

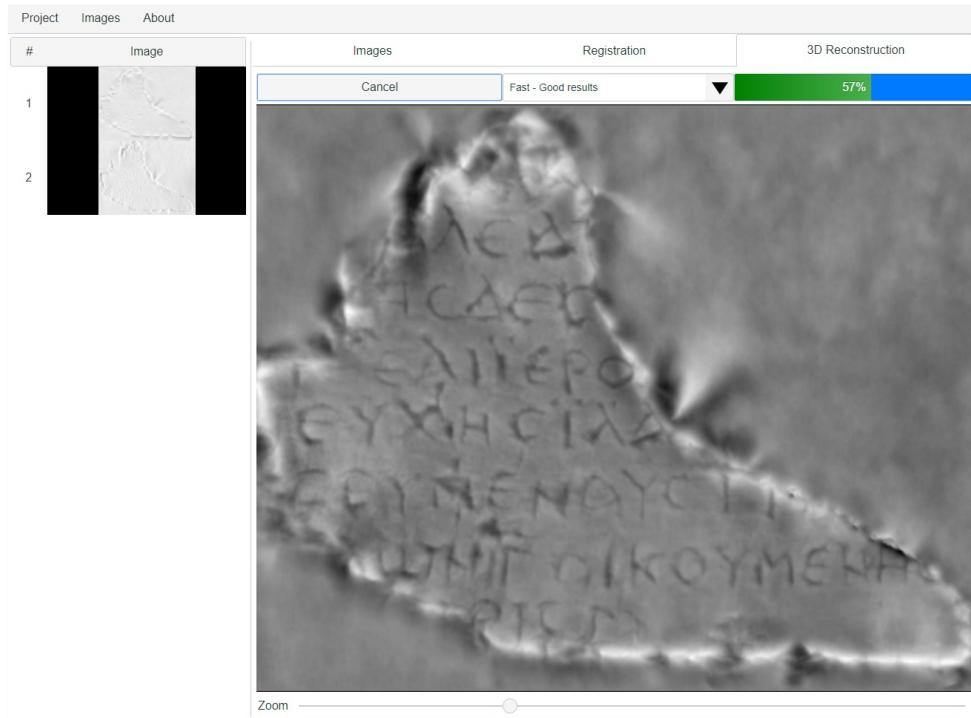


Digital Epigraphy and
Archaeology project

Shape from Shading Toolbox

User Manual

v.1



Jacob R. Roberts, Eleni Bozia, Angelos Barmpoutis

University of Florida

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1. Description and scope

The shade-from-shading toolbox can be used for 3D reconstruction of epigraphic squeezes, inscriptions, paper embossments, wax seals, and other flat objects that have been inscribed or embossed. The reconstruction is performed, using the technique presented in the paper: Bampoutis, A., Bozia, E. and Wagman, R., 2010. A novel framework for 3D reconstruction and analysis of ancient inscriptions. *Journal of Machine Vision and Applications*, vol. 21(6), pp. 989-998. <https://doi.org/10.1007/s00138-009-0198-7>

The method requires 2 or 4 images of the object acquired with distinct lighting orientations, using a conventional flatbed document scanner or fixed camera. Typically, 2 images, one taken with horizontal scanning light, and one with vertical scanning light, suffice for porous materials with uniform color, such as epigraphic squeezes. However, more complex objects such as shiny or colored surfaces may require 4 images.

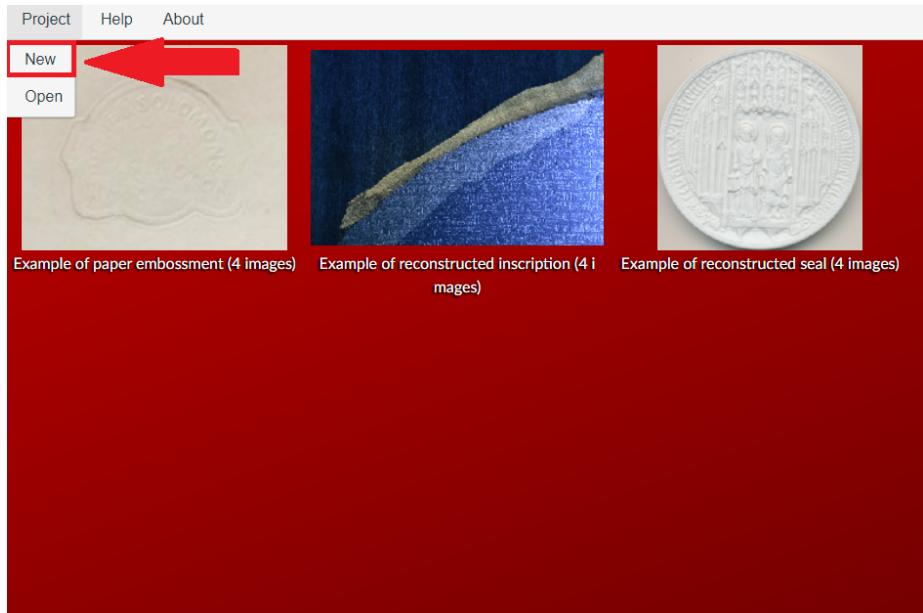
The tool has been used in several digitization projects such as those undertaken in collaboration with the British Museum (M. Amin, A. Bampoutis, M. Berti, E. Bozia, J. Hensel, and F. Naether. "The Digital Rosetta Stone Project." In *Ancient Egypt, New Technology: The Present and Future of Computer Visualization, Virtual Reality and other Digital Humanities in Egyptology*, R. Lucarelli, J. Roberson, and S. Vinson (ed.), Harvard Egyptological Studies 17, Brill, Dec 2022, ISBN 978-90-04-50128-7. <https://doi.org/10.1163/9789004501294>), the University of Venice (Antonetti, C., Matijašić, I., De Vido, S. and Mignosa, V., 2017. Digital Epigraphy at the Greek Epigraphy Laboratory, Ca' Foscari University of Venice. *Historika*, vol. 7, pp. 491-502. <https://journals.openedition.org/historika/419>), and the University of Lyon (Levivier, A., Leblanc, E. and Brunet, M., 2016. E-STAMPAGES : archivage et publication en ligne d'une ectypothèque d'inscriptions grecques. *Les nouvelles de l'archéologie [En ligne]*, vol. 145, pp. 24-27. <https://doi.org/10.4000/nda.3801>).

The tool can be accessed at the following link: <https://www.digitalepigraphy.org/db/app/sfs>



2. User Login

To begin, you first need to be logged into the software. To do this, select the “New” button from under the “Project” drop-down menu.



