SHREC 2026: Retrieval of High-Frequency Geometry in Synthetic Heritage

The Track

In cultural heritage, the value of an artifact often lies not in its overall shape, but in its surface details—such as engravings, erosion patterns and reliefs. This track focuses on 3D analysis to achieve geometric fidelity in 3D reconstruction from multiple-view images. We introduce a novel challenge focused on retrieving objects based on localized surface features rather than global structure.

We present a controlled synthetic dataset inspired by the intricate stone reliefs found in heritage artifacts (such as Khachkars or decorative steles). The dataset consists of parametrically generated meshes derived from a canonical cube primitive. These objects are procedurally sculpted to emulate the engraving and relief patterns of real-world artifacts.

By participating in this track, researchers will test the ability of their algorithms to reconstruct 3D objects from a synthetic but realistic rendering of Khachkars.

Challenge

The challenge is to reconstruct synthetically created objects from the dataset (explained in the next section) using 2D renderings of them. Researchers may employ any 3D reconstruction methods they find suitable. Evaluation will be performed using the weighted metric described above.

The Dataset & Feature-Aware Ground Truth

The dataset is generated using a novel procedural pipeline that combines mesh sculpting with semantic vertex annotation, i.e., our ground truth includes per-vertex semantic metadata.

The reconstruction similarity to the ground truth can be ponderated by using the weights provided by each category in the per-vertex metadata. We refer to this as the "Semantic Weighting Scheme." An initial set of weights is associated with the following ground truth categories:

- Corners: High importance to corner preservation (structural integrity).
- Edges: Moderate importance to sharp transitions.
- Sculpted Reliefs: Priority given to the artistic/historical surface content.
- Flat Faces: Baseline importance.

The weights can be seen in Figure 7.

Dataset Characteristics:

Researchers will be provided with the renderings of the objects to facilitate their reconstructions.

- Materiality: Objects are rendered with physically based materials (high roughness, low metallicity) approximating diffuse stone.
- Environment: The rendering uses two suns to create a realistic world scenario and an HDRI map to enhance realistic illumination reflection.
- Resolution: Images will be 1920×1080 pixels in PNG format.

Dataset Elaboration

First, a real image of a cultural heritage object with interesting features (specifically, Armenian Khachkars) is converted to grayscale and its resolution is adjusted to match the intended mesh resolution—for example, 300×300 pixels for a 300×300 mesh. Alternatively, the mesh resolution can be adapted to match the image, in another approach. Figure 1 shows an exammple.

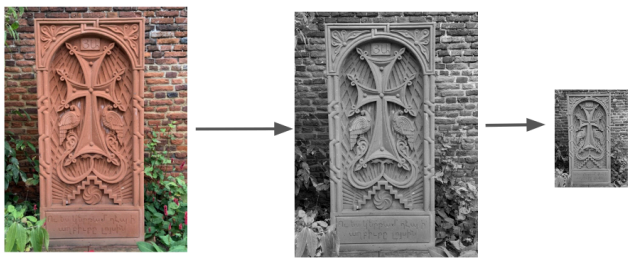

Figure 1: Convert the original image to grayscale, then scale.

Then, the grayscale image is sculpted into the main face of the Khachkar, creating the 3D object and preserving real features. For expanding the dataset, this mesh is transformed to get four categories of objects: the normal object, a large version, a wide version and a realistic version. See Figure 2 for an example with the image above.

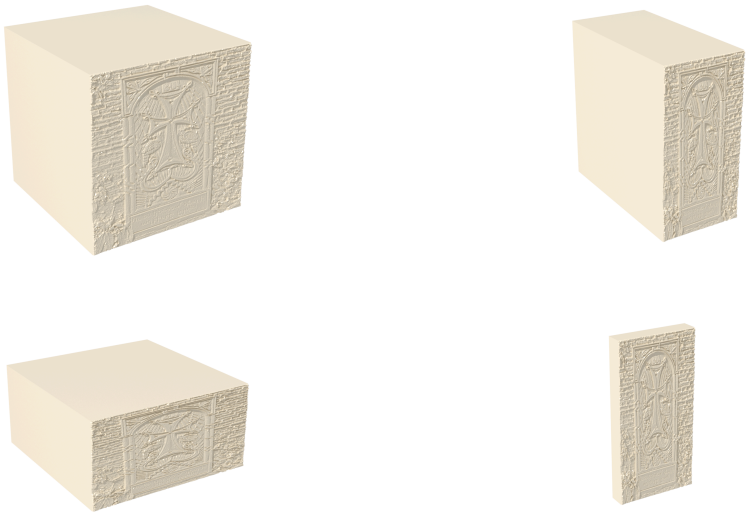

Figure 2: Four classes of the same object. From left to right and top to bottom: normal, large, wide and realistic version.

