SHAPESHIFTER: MESH EDITOR BASED ON NORMAL DRIVEN SPHERICAL SHAPE ANALOGIES

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ABSTRACT

Mesh style transfer is a common operation for 3D artists. One example of mesh style transfer is cubification, in which 3D meshes are made to look cubic. Traditionally, applying such styles to an existing triangle mesh is a tedious process that requires manual manipulation of individual faces and vertices. In order to automate and generalize mesh style transfer, recent work has framed this problem as a spherical shape analogy [1]. A spherical shape analogy is such that the relationship between a primitive, such as a cube, and a sphere, is analogous to the relationship between an initial mesh and the deformed mesh. To uphold this analogy, the resulting deformation is defined by solving an optimization problem that seeks to jointly preserve the geometry of the initial mesh, while matching the normals defined by the primitive. Preservation of the mesh's geometry is defined as constraining the deformation to be as rigid as possible (i.e minimizing the ARAP energy [2]). Matching the normals involves mapping the normals from the primitive onto the initial mesh, thereby defining a set of target normals. We iteratively minimize this error to approximate an optimal deformed mesh. In this project, we implement this method for constructing normal driven spherical shape analogies and create ShapeShifter, a mesh editor that allows users to construct their own shape analogies and perform style transfer. Using ShapeShifter, users are able to manipulate a spherical mesh to create more complex shape analogies that extend beyond primitives and quickly apply these styles to large meshes.

1 Figures

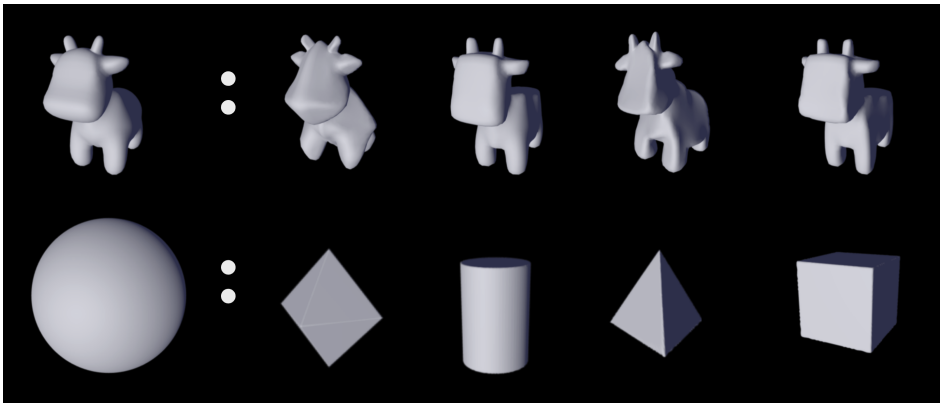

Figure 1: Examples of spherical shape analogies for several different primitive shapes

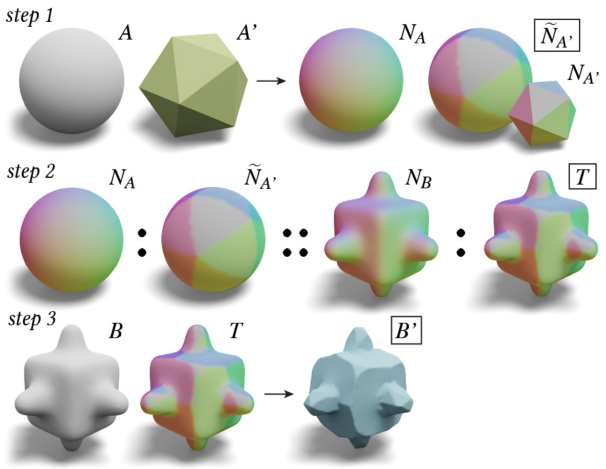

Figure 2: Step (1) illustrates how a primitives face normals are associated with a sphere. Step (2) depicts how target normals, T are constructed via a the spherical shape analogy. Step (3) illustrates how the deformation is applied, preserving initial geometry, B, while matching the target normals, T.

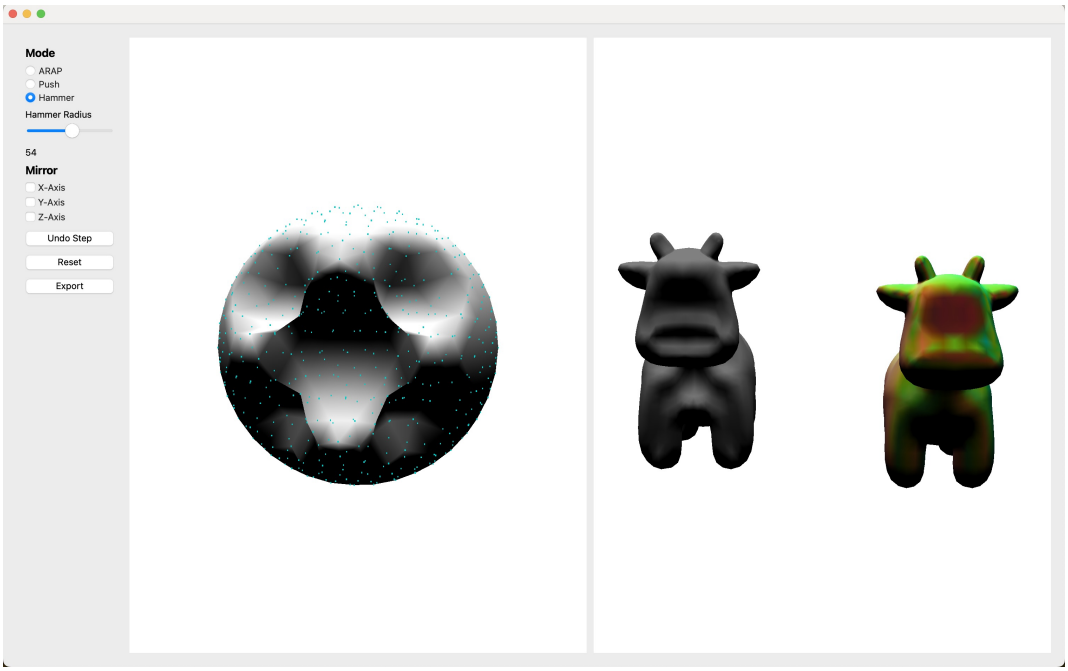

Figure 3: Our interactive editor allows users to create more complex shape analogies to modify their custom meshes

References

[1] Hsueh-Ti Derek Liu and Alec Jacobson. Normal-driven spherical shape analogies, 2021.

[2] Olga Sorkine and Marc Alexa. As-rigid-as-possible surface modeling. In *Proceedings of EUROGRAPHICS/ACM SIGGRAPH Symposium on Geometry Processing*, pages 109–116, 2007.