EVAN-SOCIETY
setting landmarks in science

Manuals for the EVAN Toolbox

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Paul O'Higgins, Hester Baverstock, Miguel Proa, Jason Dunn
University of York

Templand

Creating landmarks and semilandmarks on surfaces

The EVAN Toolbox is software designed by Roger Phillips of the University of Hull, Paul O'Higgins of the University of York, and William D. K. Green and Fred Bookstein of the University of Vienna. Its principal systems programmers were Helgi Gunnarsson, Ramy Gowigati, Youssef Shady George-Nashed, Vincent Dalge, and Oualid Ben Ali.

The EVAN Toolbox software and all the manuals in this series are distributed by the EVAN Society
EVAN-Society, c/o Dept of Anthropology, University of Vienna, Althanstr. 14, A-1090 Vienna, Austria
✉ evan-society@univie.ac.at 💻www.evan-society.org

Introduction

Templand is a node within the EVAN toolbox that allows landmarking and semilandmarking of specimens. The basic principle of Templand is that it operates by first creating a template on a single specimen and then transferring the landmarks and semilandmarks to other specimens. As a final step it is possible to slide to landmarks to provide slid semilandmarks for subsequent analyses

Help

Help is available on how to use the Templand node through a help button along the top bar of the GUI (Graphic User Interface).

File Types

Templand uses two types of file, one is a **form file** (.frm) and the other is a **tableau** (.ltb).

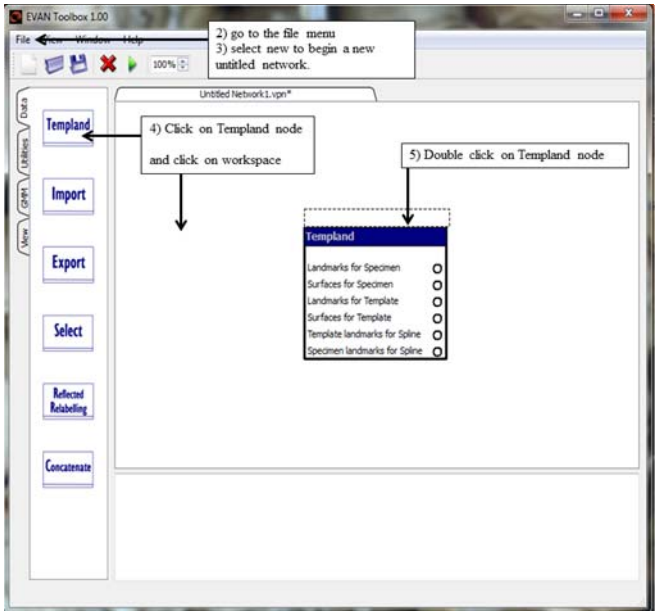
- **Form files** (.frm) contain the surface, associated landmarks and other information (e.g. about symmetry) related to the landmarking operation. Each form file can be thought of as storing either the full set of landmarks or an intermediate stage in landmarking**.**

- **Tableau files** (.ltb) contain information which connects sequences of form files allowing, for example, an animation or video of the landmarking sequence to be produced and displayed. This can be used for demonstration and tutorial purposes.