For the remaining mesh faces, flat surfaces may optionally be sculpted with textures from real Khachkar backgrounds, selected randomly to enhance realism. See Figure 3 for an example.

Figure 3: Apply back texture of the Khachkar to the ground truth flat faces. In the image, it can be seen on top of the object.

Next, camera poses are computed in Blender. A total of 90 poses are arranged in a helical path around the object across two levels: from top to bottom and from near to far. See Figure 4 for an example.

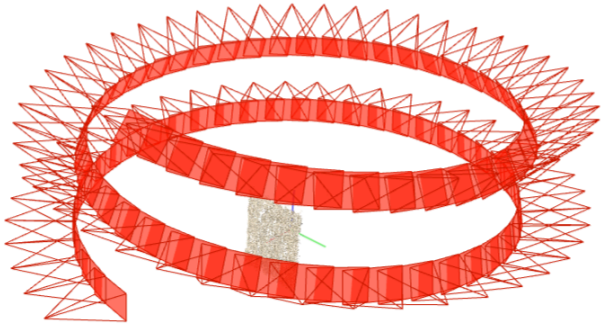

Figure 4: Cameras around the object visualized in COLMAP.

Each pose is then rendered using Blender. In Figure 5 and Figure 6, two subsets, one for a cubic object and one for a wider object, are provided as examples.

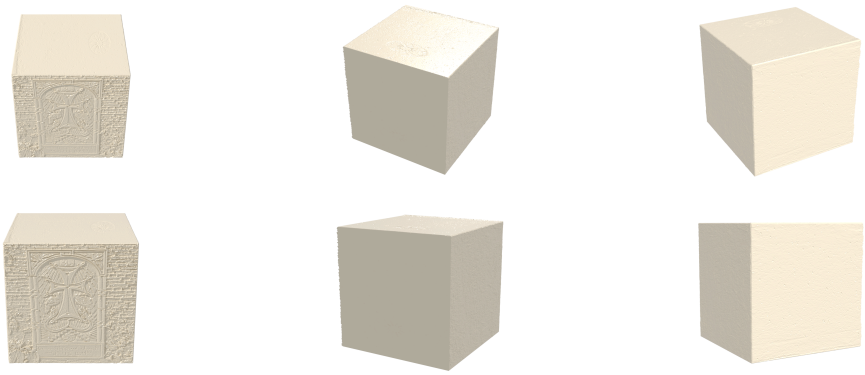

Figure 5: Renderings examples for the cubic ground truth generated with the image in Figure 1.

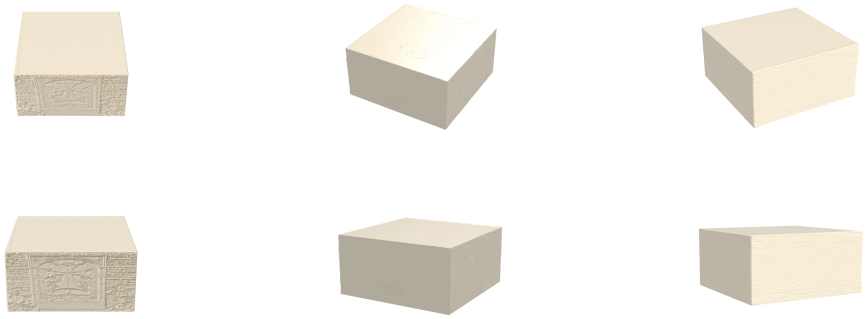

Figure 6: Set of renderings for a wider cube generated ground truth.

The final step involves assigning weights to the predefined categories, as shown in Figure 7.

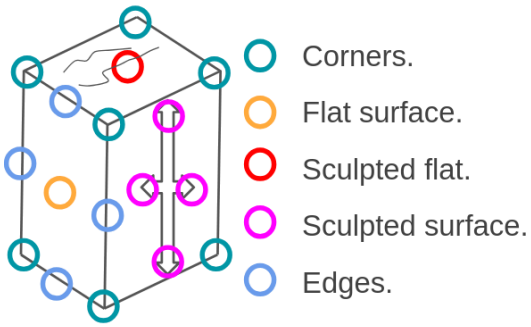

Figure 7: Weight selection system. Corners provide structural integrity, as well as edges; flat surfaces do not provide relevant information; 'Sculpted flat' are faces with textures added for realism, and 'Sculpted surface' are surfaces sculpted with human-created reliefs and motifs carved on the stone.

Timeline

- January 9th: deadline for track registration.

Organizers

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