Resting-state fMRI with Anesthetized Rat

MRI-B Team (MRI Lab, CNI Lab)

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Introduction

- Resting-state functional MRI is a functional MRI in the absence of a task or stimulus paradigm.

- Default mode network (DMN) is a network which is highly correlated at resting state.

- Rodent has also the similar resting-state network with human.

- Recently, the anesthesia level is known to one of a factor to adjust the brain activity in rats.

Goal

- **Resting-state fMRI with Anesthetized Rat**

1) Preliminary evaluation of rat EPI setting

- Rat DMN should be reproducible in our rat EPI setting

2) DMN changes according to the level of anesthesia in rat

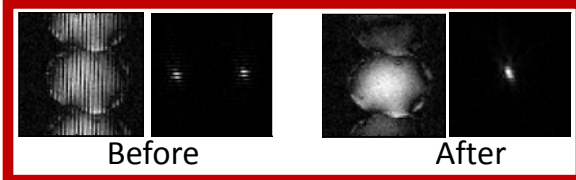- DMN changes according to the level of anesthesia aren't reported in rat   vs
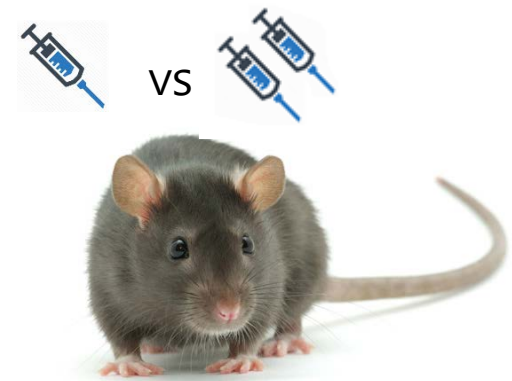
MRI Lab

1. MR imaging System optimization
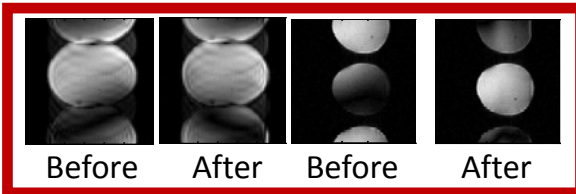
2. Sequence/ animal preparation

3. Data acquisition
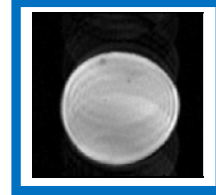
Methods

Sequence Optimization

Single-shot EPI

Before   After

1. Parameter optimization

Before   After   Before   After

2. Ghost correction

Segmented EPI

Animal Preparation

▪ During the scan, following physiological conditions were monitored and controlled.
   - Temperature : 36.5 ~ 37 °C, Breathing : 60 ~ 90 breath/min

▪ Anesthetization method: Isoflurane (3%: preparation, 1.4%/1.6%: scan)
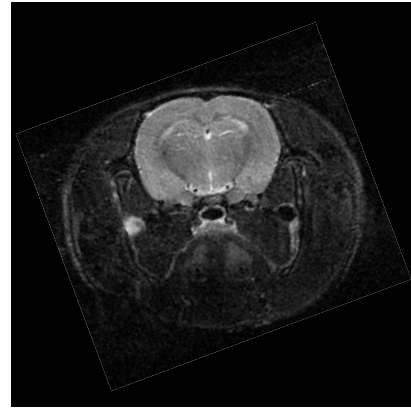
Data Acquisition

Matrix	76*68
FOV	$30 * 30 \ mm^2$
No. slices	40
Slice Thickness	$0.7 \ mm$
TE/TR	10ms/4000ms
Receiver bandwidth	200 kHz
Repetition	200
Total scan time	15 min