Accessing Templand

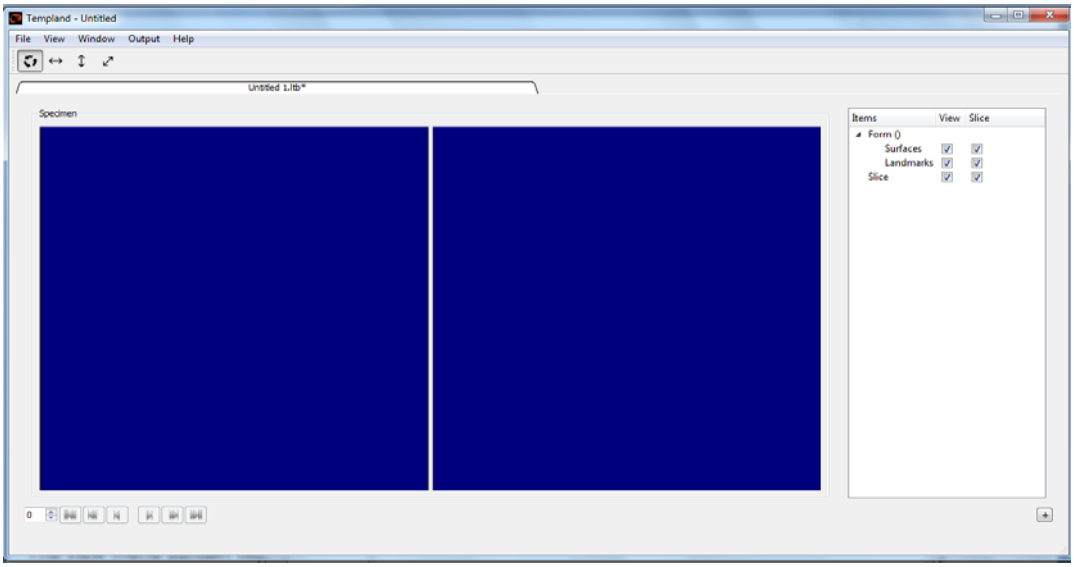
To open Templand:

1. open the EVAN toolbox
2. go to the file menu
3. select new to begin a new untitled network.
4. click on the Templand node (left hand menu) and click on the work space
5. Double click on the Templand node (that appears centre screen)
6. In the new window (Templand GUI) that appears click file new



The Templand GUI

The Templand GUI is the window within which you will place the initial landmarks. It has a number of menued items at the top.



File Menu
The file menu allows you to:

- open a new tableau
- opens an existing tableau file
- save and save as tableau files

Output Ports
It is important to note the "refresh output ports" item. This refreshes the data, i.e. the landmarks that you have gathered in the output of the Templand node for subsequent analyses by other nodes in an analytical network.

View menu
The view menu contain two items

- a template command: brings up the window required to transfer landmarks from a template (a specimen that is already landmarked) to another specimen on which you wish to transfer the same landmarks.
- windows: display the specimen onto which the landmarks are to be transferred.

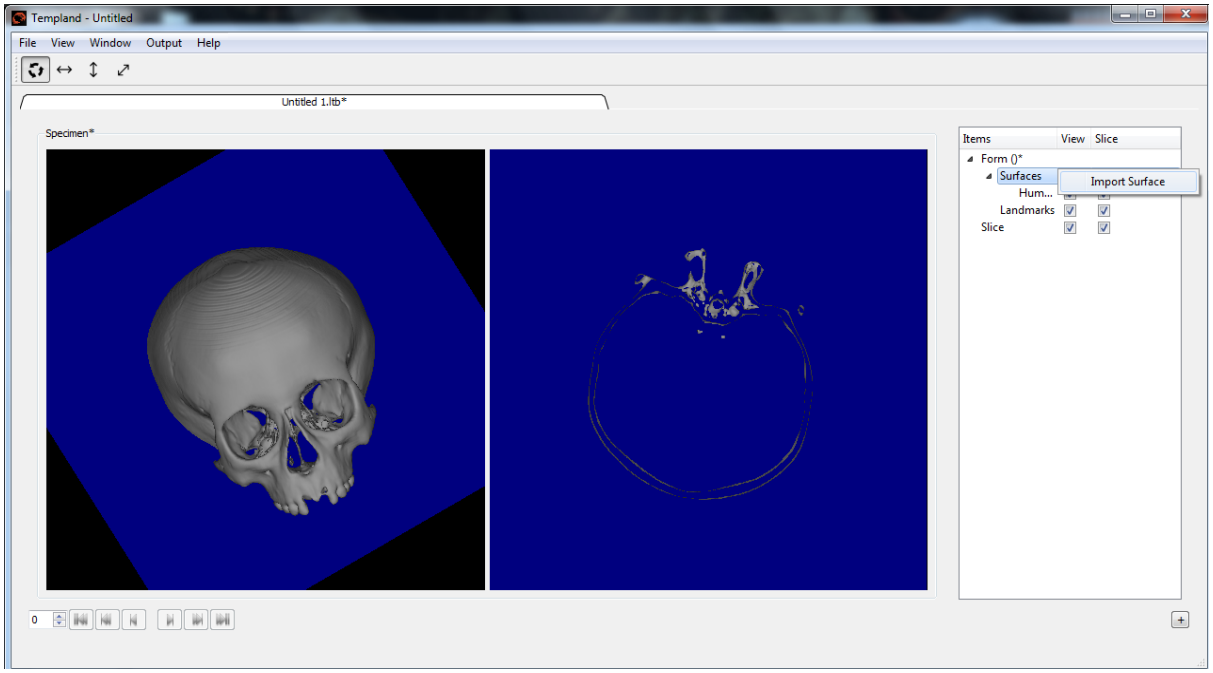
GUI Windows
There are two windows: one showing the full three dimensional shape of the surface that has been uploaded and another displaying a sliced view of the three dimensional one. To the right of these windows is the item menu. When a surface has been imported, this contains information about the form in terms of the surface, the landmarks and semilandmarks. It also allows the user to control whether or not the slice through the object is visible in either the left hand window (the view window) or the right hand window (the slice window). Surfaces and

