3D Digitization Protocol for Small Bone Elements Using Artec Micro

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CONTENT

PRELIMINARY RECOMMENDATIONS

- Prepare different materials to secure the objects (tape, Blu-Tack, etc.).
- Wear appropriate lab attire, including gloves and lab coats.
- Ensure sufficient power outlets are available (at least 2, one for the computer and one for the scanner).
- Work in an area with consistent lighting or have supplemental lighting available (such as spotlights or desk lamps).
- For fragmented bones, bring easily erasable notation tools (pencils and erasers).

1. INITIAL SETUP

A. BASIC SETUP

The Artec Micro is a semi-automatic scanner, meaning you only need to position the object on the rotating arm, and the scanner will handle the scanning.

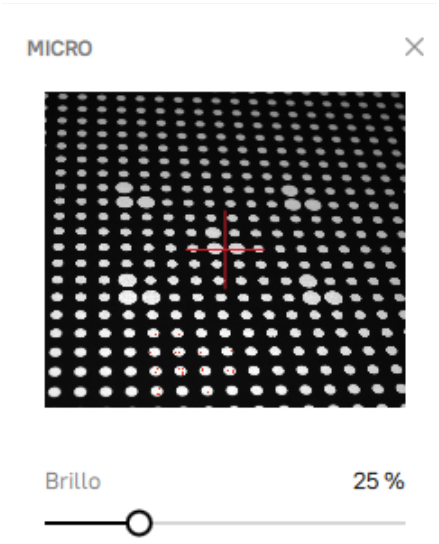
- Connect the scanner to your computer and launch the **Artec Studio** software. Be cautious of software version compatibility; always save projects in formats that can be opened with the specific version you're using.

B. FOLDER STRUCTURE

Before scanning, especially for projects with multiple pieces, take a moment to organize your folder structure. This will help avoid file mismanagement during post-processing.

C. CALIBRATION

The Artec Micro is not designed for transport. If the scanner is moved, calibration is necessary before use. Insert the calibration plate and follow the software instructions.

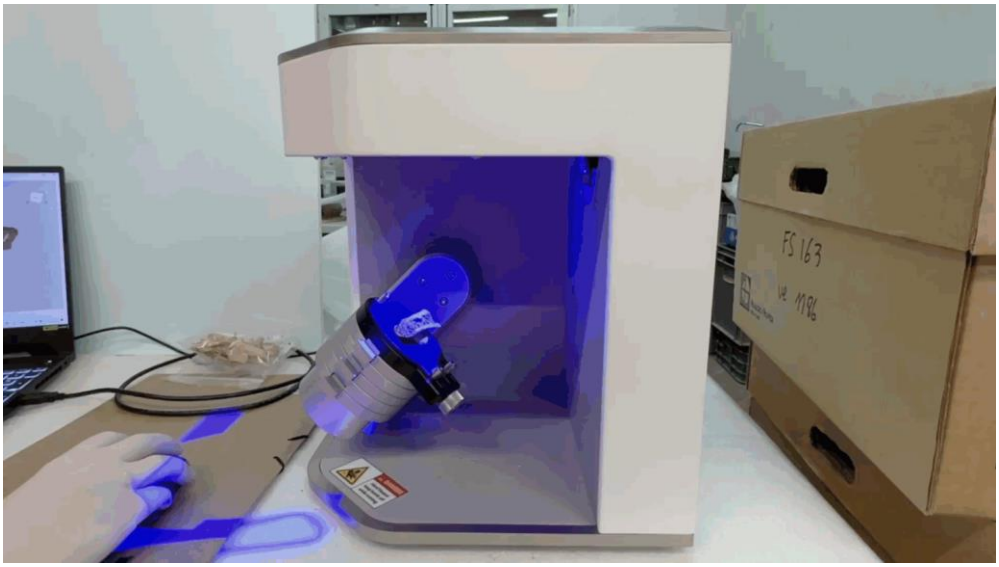


2. SCANNING PROCESS

The scanner has a limited scanning volume, fitting objects up to 6 cm in size (according to the manufacturer, the scanning area is 324 cm^3). This makes it ideal for scanning teeth, carpal and tarsal bones, metacarpals, metatarsals, phalanges, vertebrae (especially cervical), and small bone fragments.

STEPS FOR SCANNING:

1. **Mounting the Object:** Secure the object onto the rotating arm's base. The base has two height settings to accommodate different object sizes. After positioning the object, configure the scan settings on the computer.