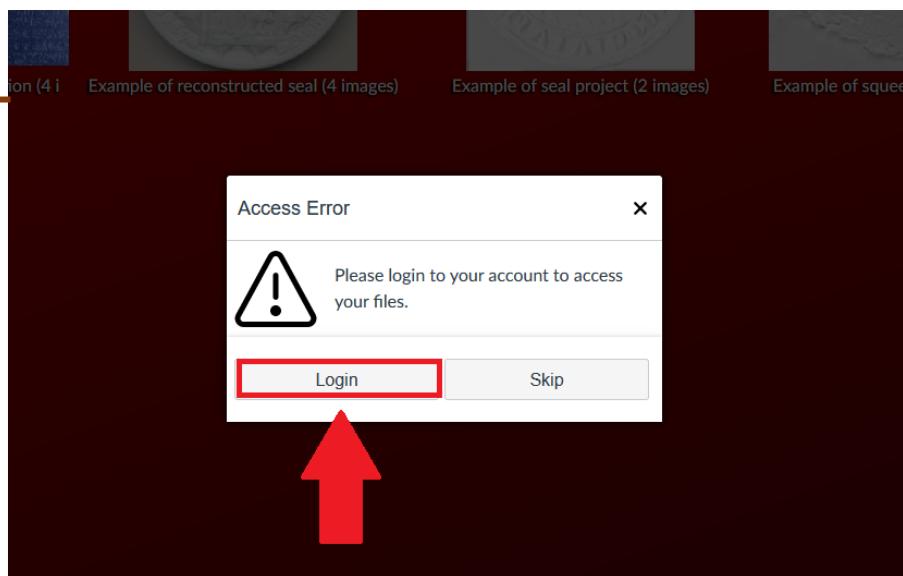
Did you know?

The home screen shows examples of various reconstruction projects that you can use as a reference.

After doing this, you will be prompted with a window labelled “Access Error” to select the “Login” option

Useful tip

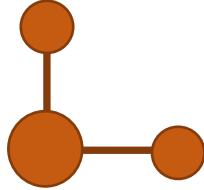
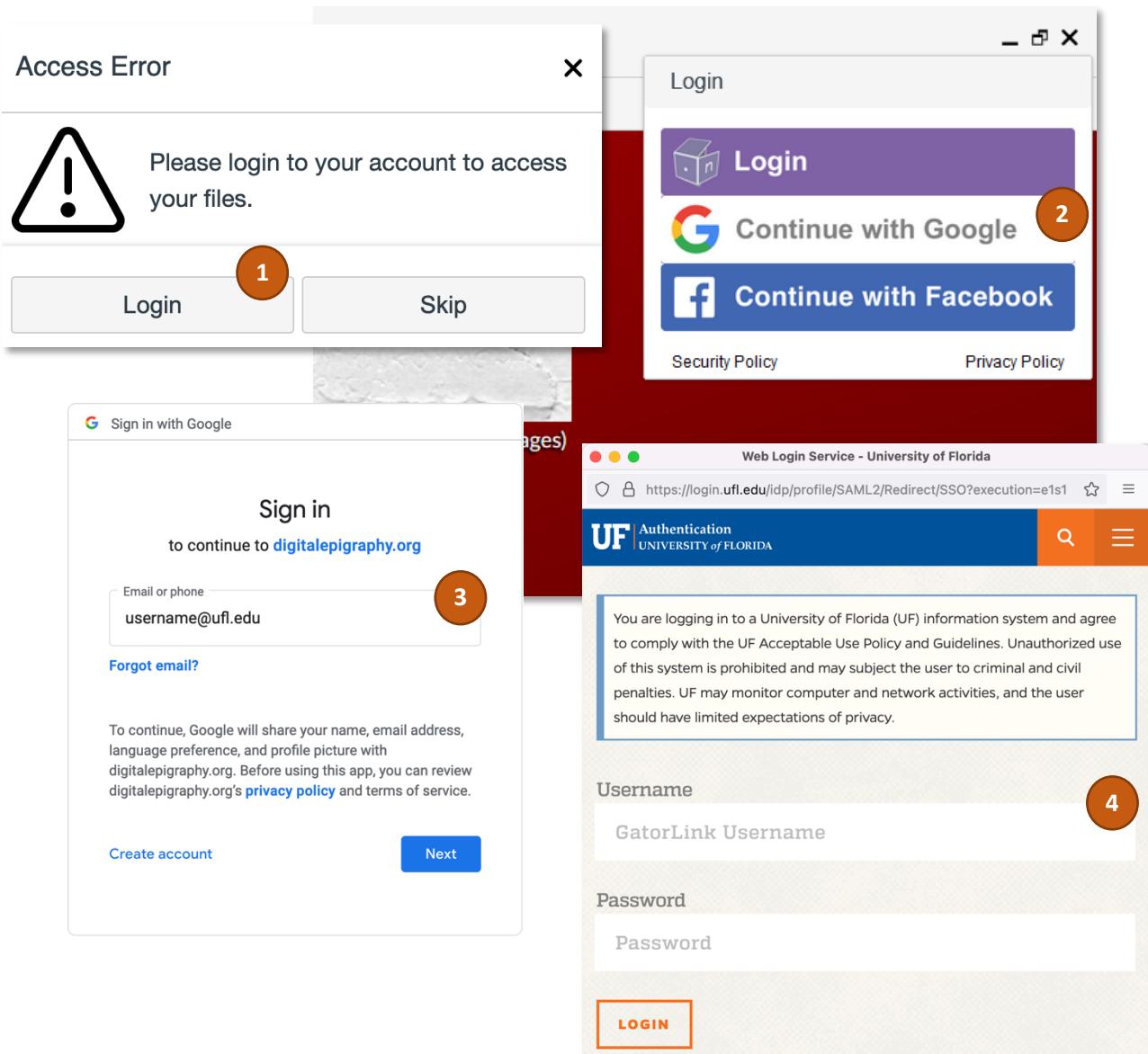
The app remembers you for several hours, so you only have to login once in the beginning of your session.





After selecting “Login”, a menu will appear with several login options. Third-party authentication providers will provide us with your name and email. You can use your own institutional login if your institute, university, or organization has subscribed to any of the available authentication providers.

