

ElementSets from MeshConnectivity

NeighborVerticesInFace, Faces, VertexOneRing from Neighborhoods(M)

$$\begin{aligned}
& M: \text{TriangleMesh} \\
& x_i \in \mathbb{R}^3 \\
\\
& V, E, F = \text{ElementSets}(M) \\
& \text{VertexNormal}(i) = \frac{\mathbf{w}}{\|\mathbf{w}\|} \\
& \text{where} \\
& \quad i \in V \\
& \quad \mathbf{w} = \sum_{f \in \text{Faces}(i)} (\mathbf{x}_j - \mathbf{x}_i) \times (\mathbf{x}_k - \mathbf{x}_i) \quad \text{where } j, k = \text{NeighborVerticesInFace}(f, i) \\
\\
& \text{CalcNorm}(i, \mathbf{v}, n, \sigma_c, \sigma_s) = w_c \cdot w_s \\
& \text{where} \\
& \quad i, \mathbf{v} \in \mathbb{Z}, \text{ vertices} \\
& \quad \sigma_c, \sigma_s \in \mathbb{R} \\
& \quad n \in \mathbb{R}^3 \\
& \quad t = \|\mathbf{x}_i - \mathbf{x}_v\| \\
& \quad h = \langle n, \mathbf{x}_v - \mathbf{x}_i \rangle \\
& \quad w_c = e^{-\frac{t^2}{2 \sigma_c^2}} \\
& \quad w_s = e^{-\frac{h^2}{2 \sigma_s^2}} \\
& \text{CalcS}(i, \mathbf{v}, n, \sigma_c, \sigma_s) = \text{CalcNorm}(i, \mathbf{v}, n, \sigma_c, \sigma_s) \cdot h \\
& \text{where} \\
& \quad i, \mathbf{v} \in \mathbb{Z}, \text{ vertices} \\
& \quad \sigma_c, \sigma_s \in \mathbb{R} \\
& \quad n \in \mathbb{R}^3 \\
& \quad h = \langle n, \mathbf{x}_v - \mathbf{x}_i \rangle \\
& \text{DenoisePoint}(i) = \mathbf{x}_i + n \cdot \left( \frac{s}{\text{norm}} \right) \\
& \text{where} \\
& \quad i \in V \\
& \quad n = \text{VertexNormal}(i) \\
& \quad \sigma_c = \text{CalcSigmaC}(i) \\
& \quad \text{neighbors} = \text{AdaptiveVertexNeighbor}(i, \{i\}, \sigma_c) \\
& \quad \sigma_s = \text{CalcSigmaS}(i, \text{neighbors}) \\
& \quad s = \sum_{v \in \text{neighbors}} \text{CalcS}(i, v, n, \sigma_c, \sigma_s) \\
& \quad \text{norm} = \sum_{v \in \text{neighbors}} \text{CalcNorm}(i, v, n, \sigma_c, \sigma_s) \\
& \quad \text{CalcSigmaC}(i) = \min(\{\|\mathbf{x}_i - \mathbf{x}_v\| \mid v \in \text{VertexOneRing}(i)\}) \text{ where } i \in V \\
& \quad \text{CalcSigmaS}(i, N) = \begin{cases} \sqrt{\text{offset}} + 1.0E - 12 & \text{if } \sqrt{\text{offset}} < 1.0E - 12 \\ \sqrt{\text{offset}} & \text{otherwise} \end{cases} \\
& \text{where} \\
& \quad i \in V \\
& \quad N \subset V \\
& \quad n = \text{VertexNormal}(i) \\
& \quad \text{avg} = \sum_{v \in N} \frac{t}{|N|} \quad \text{where } t = \sqrt{((\mathbf{x}_v - \mathbf{x}_i) \cdot n)^2} \\
& \quad \text{sqs} = \sum_{v \in N} (t - \text{avg})^2 \quad \text{where } t = \sqrt{((\mathbf{x}_v - \mathbf{x}_i) \cdot n)^2} \\
& \quad \text{offset} = \frac{\text{sqs}}{|N|} \\
& \text{AdaptiveVertexNeighbor}(i, n, \sigma) = \begin{cases} n & \text{if } |n| = |\text{target}| \\ \text{AdaptiveVertexNeighbor}(i, \text{target}, \sigma) & \text{otherwise} \end{cases} \\
& \text{where} \\
& \quad i \in V \\
& \quad \sigma \in \mathbb{R} \\
& \quad n \subset V \\
& \quad \text{target} = \{v \mid v \in \text{VertexOneRing}(n), \|\mathbf{x}_i - \mathbf{x}_v\| < 2 \cdot \sigma\} \cup n
\end{aligned}$$