
Instructions and codes for “Non-rigid registration for two-photon imaging using triangulation and piecewise affine transformation”

Feng Su^{1*}, Yonglu Tian^{2* #}

¹Peking-Tsinghua Center for Life Sciences, Academy for Advanced Interdisciplinary Studies, Peking University, Beijing 100871, China.

²Ministry of Education Key Laboratory of Cell Proliferation and Differentiation and State Key Laboratory of Biomembrane and Membrane Biotechnology, College of Life Sciences, Peking University, Beijing 100871, China.

*These are co-first authors.

#Correspondence to: Yonglu Tian, yonglutian@pku.edu.cn

Summary

Triangulation and piecewise affine transformation (TPAT) registration method was developed and tested on MATLAB R2019b in a PC with Intel Core i7-7800X CPU and 32G RAM. The source code is available at <https://github.com/SuFeng-SF/Triangulation-and-piecewise-affine-transformation>.

The rest of this document is organized as follows: section of “TPAT toolbox” describes the files in this toolbox; section of “Graphical User Interface” describes the example to register images by TPAT GUI; section of “Image registration results” describes the results of image registration; and section of “Image stack registration” describes the example to register image stacks.

1 TPAT toolbox

1.1 File description

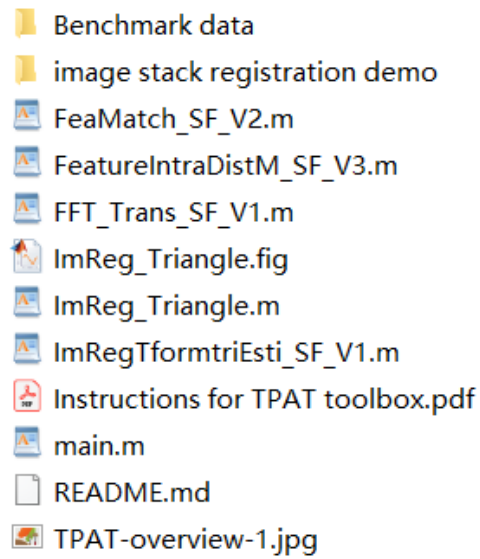


Fig. 1 Folders or files in TPAT toolbox

Table 1 Description for Folders or files in TPAT toolbox

| Folder or file | Description |
|-----------------------------------|--|
| Benchmark data | Benchmark test dataset for image registration |
| image stack registration demo | Demo for image stack registration |
| FeaMatch_SF_V2.m | Function of feature matching |
| FeatureIntraDistM_SF_V3.m | Calculate distance between features |
| FFT_Trans_SF_V1.m | Function of 2D FFT |
| ImReg_Triangle.fig | GUIDE file |
| ImReg_Triangle.m | GUIDE file |
| ImRegTformtriEsti_SF_V1.m | Function of estimating transformation matrix |
| Instructions for TPAT toolbox.pdf | TPAT instruction file |
| README.md | Introduction file in GitHub |
| main.m | Main function to implement TPAT toolbox |
| TPAT-overview-1.jpg | Summary image of TPAT toolbox |

1.2 Run

Run the file “main.m” to implement TPAT toolbox.