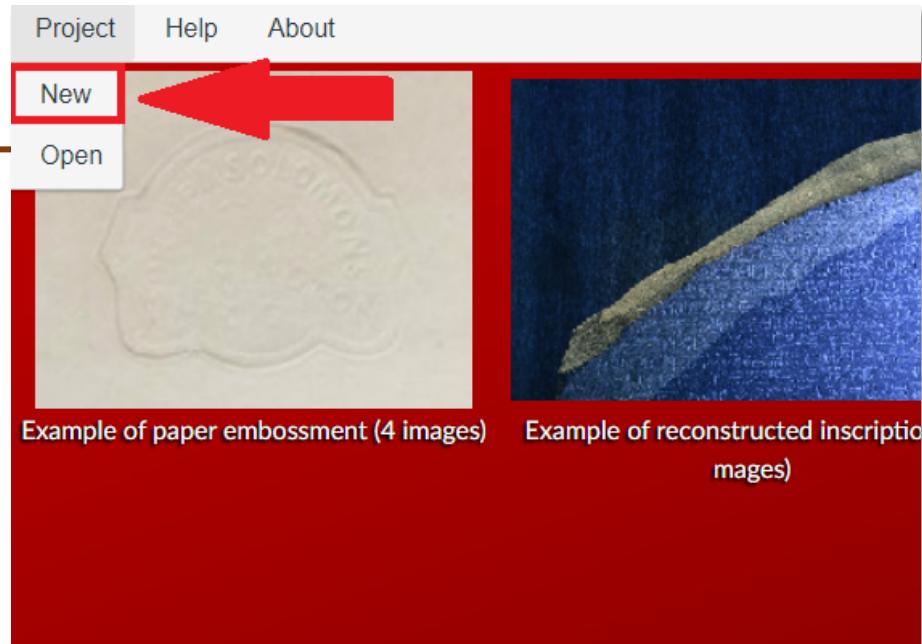
For example, the following images demonstrate how a user from the University of Florida can use their UFL.EDU credentials through Google. In this case the user will click first “Continue with Google” then, type in their UF email: username@ufl.edu and finally login with the University of Florida dual authentication system.





3. Create and Organize Projects

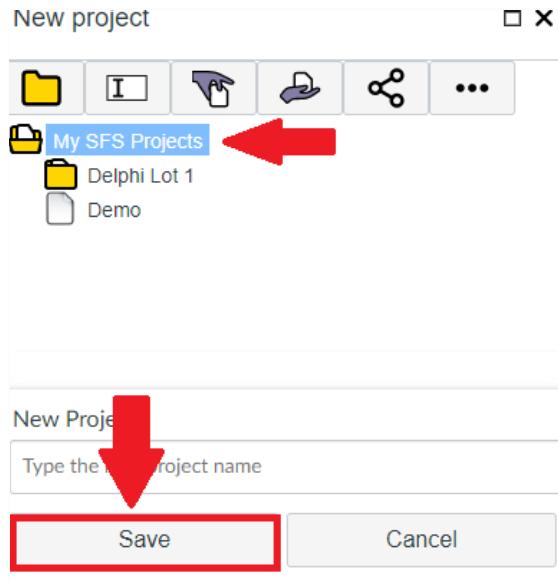
After logging into the program, you will be back at the home screen—this time logged in your account. To begin a new project, select the “New” button from under the “Project” drop-down menu.



This will open a window that allows you to name, save, and create folders and projects.

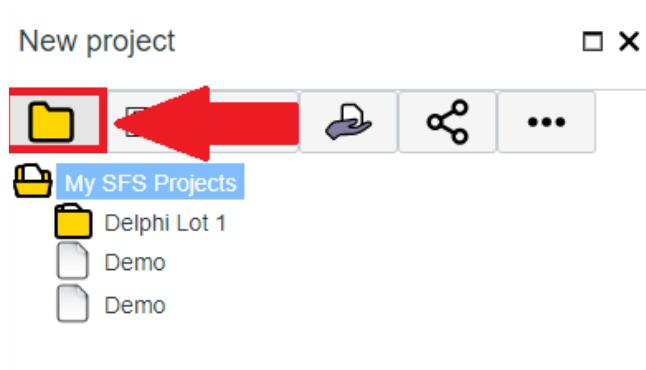


To create a new project, select a folder that you would like to create the project under, create a name for it in the text box, and then select “Save”.

**Important note**

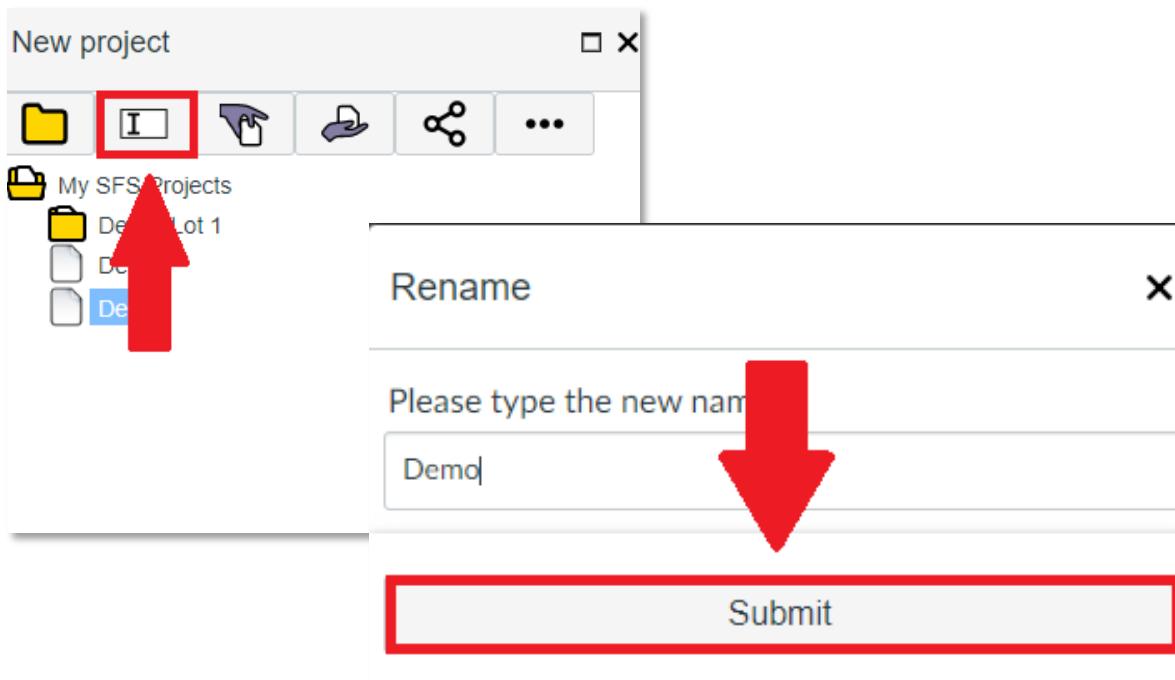
Make sure to select a folder. If you don't, then you will not be able to create a project.

To create a folder, select the option with a yellow folder (📁) icon on it. In the text box, write the name for that folder and select “Save”.