landmarks can be turned off and on by ticking the appropriate check box. If a landmark does not appear switching it on and off makes it reappear (known bug).

Loading and Manipulating a Surface

The first step in building a template is to load a surface. To do this:

1. right click on surfaces in the item menu and select "Import Surface"
2. select the surface that you wish to import from the menu (the only format supported is .obj) and open the file. The 3D surface will appear in the left hand window ('View') and a section through this surface will appear in the right ('Slice').



- This section can be tumbled and manipulated according to the instructions within the help menu, reproduced below:

Templand User Controls:	
Left mouse button drag	→ Tumble
Right mouse button drag	→ Zoom
Right mouse button	→ Selects a Landmark
Middle mouse button drag	→ Translate
Middle mouse button scroll	→ Push/Pull
Left mouse double click	→ Create Landmark
Arrow Keys	→ 90 degree rotations
r R	→ 120 degree rotation
[ ]	→ 90 degree twists
+ -	→ Jump Zoom
Page Up/Down	→ Jump Push/Pull
M	→ Move selected Landmark
C	→ Center View
Spacebar	→ Focus at View
Pressing and holding Ctrl along with keys/mouse navigation buttons will result in **fine control** of the movement.	

Note, the direction and keyboard keys only work when surface or slice is highlighted in the items menu; it will not work if landmarks are highlighted. Use the jump push function If when zooming in on a position the camera view cuts through the surface you wish to magnify.

In the Templand GUI top right underneath the menu labels there are a series of arrows which can be selected. These affect the way in which the slice moves under mouse control.