2 Graphical User Interface

2.1 Overview of TPAT toolbox

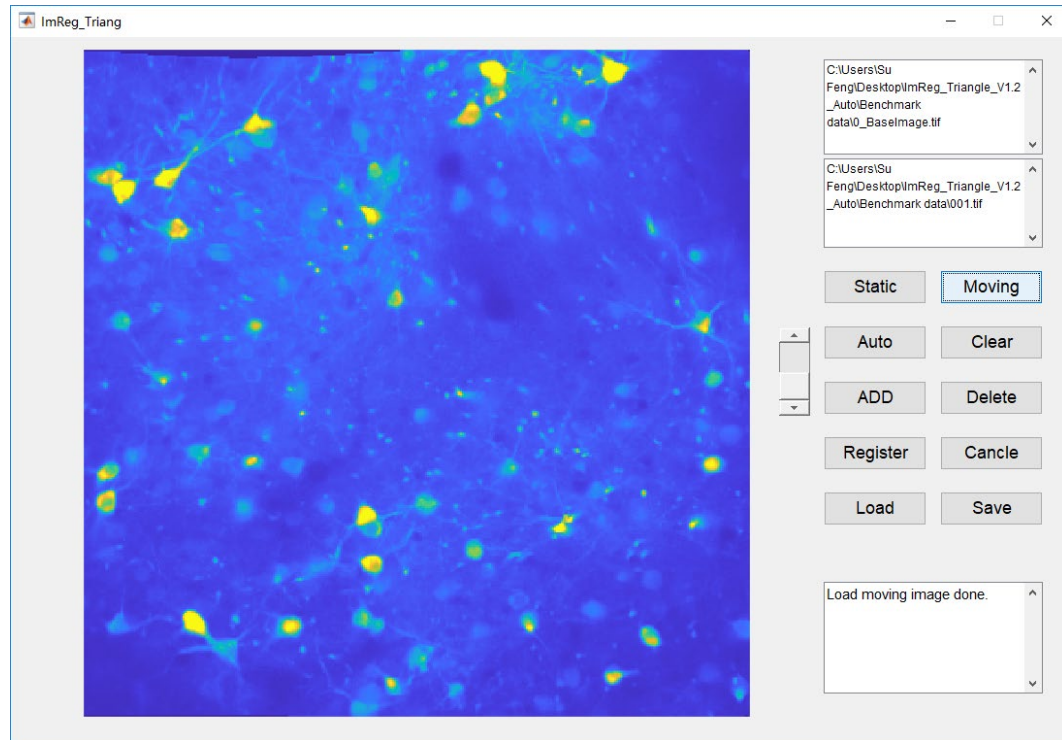


Fig. 2 Illustration of GUI

2.2 Function of buttons

Table 2 Function of buttons

| Button | Description |
|----------|---|
| Static | Import the reference image. |
| Moving | Import the deformed target image. |
| Auto | Calculate the pairing features automatically |
| Clear | Clear all the pairing features. |
| ADD | Add feature point pair manually. |
| Delete | Delete feature point pair manually. |
| Register | Register the two image using the chosen features. |
| Cancel | Cancel the image registration. |
| Load | Load the registered results (*.mat file). |
| Save | Save the registered results as *.mat file. |
| Slider | Drag the slider to switch the images. |

3 Image registration results

Reference image: 0_BaseImage.tif; target image: 001.tif.