If you need to rename any of your projects or folders, first select which project or folder you are planning on renaming and then click the text box icon () directly to the right of the yellow folder. This will prompt you with another window in which you can type a new name, then select "Submit"



You can copy and paste references of any file by selecting the “Pick” (copy reference) icon () and then, after selecting a **different** list/folder of projects, click the “Put” icon ().

If you wish to share a folder or project, select said item and then click the share icon (). This will open a new window where you can copy URLs in order to share them.

Selecting the () icon will open a new drop-down menu with another list of options that will help you navigate the menu:

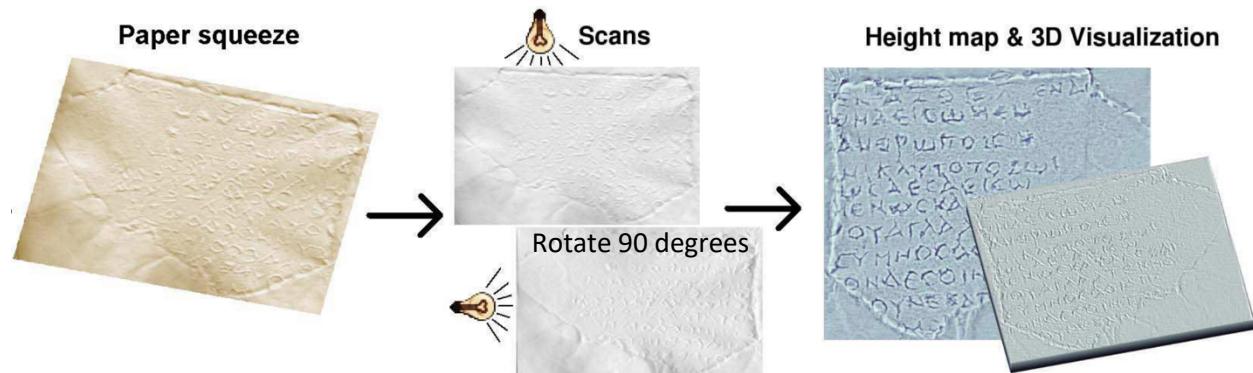
- - Reloads the menu, allowing for any new files or projects to be added into the menu.
- - Deletes whatever item/project you are currently selecting



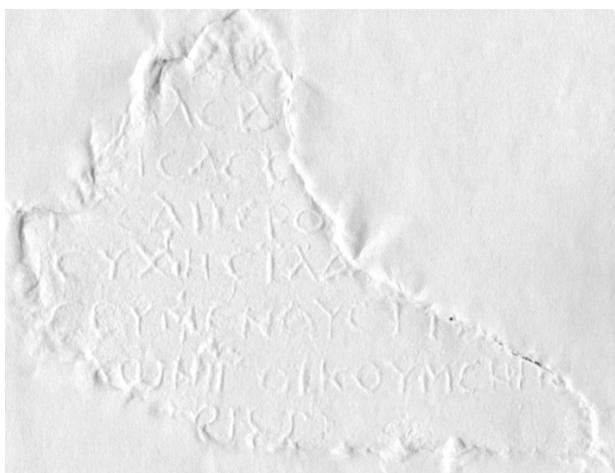
4. Import Images

The shape-from-shading method requires 2 or 4 images of your artifact. The images could be taken either with a fixed camera or with a conventional flatbed paper scanner. The images should be taken under different lighting directions in order to capture how the light is reflected on the tridimensional details of the artifact when illuminated from different lighting angles.

For example, in the case of an epigraphic squeeze, you can place the squeeze on the scanner and take one scan, and then rotate the squeeze 90 degrees and take a second scan. You will notice that the shading is different because of the difference in the lighting orientation.



If you scan the back face of the squeeze, i.e. the side that was originally touching the inscription, you need to flip the images horizontally in order to make the text legible. The two images below show an example of a pair of scanned images. In the first image, the vertical lines are highlighted (left side of vertical lines is brighter) because the light hits the surface from left to right. In the second image, the horizontal lines are highlighted (bottom side of vertical lines is brighter) because the light hits the surface from bottom to top.



