

This software tool, developed using Microsoft Visual Studio 2015, demonstrates the workflow for the facial approximation of the Yahuai (YH) skull. Before running the tool, please ensure that Visual Studio 2015 is installed or that the required '.dll' files are copied to the directory containing the executable file. Please execute FA.exe. All data used for facial approximation was saved in the 'Data' folder.

Step 1: Click on 'Landmarks+semilm' in the 'Import' menu.

The YH_skull_LM&Semi.pts file is imported. Landmarks (red points) and semilandmarks (blue points) are displayed.

Step 2: Click on 'Dry Boundary' in the 'Import' menu.

The YH_skull_Boundary.txt file is imported. The boundary curve of the YH skull (green points) is displayed.

Step 3: Click on 'Mean SoftTissue' in the 'Import' menu.

The FSTDs.pts file is imported. A colour map of the average facial soft tissue depths is displayed in the right view.

Step 4: Click on 'Coarse FA' in the 'Process' menu.

Multiple spheres (peach) representing the approximated face are generated by assigning the average FSTDs to the correspondences of the YH skull.

Step 5: Click on 'External FA' in the 'Process' menu.

The external points (green) are extracted from the generated spheres. The candidate face is recreated by warping the average female face based on the transformation computed from warping the average female skull to the YH skull.

Step 6: Click on 'Intersections' in the 'Intersection points' menu.

Fixed points (red) are generated by computing the intersection between the approximated facial envelope and the candidate face.

Step 7: Click on 'More points' in the 'Intersection points' menu.

Several points positioned away from the fixed points are sampled on the facial envelope and displayed alongside the fixed points.

Step 8: Click on 'Nose' in the 'Process' menu.

Landmarks and semilandmarks (green) of the approximated nose soft tissues and those (yellow) of the approximated ears are displayed.

Step 9: Click on 'FA result (TPS)' in the 'Process' menu.

The facial appearance is estimated by warping the candidate face using the thin-plate splines method.

Step 10: Click on 'FA result-Symmetry(TPS)' in the 'Process' menu.

The revised facial approximated is estimated by warping the candidate face to fit the correspondences, excluding those located around the asymmetric region on the right.

Figure 11: Step 4: Click on 'FA result (LP)' in the 'Process' menu.

The facial appearance is estimated by warping the candidate face using the Laplacian deformation algorithm. The revised facial appearance is displayed in the left view, while the original facial appearance is shown in the right view.