Identifying Instances of a Mesh

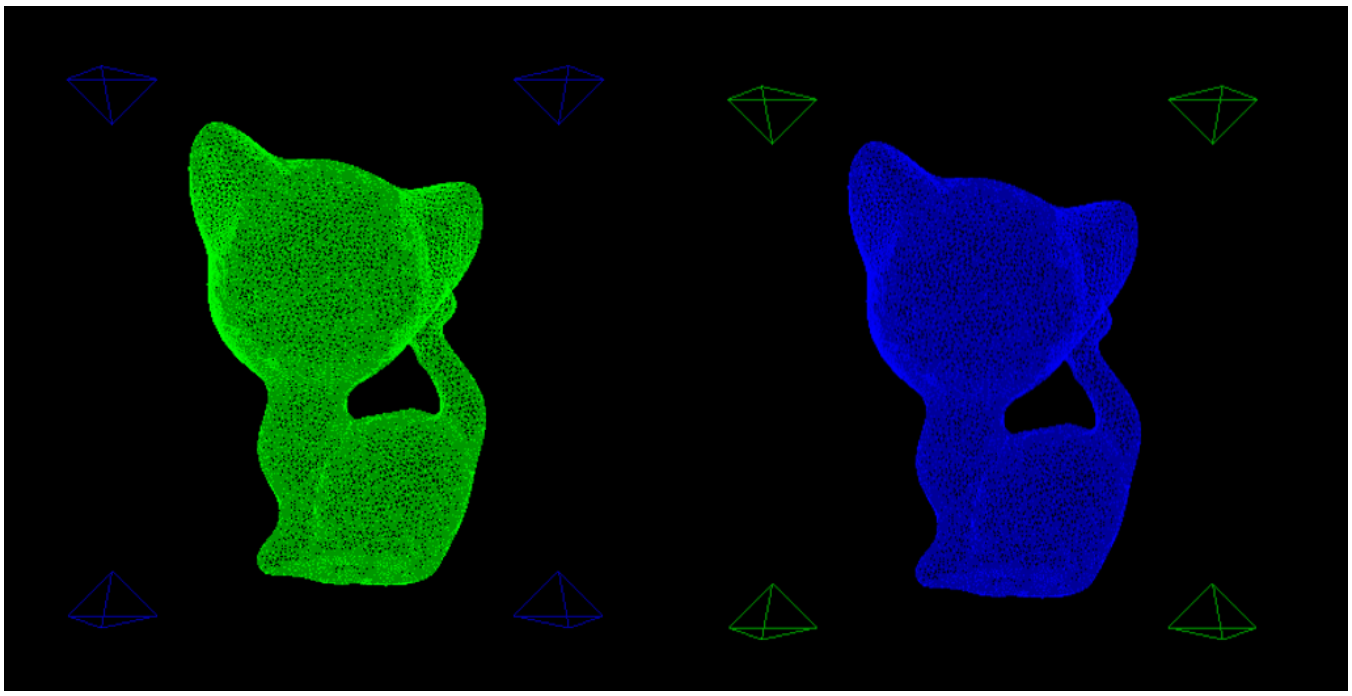
Meshes with the same number of vertices and faces do not necessarily describe the same shape. Neither do meshes with the same surface area or volume. However, the combination of surface area and volume does describe a uniquely shaped mesh. Computing the surface area of a mesh is straightforward, sum up the area of its faces. The volume of a consistently oriented triangle mesh can be computed as follows:

$$V_{total} = | \sum_i V_i |$$

where for each face,

$$V_i = (-x_{i3}y_{i2}z_{i1} + x_{i2}y_{i3}z_{i1} + x_{i3}y_{i1}z_{i2} - x_{i1}y_{i3}z_{i2} - x_{i2}y_{i1}z_{i3} + x_{i1}y_{i2}z_{i3}) / 6$$

The derivation of this formula can be found in [1].



Meshes describing a single shape are highlighted in green in the figure above.

[1] C. Zhang and T. Chen. Efficient Feature Extraction For 2D/3D Objects in Mesh Representation

Implementation: https://github.com/rohan-sawhney/instances