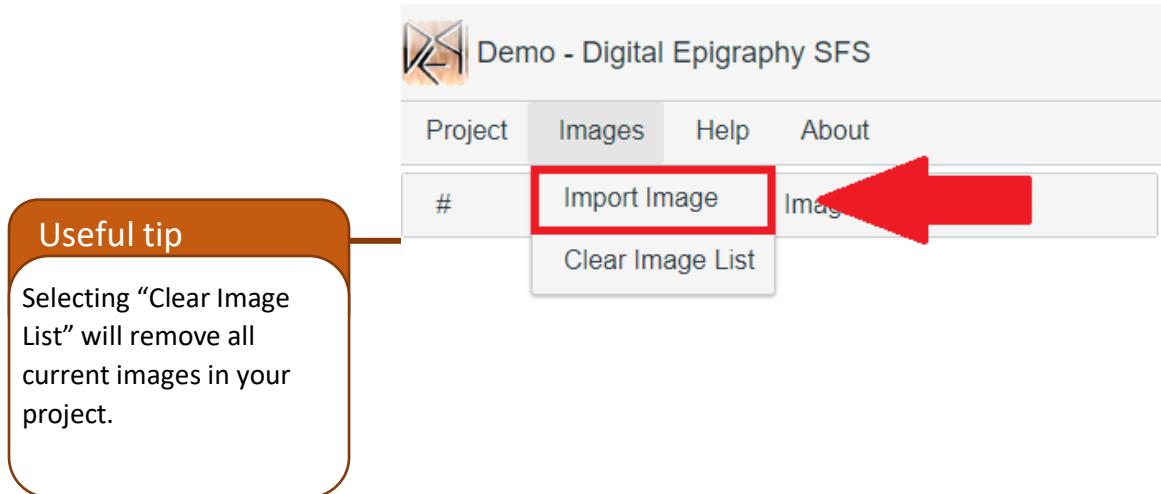
Light orientation: From left to right



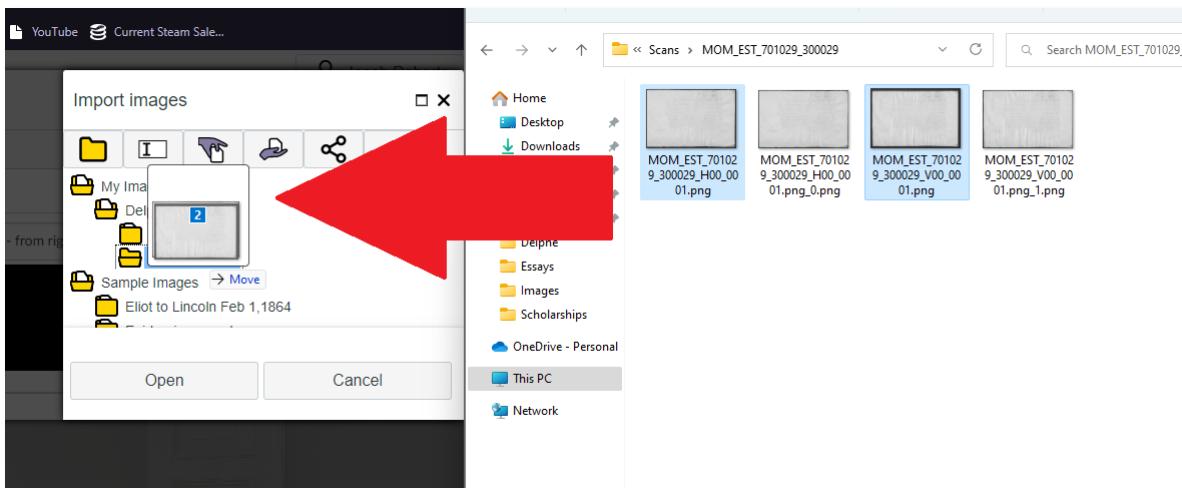
Light orientation: From bottom to top



To begin your 3D reconstruction project, you will first need to import the corresponding scanned images. You can do this by selecting “Import Images” tab from the drop-down menu in the top right of the screen.

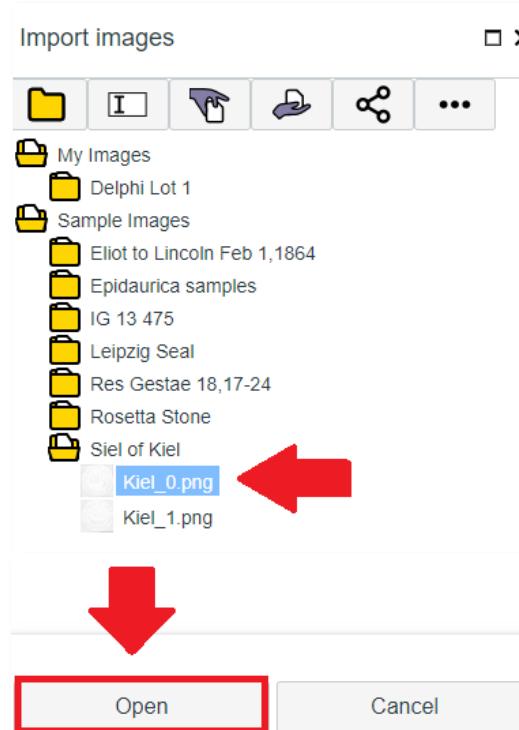


Then after selecting this, the file selector window will appear. You will first need to import images into your files before bringing them into your project. To do this, simply select your images from your computer and drag and drop them within the folder you want them in.

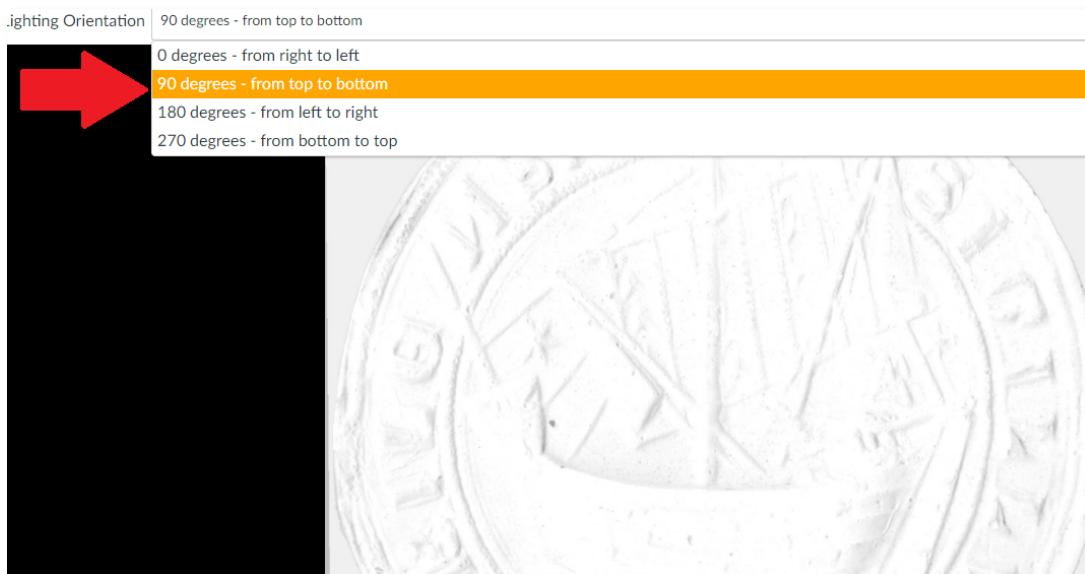




When you have the images you want in your files, you can then import them into your project page. All you need to do is select them from the menu and then select “Open”



Once you have your images imported into your project, you need to declare the corresponding lighting orientation, according to the different direction of lighting each of your pictures was taken with. This can be done by selecting the corresponding lighting angle from the drop-down menu.

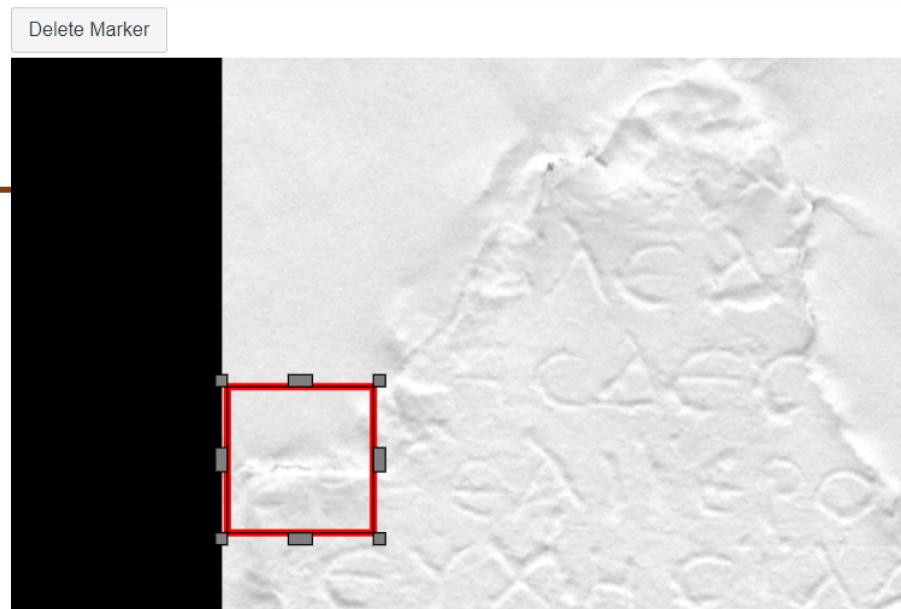




5. Align Images

The next step is to register the two images. You can do this by selecting the “Registration” tab.