Data Acquisition

Segmented GE-EPI
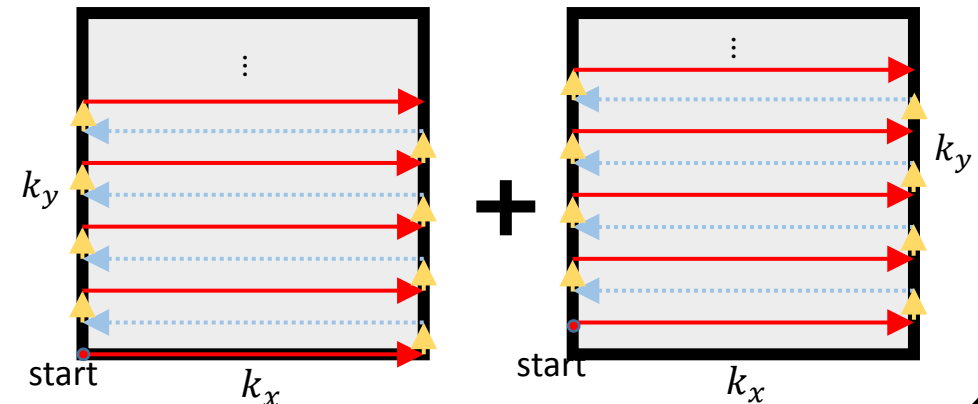
Results

Reference Image

T1 weighted image | T2 weighted image

Isoflurane 1.6%

Slice #1 | Slice #5 | Slice #10 | Slice #15 | Slice #20 | Slice #25 | Slice #30 | Slice #35 | Slice #40

Isoflurane 1.4%

Slice #1 | Slice #5 | Slice #10 | Slice #15 | Slice #20 | Slice #25 | Slice #30 | Slice #35 | Slice #40
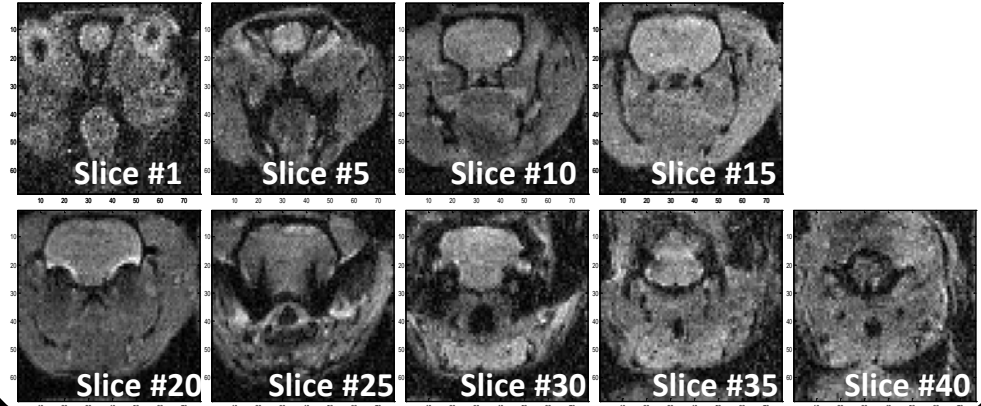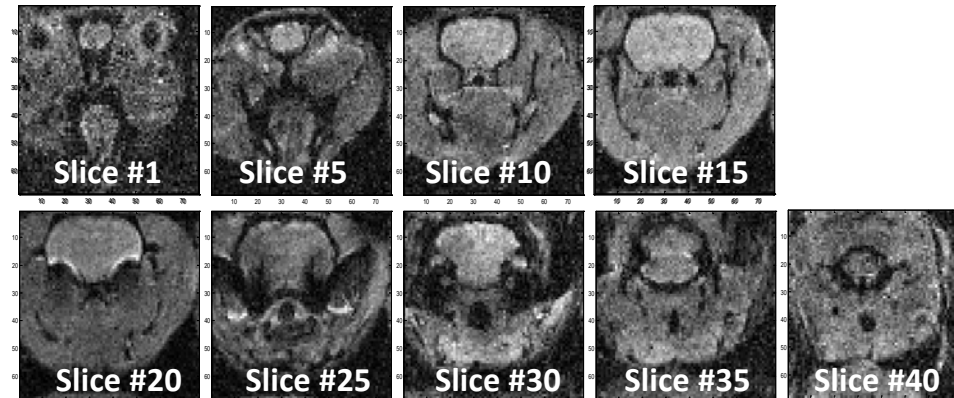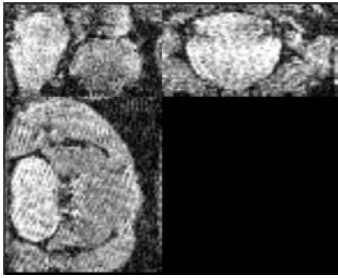
CNI Lab