2. **Adjusting Brightness:** Set the brightness based on ambient lighting and the object's cavities. Adjust until the scanner captures details (shown in red) without overexposing the object (entirely shaded red).

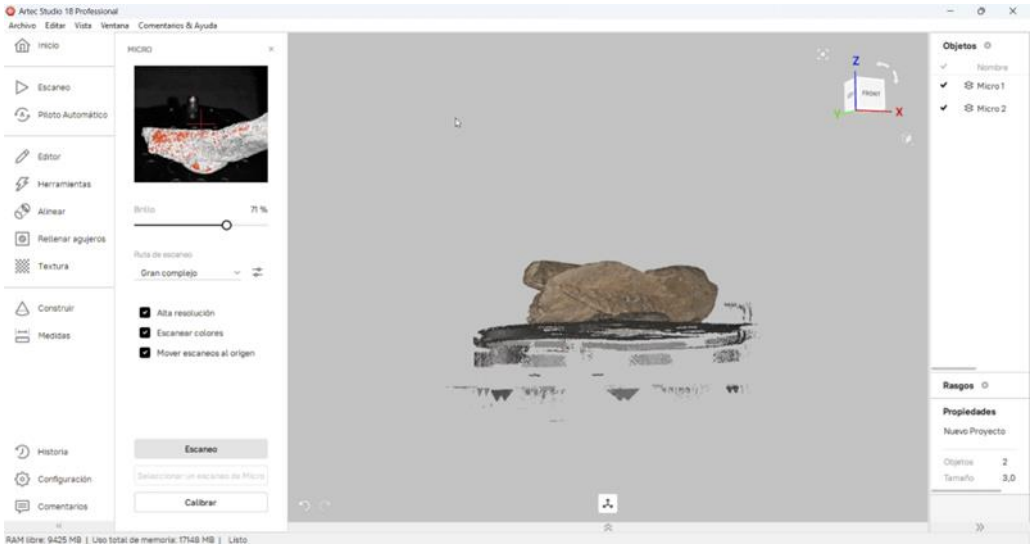
3. **Rotation Settings:** The next adjustment is the number of rotations and the degree between each frame. **Artec Studio** comes with preset configurations suitable for most cases but allows customization for specific objects.
    - For objects under 5 cm, use the "Small Complex" configuration.
    - For larger objects, use the "Large Complex" configuration.
4. **High Resolution:** Enable "High Resolution" scanning and color capture. Start the scan by selecting "Scan." If certain areas are missed, rotate the object to the problematic area and use "Add Frame" to re-scan those sections.

3. POST-PROCESSING

The post-processing steps are similar for most objects. For this guide, we will use a rib fragment as an example.

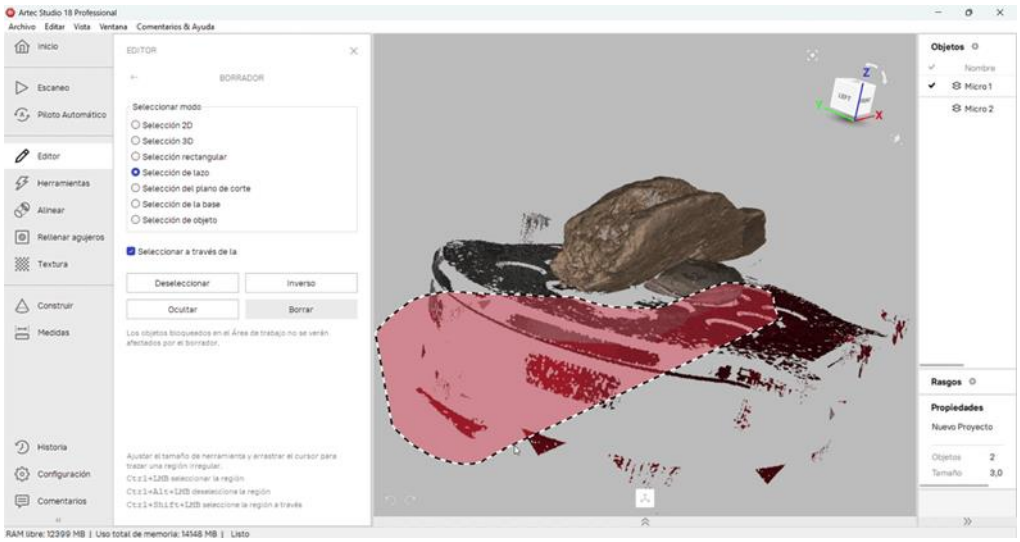
1. INITIAL CLEANING

After scanning, the point clouds will not be aligned and may contain artifacts. Clean each point cloud independently by hiding the others using the checkboxes in the "Objects" menu on the right. Be mindful that these files are larger than those from other scanners, which can impact computer performance. After each processing step, return to the "Scan" screen to save your changes before moving on to the next task.