To perform the alignment, you need to define markers on the first image. To create a marker, select the ( Add Marker) icon from the top right of the screen and then click somewhere on the object. These markers can be altered (moved and resized) to cover the desired area.



Useful tip

Make sure you select locations for your markers that can be easily identified on all images.

Did you know?

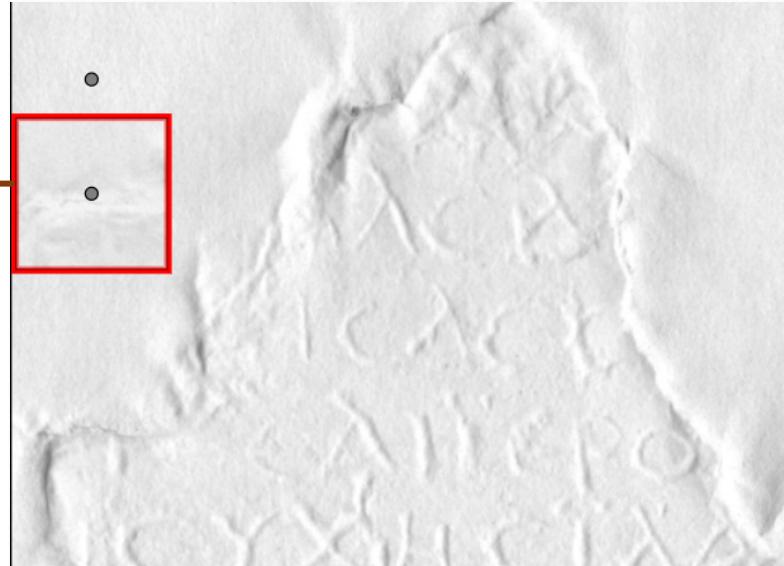
The markers can be resized to a convenient size by dragging the corners or sides of the marked region.



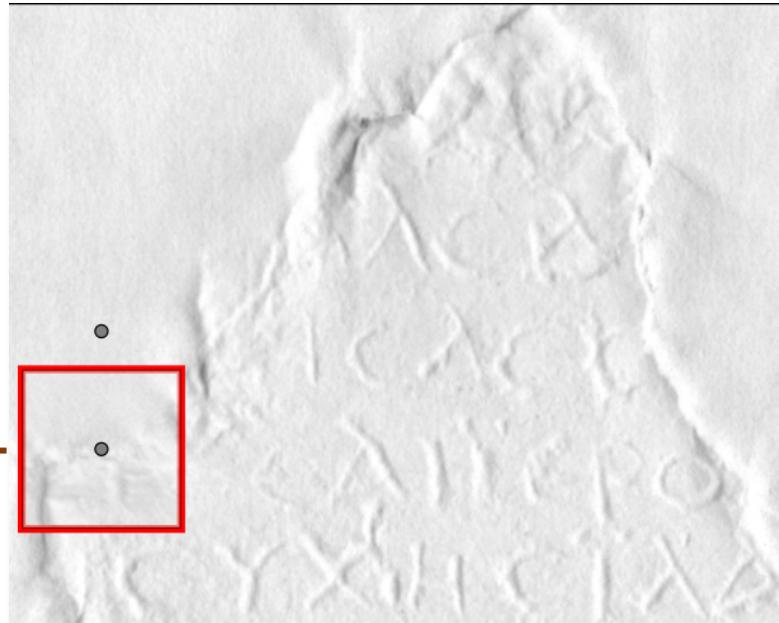
After doing this as many times as needed to encompass the main identifiers of the object, select the next image. You will now need to align the translucent markers onto their corresponding locations on the next image, as seen below:

Example

The marker is misaligned in this example. We need to move it lower to the image to the correct position.

**Example**

The marker is now properly aligned. Optionally, you can test the alignment using the "Test Alignment" button.

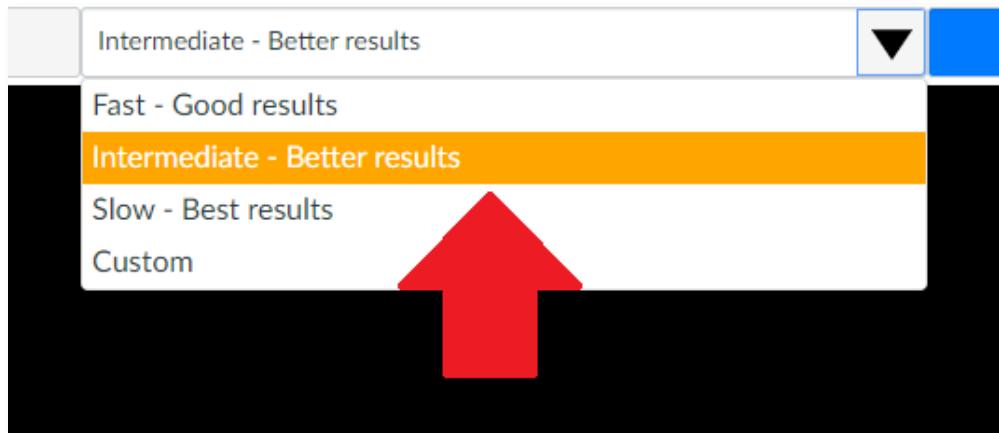


The markers can be rotated in any direction to match the image optimally.

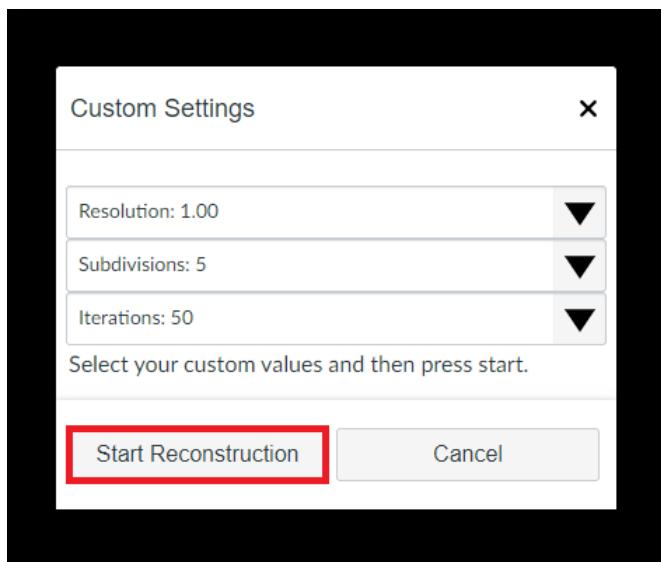


6. 3D Reconstruction

After finishing registration, you can now select the “3D Reconstruction” tab. Here you can select from the drop-down menu which type of reconstruction you would like to perform; it is recommended to select the “Intermediate” option.



