

This prototype software is developed using Microsoft visual studio 2015 (LS&ICP), MATLAB R2016b (TPS&NICP) and R (Sliding TPS). Before running our software, please ensure that you have installed Visual Studio 2015 (or relevant '.dll' files), R Studio, and MATLAB R2016b Runtime (64-bit).

If your computer has already installed MATLAB, please install MCRIInstaller.exe located in the './toolbox/compiler/deploy/win64/'. Alternatively, you can download it from <https://www.mathworks.com/products/compiler/matlab-runtime.html>.

1. Generate semilandmarks using LS&ICP

Please open the 'LS&ICP' folder and run the LS&ICP.exe. The input data is archived in the 'Data' folder.

Step 1: Click on 'SourceMesh' in the 'Import' menu.

Import the 'Source.obj' file as the template model. Press and hold the left mouse button while moving it to rotate the object.

Step 2: Click on 'SourceLM' in the 'Import' menu.

Import the 'Source-Lm.txt' file as the landmarks of template model. Red points represent landmarks.

Step 3: Click on 'SourceSemi' in the 'Import' menu.

Import the 'Source-Semi.txt' file as the semilandmarks of template model. Blue points represent landmarks.

Step 4: Click on 'TargetMesh' in the 'Import' menu.

Import the 'Target.obj' file as the target model. Press and hold the left mouse button while moving it to rotate the object.

Step 5: Click on 'TargetLM' in the 'Import' menu.

Import the 'Target-Lm.txt' file as the landmarks of target model.

Step 6: Click on 'LS+ICP' in the 'Process' menu.

Perform the LS&ICP method. The semilandmarks can be visualised in the right view. The registered model using the LS method is saved as a 'Source-LS.obj' file. Subsequently, the registered model using the ICP method is saved as a 'Source-ICP.obj' file. The generated semilandmarks are saved as a 'Target-Semilandmarks.txt' file.

2. Generate semilandmarks using TPS&NICP

Please open the 'TPS&NICP' folder and run the TPS&NICP.exe. The input data is archived in the 'Data' folder.

When running the code, it will display the following dialogs to show the process, including: a) Read source and target models; b) Perform TPS; c) Complete TPS; d) perform NICP; e) Complete NICP. The execution time will vary and depend on the size of the template model, parameters of algorithm and computer hardware. It takes almost 13 minutes to process the current data. The running process can be monitored or terminated in the Task Manager.

Input:

Source.obj: the template model;

Source-Lm.txt: the landmarks of template model;

Source-Semi.txt: the semilandmarks of template model

Target.obj: the target model;

Target-Lm.txt: the landmarks of target model;

Output (save as in the 'Data' folder):

The registered model using the TPS method is saved as a 'Source-Tps.obj' file. Subsequently, the registered model using the NICP method is saved as a 'Source-nicp.obj' file. The generated semilandmarks are saved as a 'Target-Semilandmarks.txt' file.

3. Generate semilandmarks using sliding TPS

Please open the 'Sliding TPS' folder and run the Sliding.R. The input data is archived in the 'Data' folder.

Input:

Source.obj: the template model;

Source-Lm.txt: the landmarks of template model;

Source-Semi.txt: the semilandmarks of template model

Target.obj: the target model;

Target-Lm.txt: the landmarks of target model;

Output:

The generated semilandmarks are saved as a 'Target-Semilandmarks.txt' file.

4. Visualise all semilandmarks of the target model generated by three different approaches.

Please run the 'Landmarks.R' in R Studio.

5. Perform morphometric analysis of semilandmarks.

Please run the 'R-analysis.R' in R Studio to compute Procrustes distance between estimates of mean landmarks and semilandmarks, correlation of vector of Procrustes distance, correlation of PC, angles of allometric vector.

6. Compute the Procrustes distance between mean surfaces

Please open the 'Surface' folder and run the Procdist.m in MATLAB. The input data is archived in the 'Data' folder.

Input:

Sliding-Target.obj: the mean surface generated by sliding TPS and high-density semilandmarks.

NICP.obj: the mean surface generated by NICP and high-density semilandmarks.

7. Visualise the difference between mean surfaces

Step 1: Please run the Procdist.m in MATLAB to register the surface generated by low-density semilandmarks to the surface generated by high-density semilandmarks. The registered model is saved as a 'Sliding-Source-register.obj' file in the 'Data' folder.

Step 2: Please run the 'colour map.R' in R Studio.