2. REMOVING ARTIFACTS

Use the "Eraser" tool from the "Editor" menu, primarily working with the "Lasso Selection." Enclose the artifacts you want to remove by holding **Shift** and left-clicking, selecting as little bone as possible. First, remove the bulk of the turntable or Blu-Tack, then focus on smaller remnants attached to the bone.



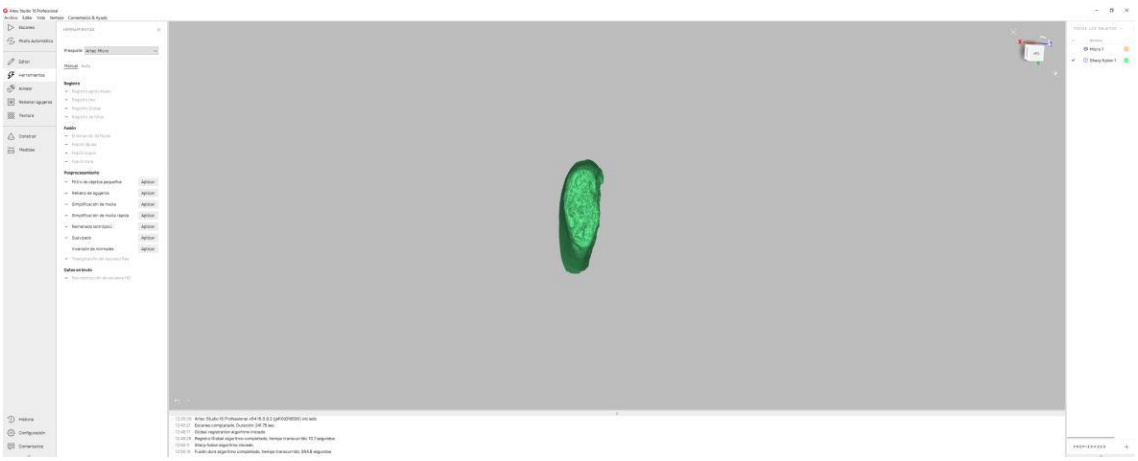
3. POINT CLOUD ALIGNMENT

Once the scans are cleaned, proceed to align them to create a complete point cloud representing the bone's original shape. Use the alignment tool, where you will see a list of scans. The blue point cloud is the reference, and the gray ones will align with it. Automatic alignment works well for bones with distinct shapes but may fail for smaller fragments. In such cases, manually mark corresponding points between the models (at least two pairs of points are required). Ensure you adjust the orientation of the models beforehand to see the matching points clearly.

- Place alignment points on distinctive areas or bone extremities.
- Enable "Texture Alignment" for better results.

4. GLOBAL REGISTRATION AND MESH CREATION

After aligning the point clouds, go to "Tools" and execute the "Global Registration" to improve the overlap. Then select "Fusion" to create the final mesh.



- Optimize the mesh using the preset values to avoid complexity, which can hinder texture creation.