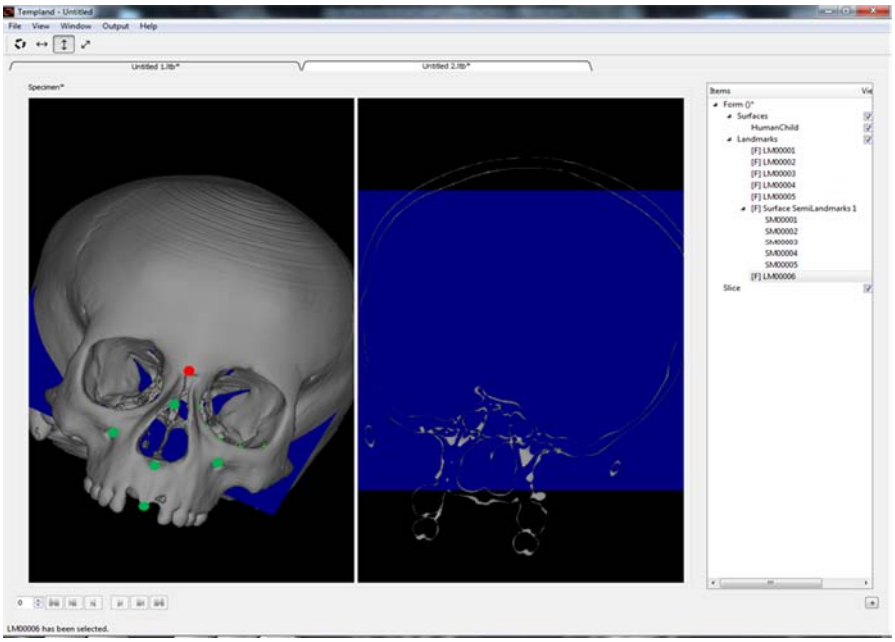
Landmarking

To place a landmark, position the cursor over the relevant point in either the surface view or the slice view and double click. A dialogue box will appear with a suggested name for the landmark, which can be edited. If the name and position are correct, click the "OK" button and the landmark will be sited on the specimen.

The selected landmark (right screen item menu or most recently sited landmark) is displayed in red, the remaining landmarks in green. Note, the colours that are used to display the landmarks can be changed by right clicking on the relevant landmarks tab within the item menu and selecting colour, as can the shape (circle, dot or cross). This can be particularly useful for those who suffer from colour blindness.

In order to add semilandmarks, right click on the landmarks heading within the item menu and select "Add surface semilandmark". There is a GUI allowing you to rename semilandmarks. Semilandmarks are treated as a group and are numbered sequentially. Once you have done this you can click repeatedly over the surface or the sections of the specimen and semilandmarks will be added.

You can add different groups of surface semilandmarks and each group can be allocated a name (e.g., parietal bone, frontal bone, etc.). This is useful when digitising surfaces that comprise separate sub surfaces.



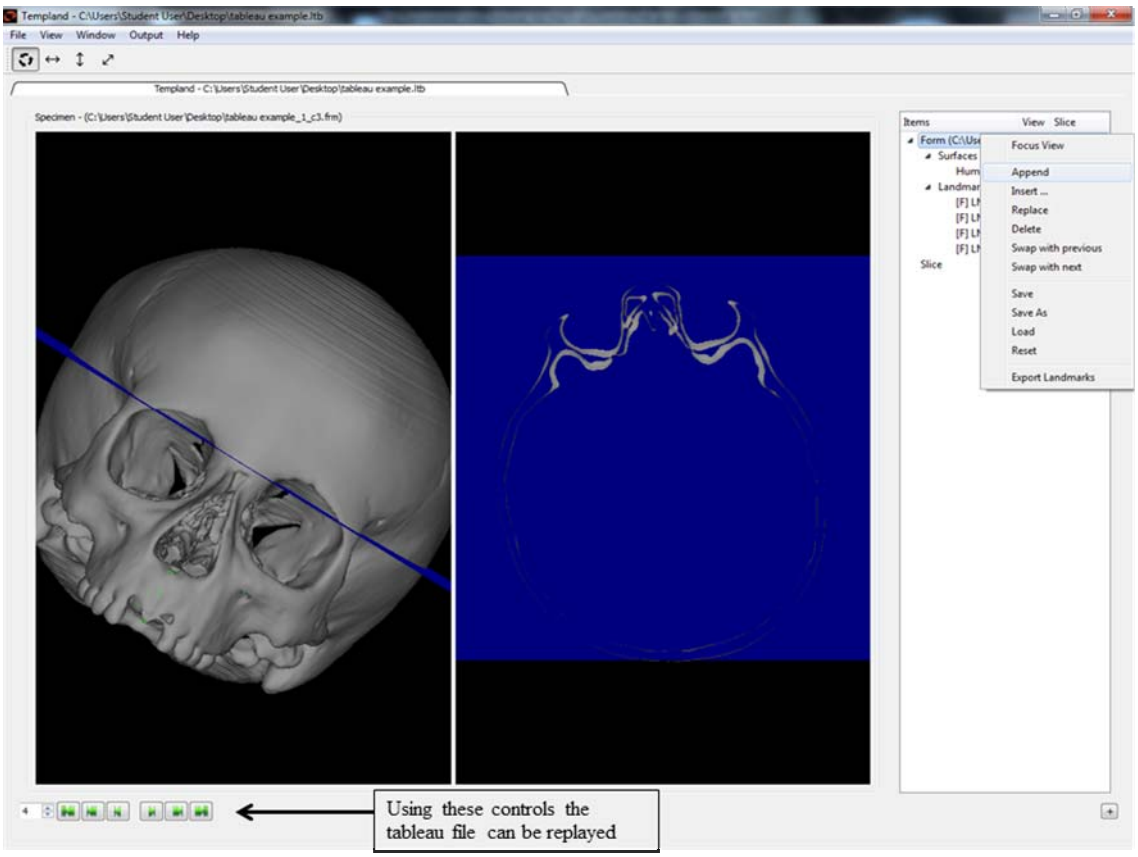
Saving: At any stage during landmarking you can save a new form file, which will contain the landmarks and the pointer to the surface upon which the landmarks sit:
* right click on ‘Form’ (right hand menu) and select save or save as.