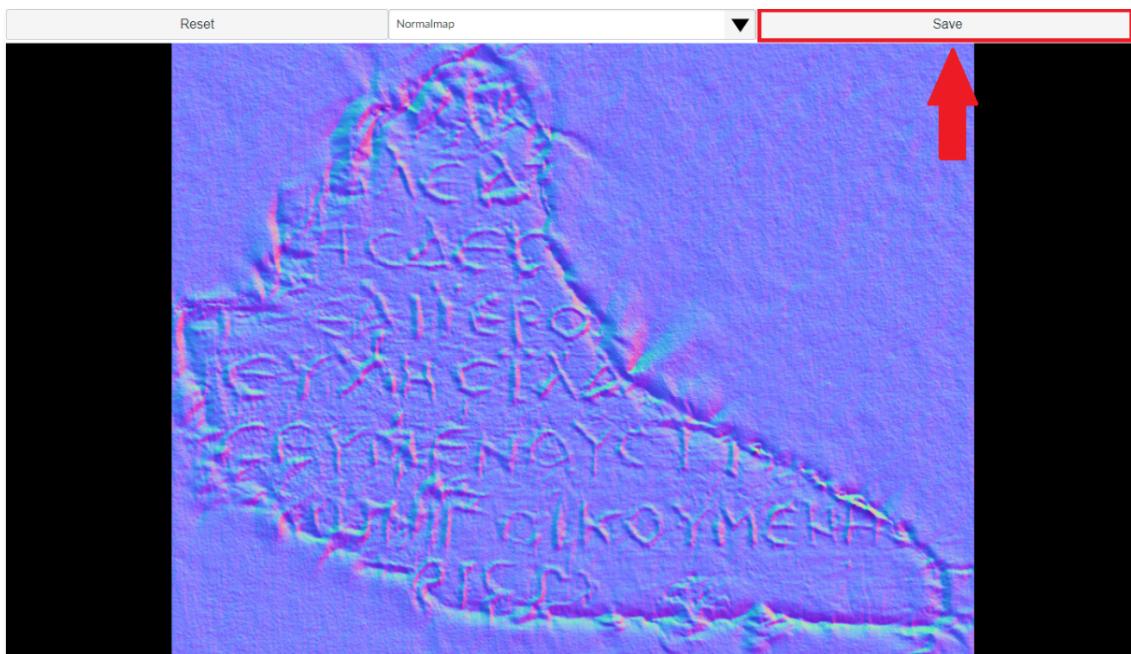
You may also select the “Custom” option in order to set the various variables used in creating the 3D model to more specific values. When you select the “Custom” option and attempt to reconstruct the model a window will appear that allows you to change the resolution as well as the number of subdivisions and iterations. After selecting your chosen values, you click “Start Reconstruction” to begin the creation of the model.



The “Fast – Good results” preset option corresponds to Resolution=0.5, Subdivisions=5, Iterations=50, the “Intermediate – Better results” option corresponds to Resolution=1.0, Subdivisions=5, Iterations=50, and the “Slow – Best results” option corresponds to Resolution=1.0, Subdivisions=5, and Iterations=200.



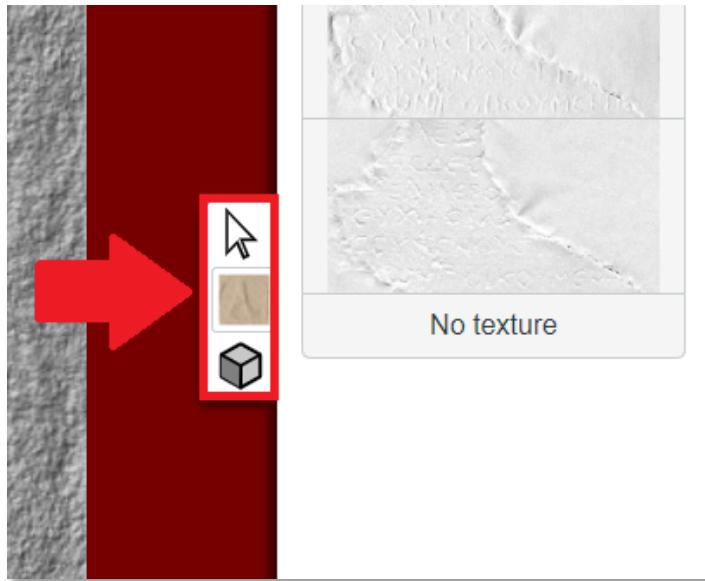
After choosing your type of reconstruction, finalize it by selecting “Reconstruct”. This will take a few seconds or minutes based on the size of your images and then it will present you with a preview of the reconstructed normal map and height map of your object. If you are satisfied with the way it looks, you can select “Save”. Perhaps add here sth to the effect of “if you are not satisfied...” or “I you would like to try again...”