3.1 Auto-TPAT

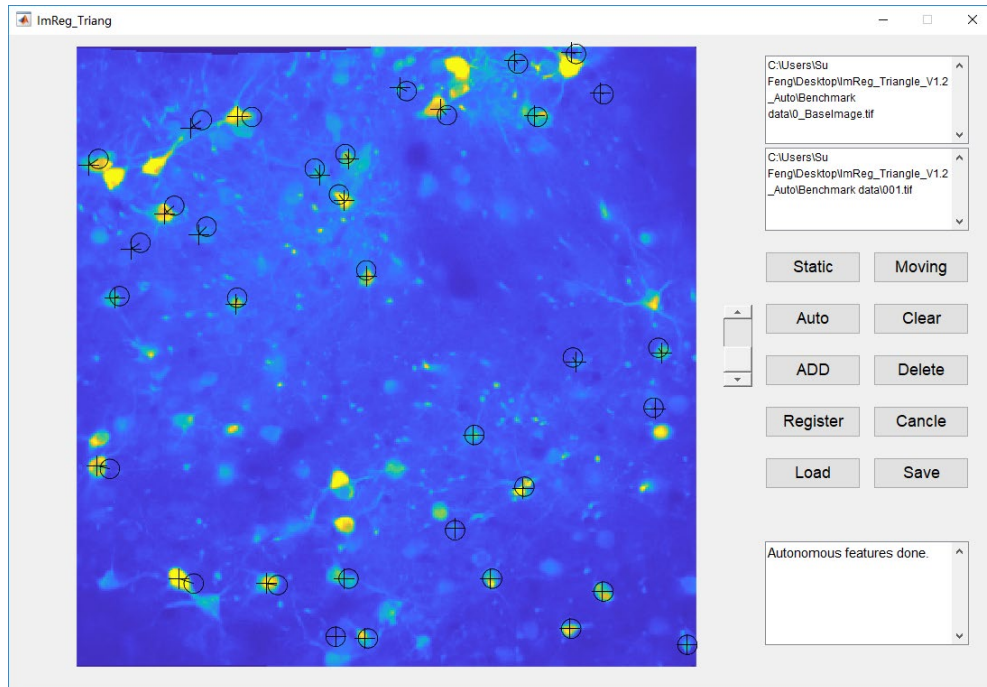


Fig. 3 Automatically recognized pairing feature points

3.2 Semi-auto-TPAT

On the basis of automatically recognized pairing feature points, delete the incorrect pairing feature points or add new pairing feature points manually.

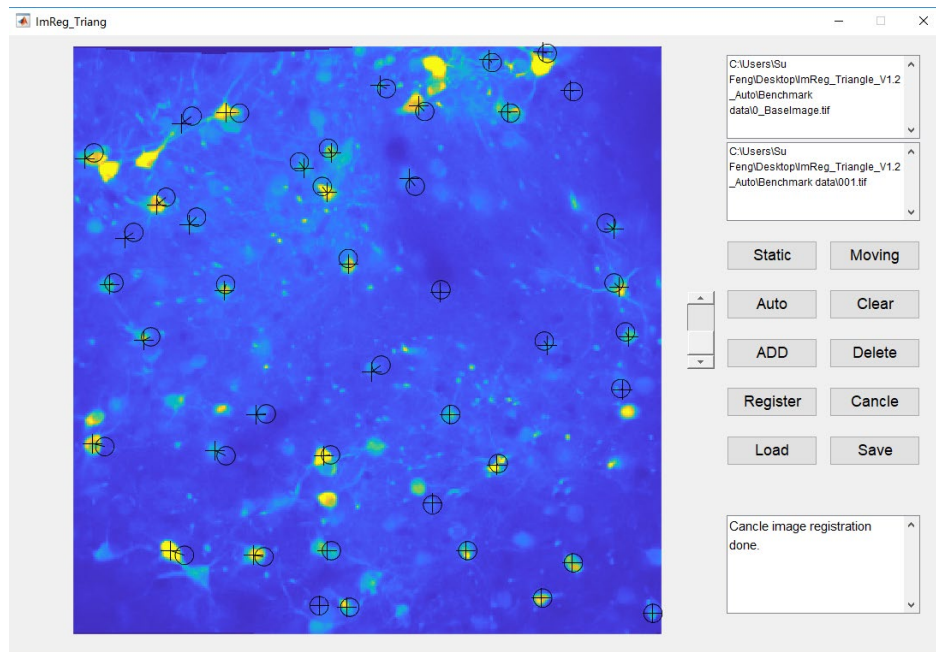


Fig. 4 Semi-automatically recognized pairing feature points

3.3 Registration results

Registration results files: 001_RegtriEsti.mat, 001_RegtriEsti.tif.