Landmarks themselves can be exported as simple text files

Creating a Tableau file

A tableau is a sequence of form files that shows the landmarking process. To create a Tableau file:

1. Follow steps for ‘Accessing Templand” to open a new Templand GUI
2. Follow steps to ‘Load a surface’
3. Prior to adding any landmarks select file menu (tool bar) and save a new tableau file (select save or save as). This will save a tableau file in the *.ltb format
4. Add one landmark (by double clicking on view)
5. Right click on ‘Form’ in the left-hand menu and select ‘Append’
6. Add a second landmark
7. Right click on ‘Form’ in the left-hand menu and select ‘Append’
8. Following each subsequent landmark added select ‘Append’ before adding the next landmark
9. After the landmark sequence is complete select the file menu again and ‘Save’



The Tableau file can be replayed as it is being built (or reloaded from a saved Tableau file) by using the controls at the bottom left of the Templand GUI. These controls are similar to the controls you would find on an mp3 player and have similar action.

Note – each individual landmark will be saved as a .frm file, and there will also be a Tableau file save in the .ltb format. It is the Tableau (.ltb) file that needs to be opened in order to replay the landmark sequence.

Transferring landmarks and semilandmarks from the template to other specimens

This allows you to transfer landmarks from a template to another specimen/s.

1) Use steps outlined above to digitise a template specimen. To transfer the landmarks the file will need to be saved in the 'Form file' format (*.frm). The 'target' file to which you wish to transfer the landmarks will also need to be in the 'Form file' format (*.frm)

2) Start a new session and launch the 'Templand GUI' (steps outlined above)

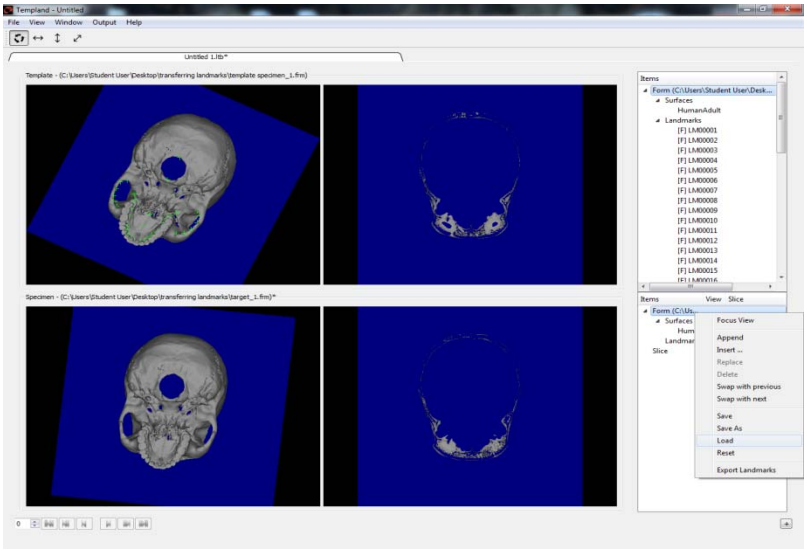
3) Open a new tableau (select 'New' under the file menu)

4) Click on 'View' (on top tool-bar) and select 'Template'
   A new screen with four windows will appear. The top two windows, left and right, will contain the surface and slice views of the template specimen respectively. The bottom two windows, left and right, will contain the surface and slice views of the target specimen respectively.

