國立清華大學
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Data Analysis & Interpretation Lab

Readme – motion correction

registration_ver4

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1. System requirements

- Our environment
  - Windows 10
  - Matlab R2021b
  - CPU 11th Gen Intel Core
- This code has been tested on our environment and Matlab R2020b.
- No non-standard software required.

2. Installation guide

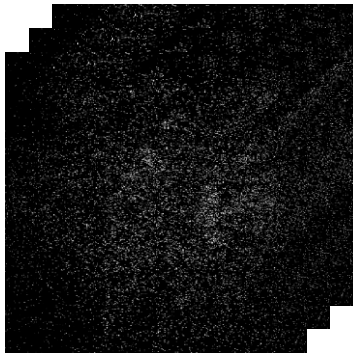
- Please refer to the following URL for MATLAB installation instructions.
  - https://www.mathworks.com/help/install/install-products.html
- Typically, installing MATLAB on a "normal" desktop computer takes around 30 minutes to 1 hour.
- Typically, installing our code takes less than one minute.

3. Demo

- Perform motion correction using auxiliary corrected data (denoised, cropped, etc.), then apply the parameters back to the original data.
- Running the program with demo data on a normal computer should complete within five minutes.

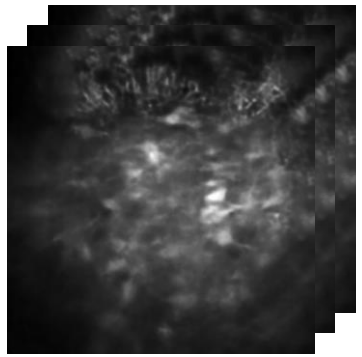
3. Demo

Functional raw data



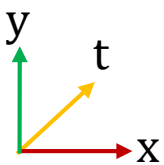
DeepCAD-RT

Denoised data



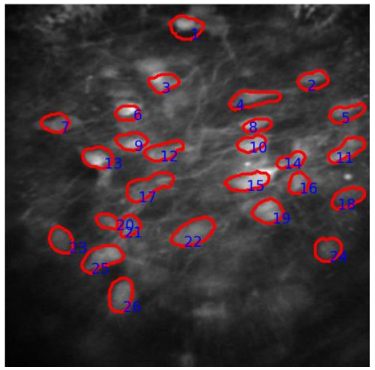
Motion correction transform matrix

$$\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ t_x & t_y & 1 \end{bmatrix}$$



Apply

expected output

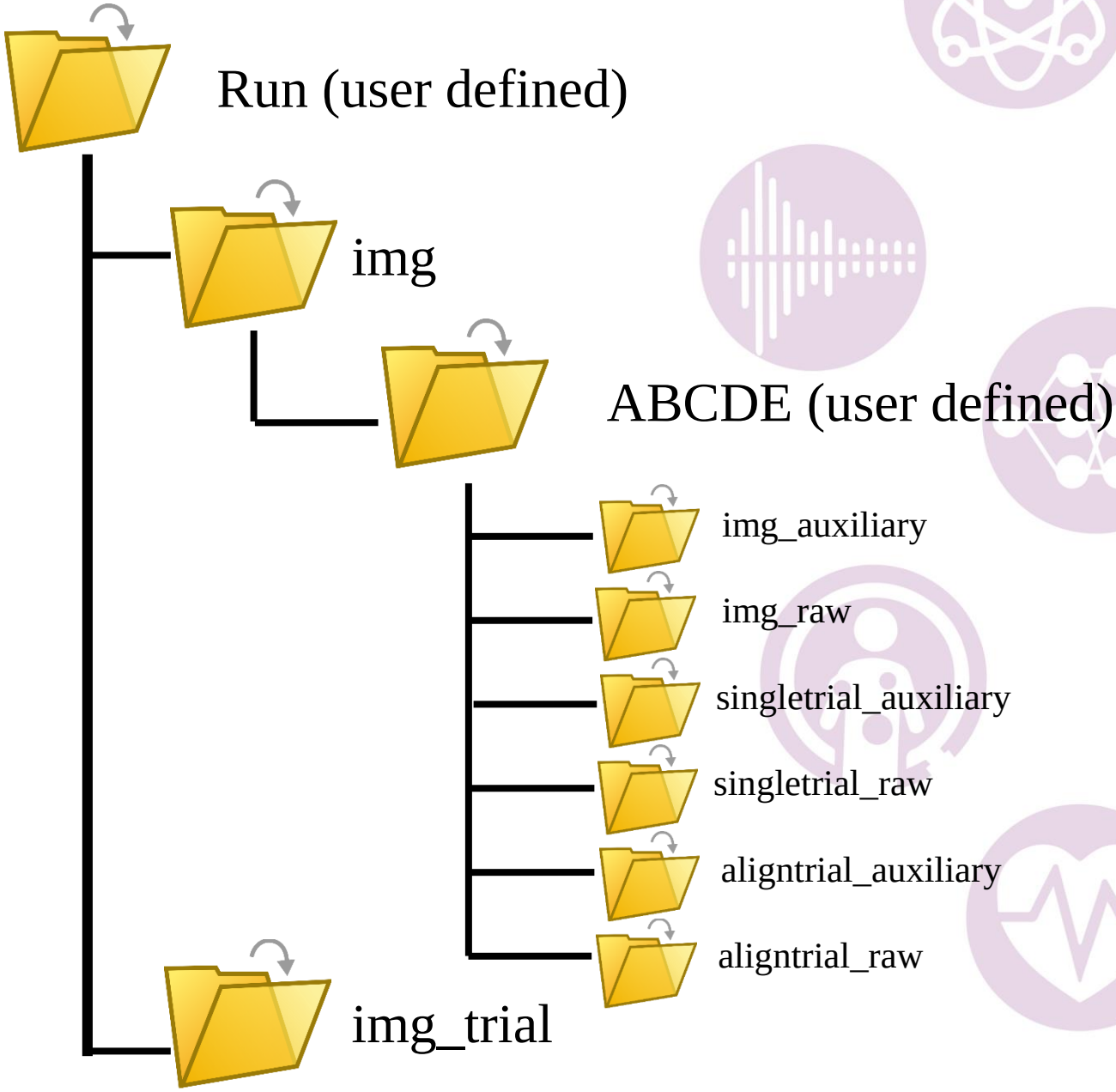


After motion correction:
U-Net cell segmentation

We use the DeepCAD-RT algorithm to obtain denoised images.
https://github.com/cabooster/DeepCAD-RT