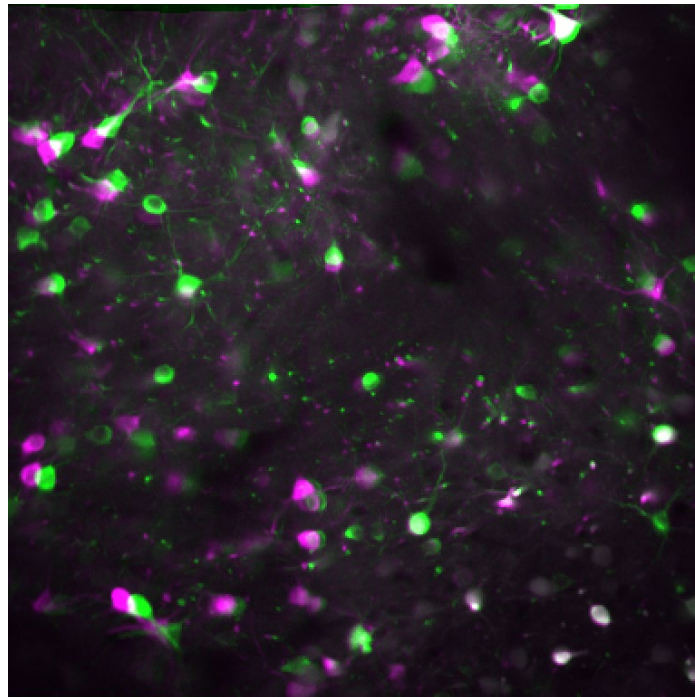


Fig. 5 False-color fusion plot of two images before registration

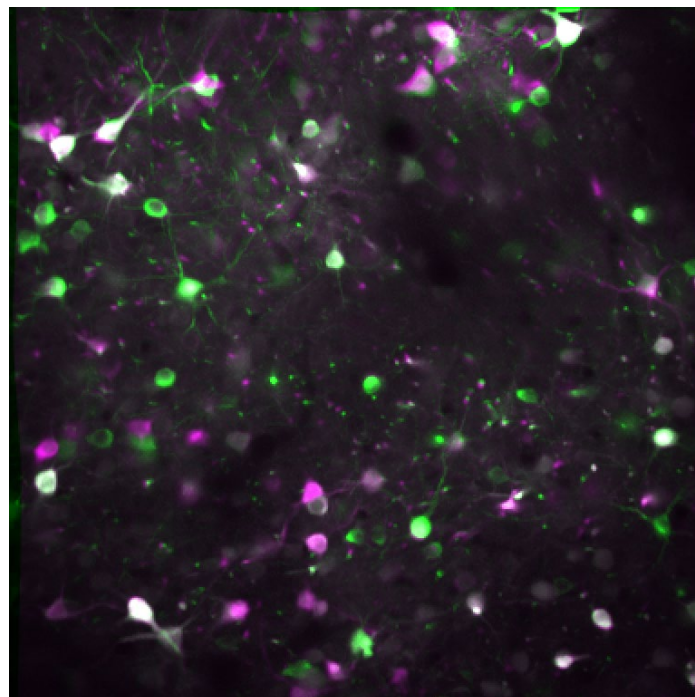


Fig. 6 False-color fusion plot of two images after registration

4 Image stack registration

Locate to the folder of “image stack registration demo”.

Run the file “demo_ApplyToTiff.m” to implement image stack registration.

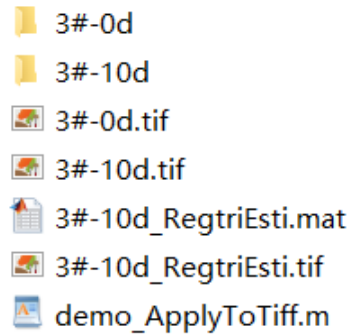


Fig. 7 Folders or files in the folder of “image stack registration demo”

Table 3 Description for Folders or files in the folder of “image stack registration demo”

| Folder or file | Description |
|-----------------------|--|
| 3#-0d | Image stack for mouse 3# in day 0 |
| 3#-10d | Image stack for mouse 3# in day 10 |
| 3#-0d.tif | Reference image of day0 (average time-series projection) |
| 3#-10d.tif | Reference image of day 10 (average time-series projection) |
| 3#-10d_RegtriEsti.mat | Accomplished registration results. |
| 3#-10d_RegtriEsti.tif | Accomplished registration results. |
| demo_ApplyToTiff.m | Main function to run. |

Image stack registration results file: Substack (1-100)_Reg.tif.