5) In the right-hand menu of the top window (the template window)
   a. Right click on 'Form'
   b. Select 'Load'
   c. Load the template file you previously created (*.frm)
6) In the right-hand menu of the bottom window (the target specimen window)
   a. Right click on 'Form'
   b. Select 'Load'
   c. Load the target specimen you wish to transfer the template landmarks onto (*.frm)

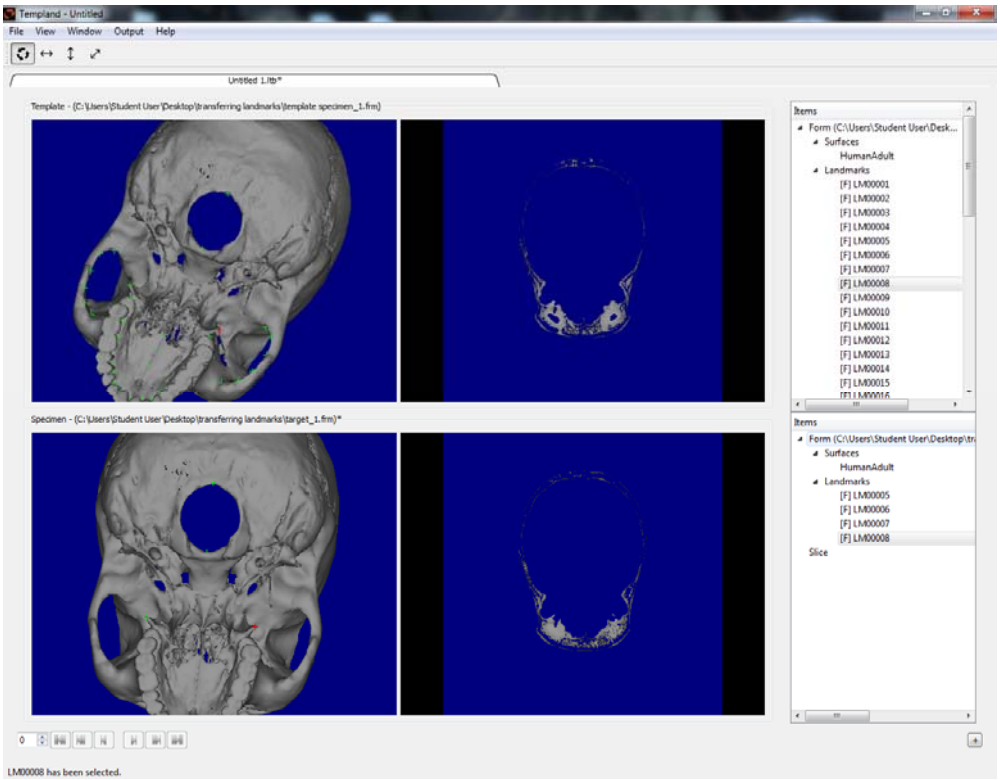
When you have done this you should have four windows containing the template and target specimen surface and slice views.

The item focus view restores the original scaling of the template or target specimen once you have zoomed out or zoomed in.



