**Background of Mesoscale Connectivity Mapping Project**

The brains of rats, mice, and many other animal models are organized quite differently from primate brains, at the level of specific anatomical circuits. The common marmoset (Callithrix jacchus) is emerging as a choice animal model in neuroscience. For neuroscientists, the marmoset is important as the simplest organism that shares many of the features that make primate brains special. The goal of the neurohistological and computational pipeline is to carry out brain-wide **mesoscale circuit mapping** of the common marmoset using the injections of anterograde and retrograde tracers (4 tracers in one marmoset), as part of the Japan Brain/MINDS project.

In order to construct a brain-wide connectivity matrix, this research presents a computational pipeline that identifies source and target brain regions through cross-modal registration and process detection. So far, a total of >160 injections have been placed in the cortex region which results in several major parcellations from the current connectivity mapping of the marmoset brain. This research serves to further formalize the analysis portion of the registration process to better serve the needs of mapping a marmoset brain.

**MRI-guided Registration and Annotation**

The major advantage of the tape-histology method is that we obtain multiple series (Nissl, Myelin in addition to the Fluoro) that are all cross-registered to ~99% accuracy.

- **Dataset**
  - Target Nissls
  - Target Fluoro etc...

- **Masking**
  - Fluoro-Nissls Rigid
  - Registered Nissls
  - Atlas

- **Atlas to Atlas (LDDMM)**

- **Ex vivo MRI**

- **Affine-Registered Nissls**

- **Ex vivo MRI**

- **Target Mask**

- **MRI-to-Atlas (LDDMM)**

- **Registration**

- **Atlas MRI-guided Registration**

- **Annotated Tracing**

**Tissue Quality / High Resolution Image Acquisition using Tape-Transfer Method**

- **Nissl-staining**
- **Myelin-staining**

- Fluorescent images (1mM formamide, 120 μM).

- [Meng Kuan Lin, Yeonsook Shin Takahashi et al., 2018 doi: 10.1101/315804](https://doi.org/10.1101/315804)

**Analysis of Shape Change Induced by Sectioning (Tape-Transfer) Process**

- (I) Mean percentage of local scale change over twelve subjects presented in atlas coordinate space.

- (II) Histogram of percentage of local scale change over the space of the entire Brain/MINDS atlas.

**Result of MRI-guided Registration and LDDMM Optimization**

- Distortion can be corrected by the MRI-guided method which uses the population-typical reference atlas, producing a Nissl volume which more closely resembles the convex hull of the same subject MRI.

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- [Marmoset Brain Architecture Project Mitra G. Okano Lab - Data Portal](http://marmoset.braincircuits.org/)