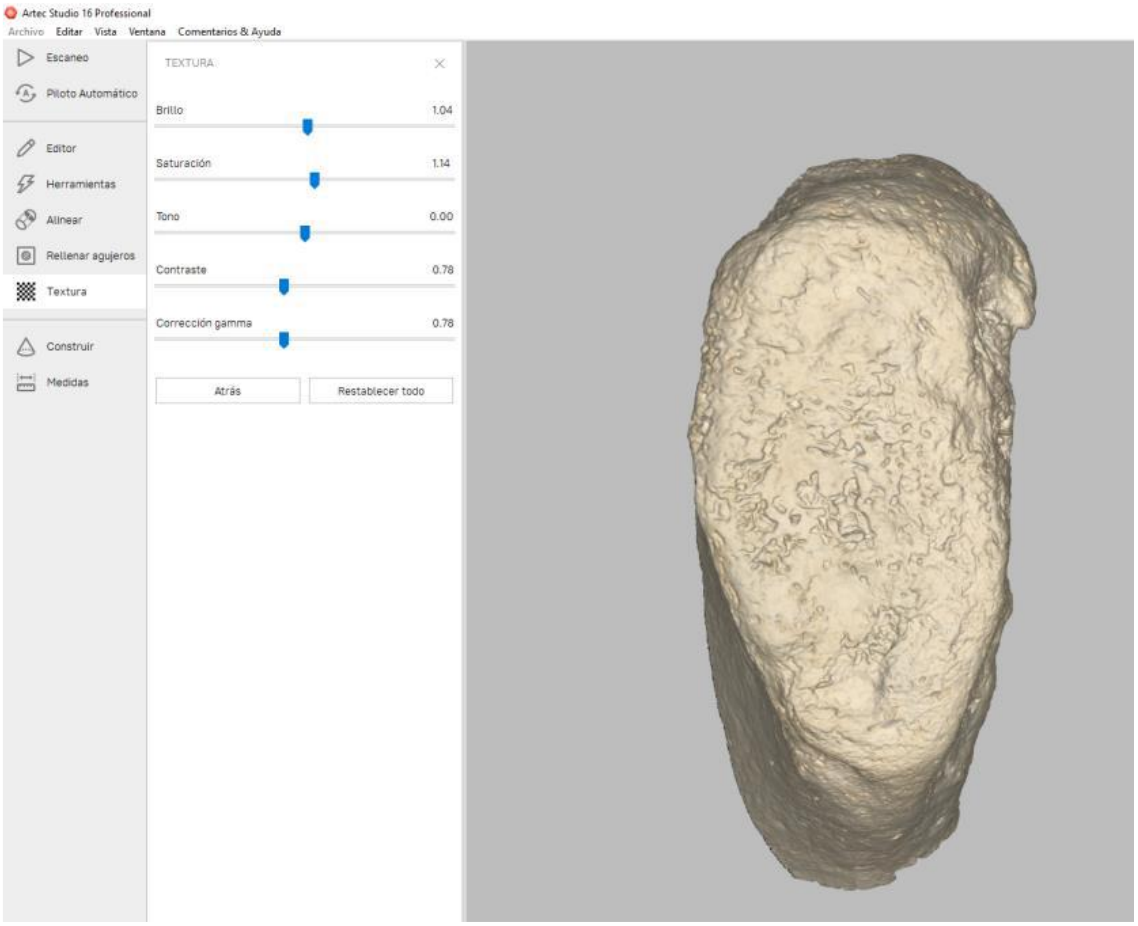
5. TEXTURE APPLICATION

The mesh's texture is generated based on the scan frames. Use the "Texture" tool from the left menu and select all scans used for the mesh. In the "Texture Destination" section, choose "Export." This option reduces mesh count and provides better control over texture quality, including features like removing markers (recommended to enable), reducing reflections (set to maximum), and eliminating background colors (also set to maximum). Additionally, deselect "Missing Texture Paint" to prevent alterations not corresponding to the scan data.

- Select a 2048x2048 texture size for optimal detail without overloading the computer.

6. FINAL TEXTURE ADJUSTMENTS

Once the texture is generated, the texture adjustment menu will appear. Similar to photo editing software, adjust the parameters to match the bone's natural appearance. Often, the Micro's default values are sufficient.



7. FINAL CLEANUP

Ensure the model is clean by going to the "Editor" and "Eraser" tools. Use "Object Selection," invert the selection, and delete any unnecessary parts.

4. EXPORTING AND SAVING MODELS

Once the model is finalized, the last step is to save the project and export the models.

- **Project Name:** The project's name will be automatically applied to both the folder and the exported files. Choose a final name and avoid changes later.
- **File Format:**
    - For models meant for display that retain their appearance, export in **PLYVC**, which doesn't require texture files for viewing. However, if you need to use the model in other software or combine it with **OBJ** models, convert the PLYVC to **OBJ** using the ply_to_obj.py script.
    - For detailed study models, export in **OBJ**. Be aware that this format doesn’t retain scene values like PLYVC, and textures may appear darker. A 3D editing program may be required to adjust the scene parameters. Additionally, to avoid issues opening **OBJ** models, run the fix_mtl_names.py script to correctly reference the models in the folders.