The first step of transferring landmarks from the template to the target specimen is to place four landmarks in equivalent positions on the target. This is achieved by

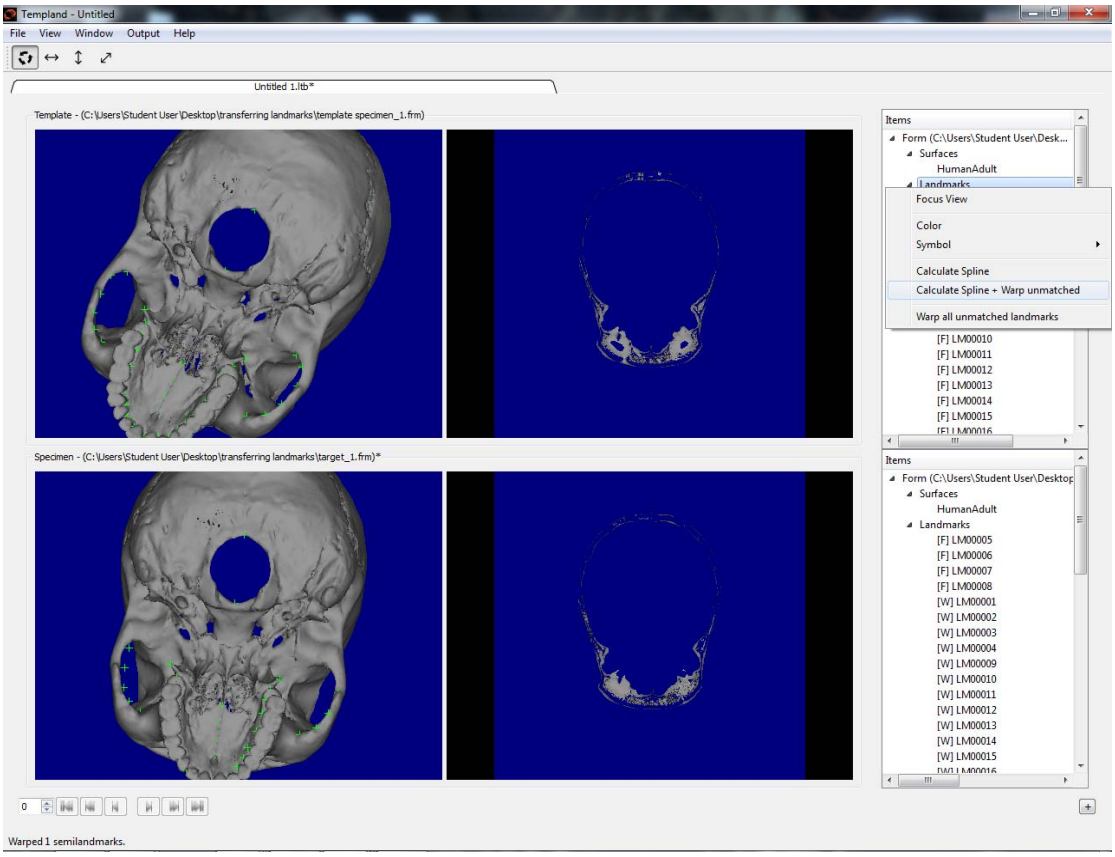
1) Select the first landmark you wish to transfer from the template by clicking on that landmark name in the (right hand) item menu of the template (top) window. The selected landmark will then show up as red in the template specimen.
2) Move to the target specimen (bottom window) and double click to place the equivalent landmark on this specimen.
3) Repeat this operation for **four landmarks as a minimum**.



After you have placed four landmarks, it is possible to attempt to automatically transfer the remaining landmarks to the target specimen. To transfer the rest of the landmarks:

1) Select the name in the right hand menu of one of the landmarks that you have placed on both the template and target specimens
2) Right click on ‘Landmarks’ in the right hand menu of the template (top) window
3) Select ‘Calculate Spline + Warp unmatched”

Note – step 3) can be divided into two separate steps by firstly selecting ‘Calculate spline’ and subsequently selecting ‘Warp all unmatched landmarks’



Projection might fail. This is particularly the case when working with surface files from CT data which contain too close surfaces. In this case it is common for the landmark to be projected onto the wrong surface (e.g., the inner surface of the cranial vault rather than the outer or vice versa).