1. Data Preprocessing

2. fMRI Data Analysis

Methods

Image pre-preocessing

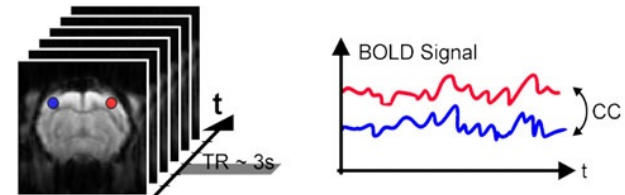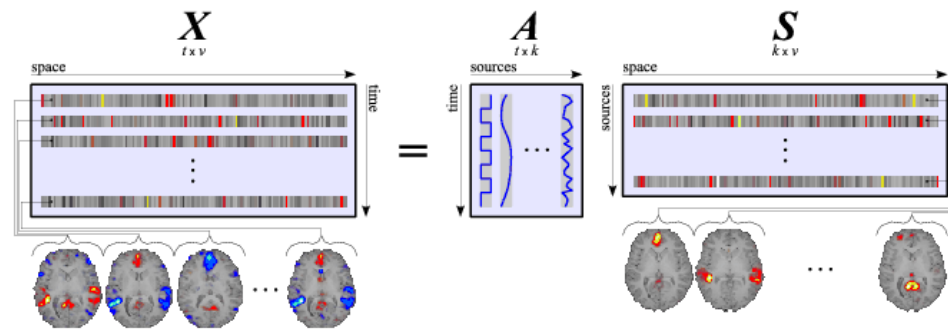**Bregma orientation**   **localization**   **Registration**
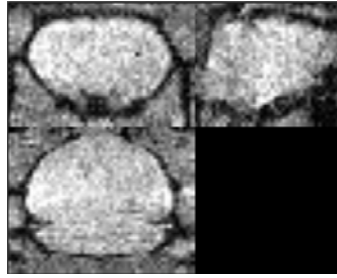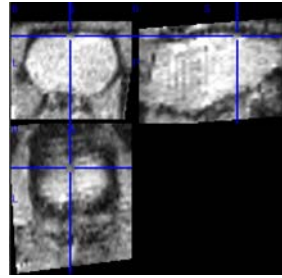
Image pre-processing

- Bregma orientation
- Spatial realignment
- T1 registration
- Template registration

Analysis

Analysis

- ICA
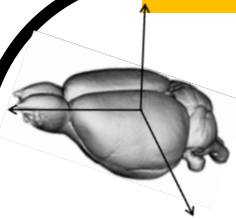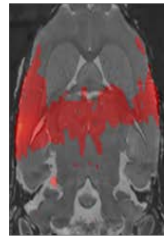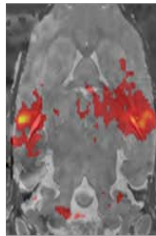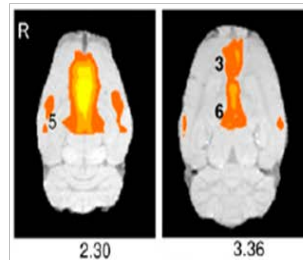- Functional connectivity
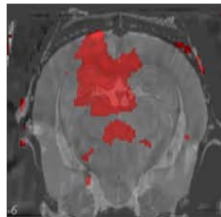- BOLD response
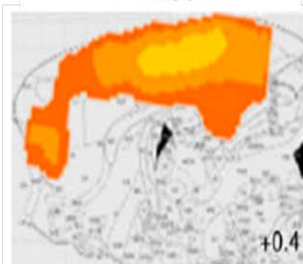
Results

