

This prototype software is developed using Microsoft visual studio 2015, MATLAB and R2016b. 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 MCRInstaller.exe located in the './toolbox/compiler/deploy/win64/'. Alternatively, you can download it from <https://www.mathworks.com/products/compiler/matlab-runtime.html>.

1. Warp the template model and yield the boundary curves of missing geometry.

Please run the TPS.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. This model is generated by reflecting the intact side of the object. 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 'TargetMesh' in the 'Import' menu.

Import the 'Damage.obj' file as the target model.

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

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

Step 5: Click on 'TPS' in the 'Process' menu.

Perform the least squares and TPS methods to warp the template model. The warped model is displayed in the right view and saved as the 'Source-TPS.obj' in the 'Data' folder. This model can be used to repair the missing geometry.

Step 6: Click on 'Boundary' in the 'Process' menu.

Extract the boundary curve of the damaged model. Since the target model may contain several boundary curves, one of which might be the boundary curve of the missing geometry, please press '1' or '2' to choose the boundary of missing geometry (yellow points).

Step 7: Click on 'correspondence' in the 'Process' menu.

Estimate the boundary curve of the warped template model.

The boundary points (blue points) of the warped template model are shown in the left view. They are saved as the 'Boundary-source.txt' file in the 'Data' folder, while

the boundary points (yellow points) of the damaged model are saved as the 'Boundary-target.txt' file in the 'Data' folder.

2. Warping the template model using the Laplacian deformation method to match the damaged model.

Step 1: Please run the Restoration.exe.

When running the code, it will display the following dialogs to show the process, including:

- a) Read source and target models;
- b) Perform Laplacian Deformation;
- c) Complete Laplacian Deformation.

The execution time will vary and depend on the size of the template model and computer hardware. The parameters of algorithm will influence the warping result. The running process can be monitored or terminated in the Task Manager. The outcome is saved as the 'Surface-LP.obj' in the 'Data' folder.

Step 2: Please click on 'Show' in the 'Process' menu (TPS.exe).

Show the deformed surface. The final result and damaged model are illustrated in the left view.

3. Visualise the scatterplots (PC1 and PC2) of every model.

Please run the 'PCA.m' file in MATLAB or the 'PCA.R' file in R Studio.