After projection landmarks or semi landmarks can be moved:

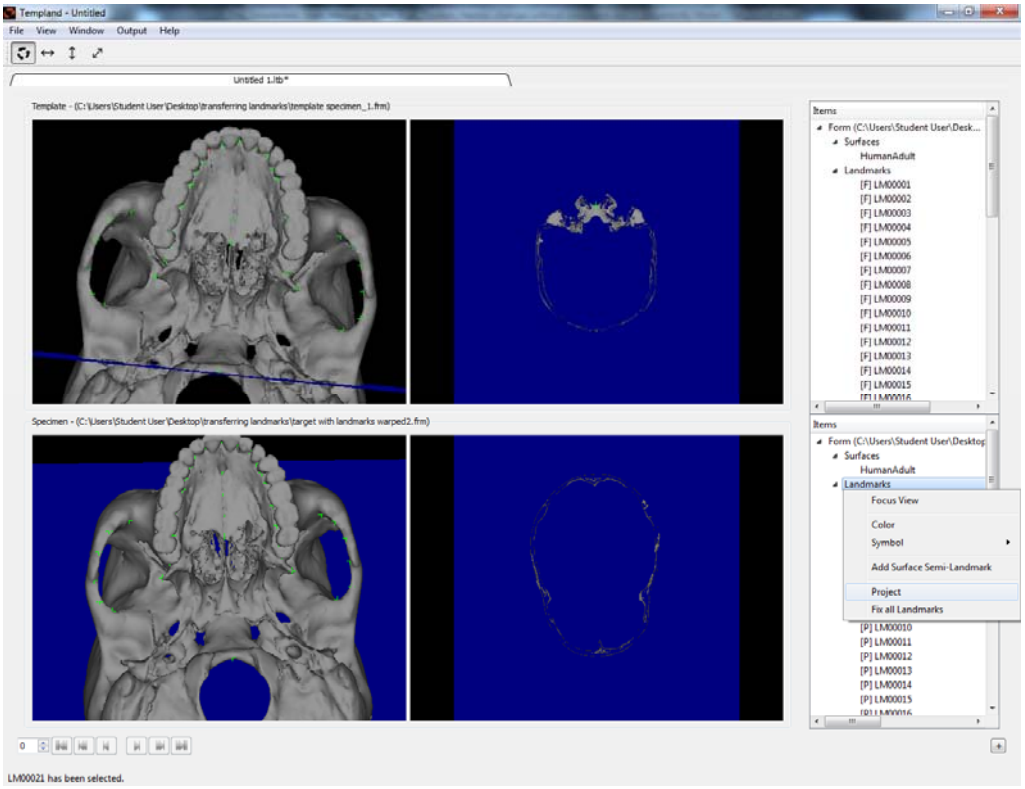
1) Select the landmark or the semilandmark in the item menu for the target specimen (the selected landmark should become red in both the template and target screens)
2) Hold down the shift + M keys (capital M)

3) In the target screen place the mouse cursor over the location where you wish the landmark to be moved to
4) Click once in that position, and then release shift + M
   The landmark should now have been moved to your chosen position

It should now be possible to realign the projection of the other landmarks according to the landmark you have just moved:

1) Right click on ‘Landmark’ in the right hand item menu of the target (lower) screen
2) Select project

This should then realign the rest of the set of landmarks



Once landmarking of the target is complete, a form file containing these landmarks and the reference to the relevant surface is saved:

1) Right click on ‘Form’ in the right hand item menu of the target (lower) screen
2) Select ‘Save’ or ‘Save as’ to save as a *.frm file

Finally in order to use these data in subsequent analyses the data have to be made available at the output ports of Templand. This is achieved by selecting refresh output ports under the file menu (top left of the Templand GUI).

Once the output ports have been updated you can return to the EVAN toolbox main window and add another node such as a 3D viewer passing landmarks and surfaces to it. Once this

network has been executed the object, current surface and landmarks will be visible within 3D viewer.

If you wish to attempt to transfer the landmarks from the template to multiple specimens and thus create a large data set for subsequent analysis by a VPN within the EVAN toolbox, then in the Templand GUI simply append the form of the specimen that you have just landmarked to the current tableau file. Repeat this operation as many times as necessary until all specimens have been digitised and you will have a complete data set.

Sliding of semilandmarks landmarks is an option when digitisation is complete.

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