vec, inversevec, diag, svd from linearalgebra

ElementSets from MeshConnectivity

NeighborVerticesInFace, Faces, VertexOneRing, OrientedVertices from Neighborhoods(M)

$$
\begin{aligned}
M &: \text{ TriangleMesh} \\
\bar{x}_i &\in \mathbb{R}^3 \text{ rest pos in 3D} \\
x_i &\in \mathbb{R}^2 \text{ current pos in 2D} \\
\varepsilon &\in \mathbb{R} \text{ eps} \\
psd &: \mathbb{R}^{p\times p} \rightarrow \mathbb{R}^{p\times p}, \text{ sparse} \\
infinity &: \mathbb{R}
\end{aligned}
$$

$$
\begin{aligned}
V, E, F &= ElementSets(M) \\
mr(f) &= \begin{bmatrix} br - ar & cr - ar \end{bmatrix} \\
&\text{where} \\
&\quad f \in F \\
&\quad a, b, c = OrientedVertices(f) \\
&\quad n = (\bar{x}_b - \bar{x}_a) \times (\bar{x}_c - \bar{x}_a) \\
&\quad b1 = \frac{\bar{x}_b - \bar{x}_a}{\|\bar{x}_b - \bar{x}_a\|} \\
&\quad b2 = \frac{n \times b1}{\|n \times b1\|} \\
&\quad ar = \begin{pmatrix} 0 \\ 0 \end{pmatrix} \\
&\quad br = \begin{pmatrix} (\bar{x}_b - \bar{x}_a) \cdot b1 \\ 0 \end{pmatrix} \\
&\quad cr = \begin{pmatrix} (\bar{x}_c - \bar{x}_a) \cdot b1 \\ (\bar{x}_c - \bar{x}_a) \cdot b2 \end{pmatrix} \\
S(f, x) &= \begin{cases} infinity & \text{if } |m| <= 0 \\ A\ \left(\|\mathcal{J}\|^2 + \|\mathcal{J}^{-1}\|^2\right) & \text{otherwise} \end{cases} \\
&\text{where} \\
&\quad f \in F \\
&\quad x_i \in \mathbb{R}^2 \\
&\quad a, b, c = OrientedVertices(f) \\
&\quad m = \begin{bmatrix} x_b - x_a & x_c - x_a \end{bmatrix} \\
&\quad A = \frac{1}{2}\ |mr(f)| \\
&\quad \mathcal{J} = m\ \ mr(f)^{-1} \\
e &= \sum_{i \in F} S(i, x) \\
H &= \sum_{i \in F} psd\left(\frac{\partial^2 S(i, x)}{\partial x^2}\right) \\
G &= \frac{\partial e}{\partial x}
\end{aligned}
$$