7. Visualization

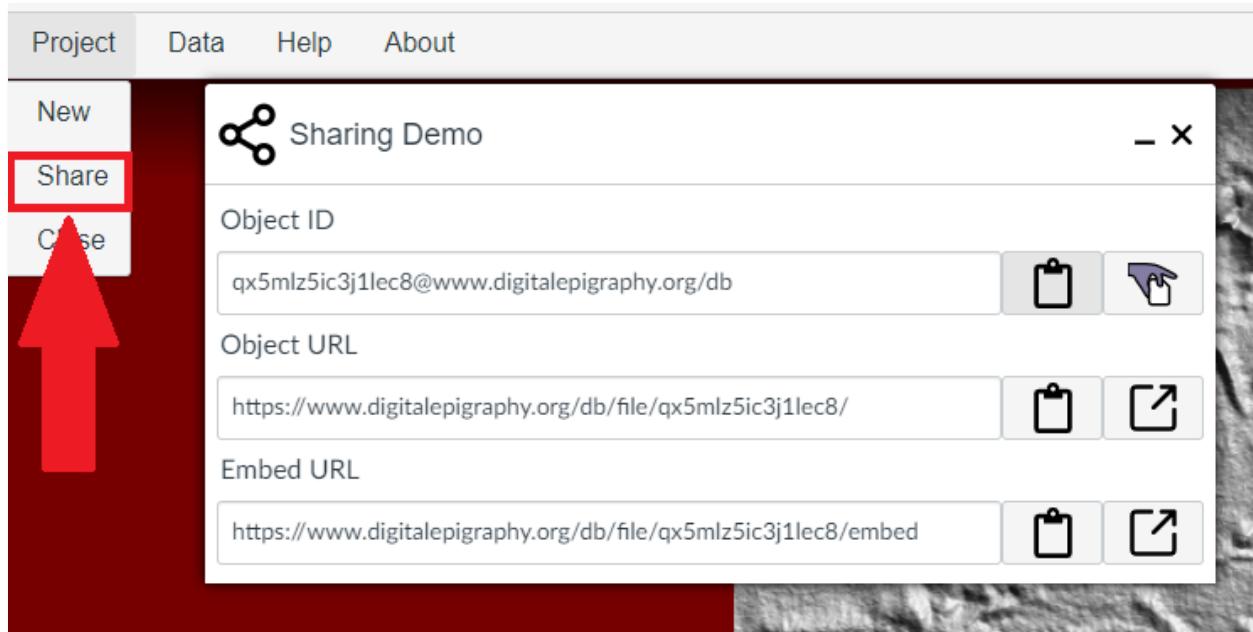
After finalizing your project, you can view the results in the interactive visualization viewer. Here you can drag your mouse to light the inscription as well as use the other visualization options in the toolbar on the right of the screen.





8. Sharing and Downloading Data

When you are ready to share your finished product, you can select the “Share” option from the “Project” drop-down menu in the top right. This will present you with a selection of three URLs that you can use to share the project



Did you know?

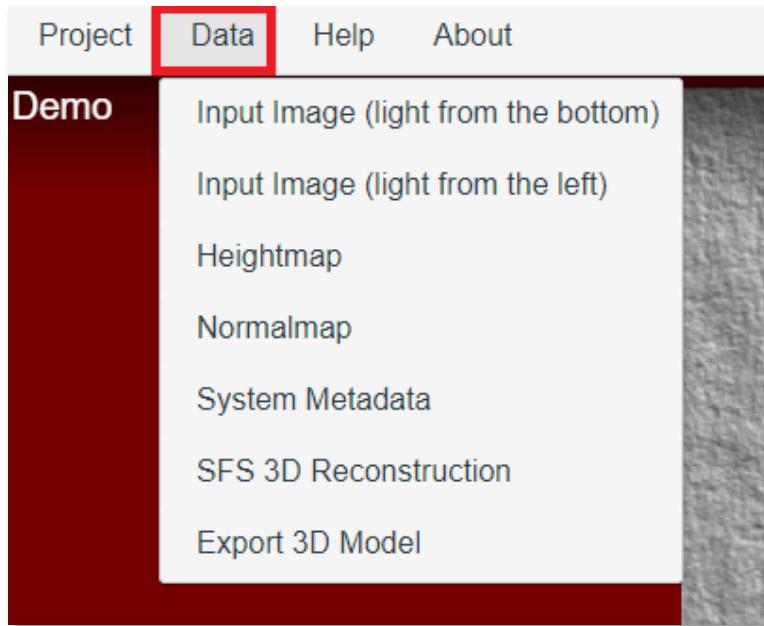
Each project has a unique URL. You can use these URLs to share your work through... including social media.

Useful tip

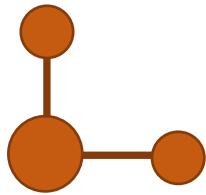
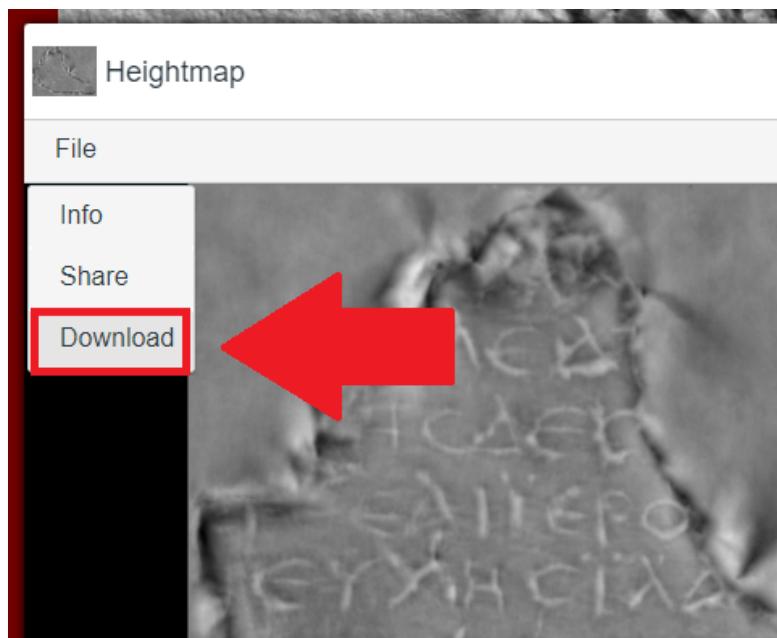
You can use the “Embed URL” to embed your 3D reconstructions in other websites, databases, archives, courses, etc.



You can also download the various aspects of the projects, such as the height and normal maps, by selecting the “Data” menu and then clicking the aspect you would like to download.



This will open your chosen aspect in a new window where, after selecting the “File” menu, you are able to download the data.





9. Citing and acknowledging this tool

If you use this tool in your research, we kindly request that you cite one or more of the following publications based on their relevance to your work:

The shape from shading algorithm used in this tool was presented in the following paper:

- Barmpoutis, A., Bozia, E. and Wagman, R., 2010. A novel framework for 3D reconstruction and analysis of ancient inscriptions. *Journal of Machine Vision and Applications*, vol. 21(6), pp. 989-998. <https://doi.org/10.1007/s00138-009-0198-7>

The digital epigraphy toolbox was first presented in the following white paper for the US National Endowments for the Humanities:

- Barmpoutis, A., Digital Epigraphy Toolbox, *Humanities Commons*, February 28, 2013, pp. 1-11. <http://dx.doi.org/10.17613/M64W9R>

The original version of the Digital Epigraphy Toolbox was made possible with a startup grant from the National Endowment for the Humanities, Office of Digital Humanities, Award HD-51214-11. <https://securegrants.neh.gov/publicquery/main.aspx?f=1&gn=HD-51214-11>