington University School of Medicine in St. Louis

Chad Donahue, Graduate Student, Department of Anatomy and Neurobiology, Washington University School of Medicine in St. Louis

Matthew Glasser, Graduate student, Department of Anatomy and Neurobiology, Washington University School of Medicine in St. Louis

5. Research Period, from/to (mm/dd/yyyy) and total number of years.

From April 2016 to March 2018 (2 years)

6. Abstract, Results, and Research Significance (300 words):

This project aimed at developing non-invasive MRI techniques for understanding plastic brain of non-human primates and continued for a period of two years. The project was started by the plans that

Japan group devotes to developing MRI RF coils and data acquisition and US group consult for the preprocessing and data analysis. The collaborative research in fact proceeded relying on close and emergent exchanges and achieved unexpectedly high increase in sophistication of research technologies and enhancement of research functionality. We are now able to prospect multiple achievements of research and technologies.

Japan group has developed MRI RF coils for macaque and marmoset brain. Notably, the world's best quality of the coils was achieved by continuously repeated qualification, re-design and reproduction. The Japan group has collected brain image data in many subjects of macaque and marmosets. The US group has proved the non-human primate (NHP) pipeline to Japan group, however, many technical refinements were needed for high quality analysis of the data. These included the supervising machine-learning system of brain parcellation, parameter optimizations for brain extraction, image homogeneity correction, cortical boundary estimation. These technical developments achieved the high quality cortical surface mapping of brain function and structure in macaque and marmoset. We also developed machine-learning system for denoising resting state functional MRI data. Based on this, we are now able to capture very high quality and dense connectome in macaques and marmoset. These achievements were based on the mutual and close exchange with US group, which further allowed emergence of technical and scientific ideas. We think our technologies may contribute to visualizing dynamic changes of brain function and architecture.

Research achievements in this project has been partly presented at the conference or in preparation for publication (Autio et al, Hori et al., Yoshida et al, Nishigori et al, Ose et al.,). Related work was published in Fukutomi et al., Neuroimage 2018 in press.

7. Other (Research-related concerns, particular points of note):

None

*Please attach any reference materials as necessary.