ICA
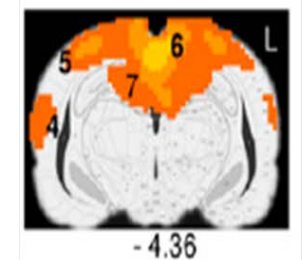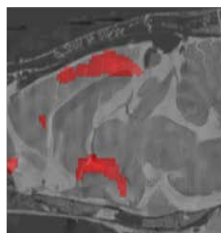
Isoflurane
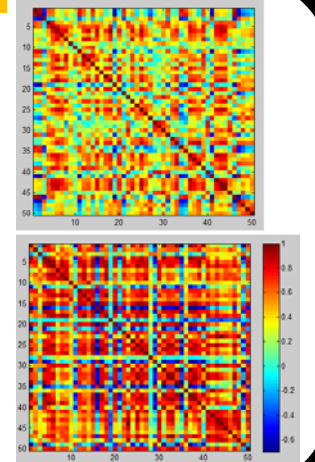
1.4%   1.6%

Axial plane
DV = 3.2
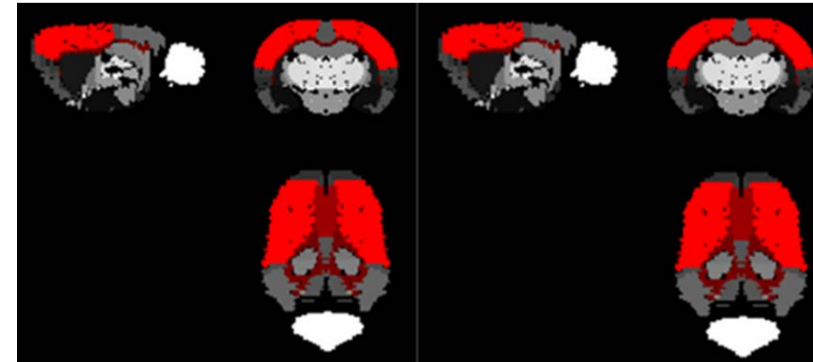
Coronal plane
AP = -5

Sagittal plane
ML = +0.4

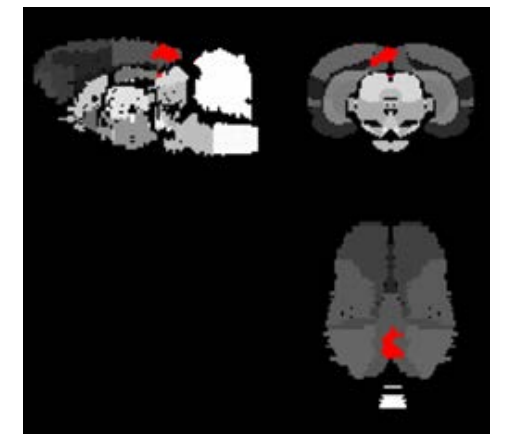**Functional connectivity**

1.4%   1.6%

Response 1.6% > 1.4%

Retrosplenial granular cortex (RSG)

Conclusion

✓ Rat DMN

- ICA & Functional connectivity

1.4% isoflurane → DMN is dissociated.
1.6% isoflurane → DMN well discovered.

- BOLD response

Higher anesthesia depth, Higher BOLD response in RSG

We can conclude :
At higher level of anesthesia,
DMN is well working and the higher activation of RSG is occurred.

Future Study

- rs-fMRI with Vascular dementia (VaD) mouse model
  - VaD is the second most common cause of dementing illnesses after Alzheimer's disease (AD)
  - Mouse model
    1) Hyperlipidemia
    2) Hypertension

- rs-fMRI with single-shot GE-EPI (ghost correction)

Thank you