4. Instructions for use

Folder organization



Example

Run (user defined)

img	2024/6/21 下午 01:53	檔案資料夾	
img_trial	2024/6/21 下午 01:43	檔案資料夾	
aligntrials	2024/6/21 下午 02:16	MATLAB Code	3 KB
apply_raw	2024/6/21 下午 02:09	MATLAB Code	2 KB
registration_trial	2024/6/21 下午 02:09	MATLAB Code	3 KB
run_loop_register	2024/6/21 下午 02:09	MATLAB Code	2 KB
run_loop_register_all	2023/3/6 下午 01:59	MATLAB Code	1 KB
transfer_stack_tif	2023/3/6 下午 02:30	MATLAB Code	1 KB

Store all the code and create two folders named "img" and "img_trial".

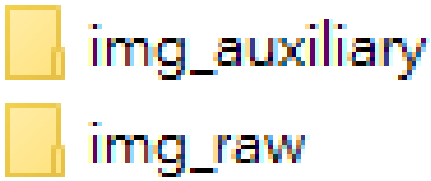
Example

img

1	2024/6/21 下午 02:15	檔案資料夾
2	2024/6/21 下午 02:15	檔案資料夾

Under the newly created "img" folder, create folders named after each data ID (note: naming order may vary).

Example



ABCDE (user defined)

- Inside each group's folder, create 2 folders as shown in the attached image.
- In the "img_raw" folder, place raw data for this group (multiple channels can be placed at once).
- In the "img_auxiliary" folder, place auxiliary corrected data for this group.
- Data format must be in 3D stack (x-y-t).

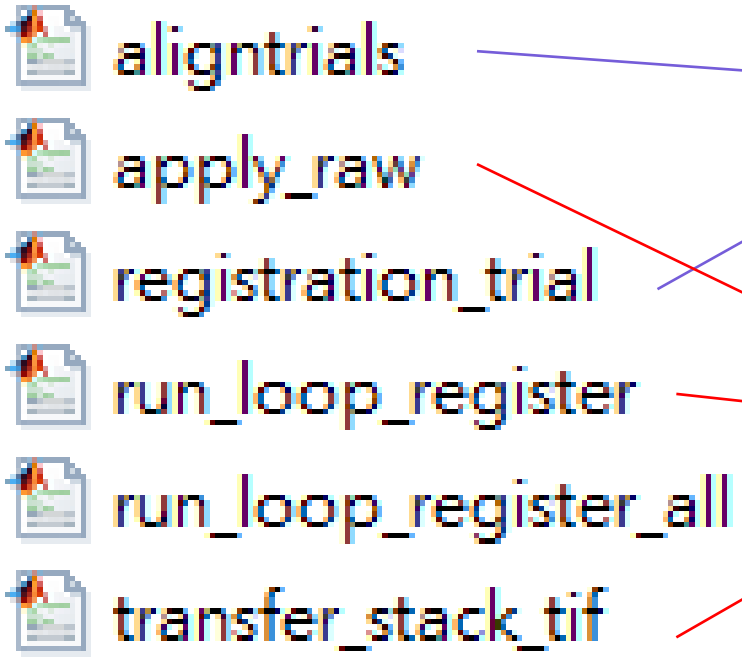
* Multiple channels must be acquired simultaneously with identical displacements in time.

img_trial

- Go back to the top-level "img_trial" folder created earlier, and place the first registered TIFF image (or any cropped image that aids in mutual alignment of each group) for each registered group inside.

- Note: The TIFF files placed must be named the same as the folders in the third level (i.e., the names of each group's folder).

Program description



Cross-correction between different groups

Single-group registration

Folder arrangement for all

- Folder structure "run" (users can change the name):
  - Place all program files ("p files") here.
- run/img
  - Place all subfolders containing images to be processed under "img".
- run/img/ABCDE/img_raw(or img_auxiliary)
  - Organize images for processing under either "img_raw" or "img_auxiliary ".
- run/img/ABCDE/singletrial_raw(or singletrial_auxiliary)
  - Results from processing a single group will correspondingly be stored here.
- run/img/ABCDE/aligntrial_raw(or aligntrial_auxiliary)
  - Final aligned results from all groups will be stored here.
- run/img_trial
  - Copy the first TIFF file (or cropped image) from each registered group here, for alignment purposes.

Execution method and workflow

The parameter for executing `run_loop_register_all`:

- True: Adjust image contrast before applying registration parameters.
- False: Apply motion correction without adjusting image contrast.

1. run_loop_register_all(false):
   - Execute this function to perform registration for each single group.
   - This will generate registration results in each group's "singletrial" folder.
2. aligntrials:
   - Run this step to align all groups.
   - It aligns all groups based on the first trial's registration results.
3. registration_trial:
   - Execute this function in MATLAB. MATLAB will prompt for which trial to adjust ("Which trial?").
   - Input a number equal to or greater than 2 to specify which trial to adjust.
   - The first trial in alphabetical order serves as the baseline for alignment (1).
   - Subsequent trials are numbered sequentially starting from 2.