ElementSets from MeshConnectivity

VertexOneRing from TetrahderonNeighborhoods(M)

$$
\begin{aligned}
M &: \text{ TetrahedralMesh} \\
x_i &\in \mathbb{R}^3 \text{ original positions} \\
m &\in \mathbb{R} \text{ mass} \\
\mathit{damping} &\in \mathbb{R} \text{ damping} \\
K &\in \mathbb{R} \text{ stiffness} \\
\Delta t &\in \mathbb{R} \text{ step size} \\
\mathit{bottom} &\in \mathbb{R} \text{ ground height}
\end{aligned}
$$

$$V, E, F, T = \mathit{ElementSets}(M)$$

$$e(i,j) = \|x_i - x_j\| \text{ where } i, j \in V$$

$$\mathit{ComputeInternalForces}(i, v, p) = \mathit{tuple}(\tilde{v}, f + \begin{pmatrix} 0.0 \\ -98.0 \\ 0.0 \end{pmatrix})$$

where

$$
\begin{aligned}
i &\in V \\
v_i &\in \mathbb{R}^3 \\
p_i &\in \mathbb{R}^3 \\
f &= \sum_{j \in \mathit{VertexOneRing}(i)} (-K)(\|d\| - e(i,j))\vec{d} \qquad \text{where } d = p_i - p_j, \vec{d} = \frac{d}{\|d\|} \\
\tilde{v} &= v_i e^{-\Delta t \mathit{damping}} + \Delta t f
\end{aligned}
$$

$$\mathit{ApplyForces}(i, v, f, p) = \mathit{tuple}(\tilde{v}, \tilde{x})$$

where

$$
\begin{aligned}
i &\in V \\
v_i &\in \mathbb{R}^3 \\
f_i &\in \mathbb{R}^3 \\
p_i &\in \mathbb{R}^3 \\
a &= \frac{f_i}{m} \\
\tilde{v} &= v_i + a\Delta t \\
\tilde{v} &= \begin{cases} \begin{pmatrix} 0 \\ -\tilde{v}_2 \\ 0 \end{pmatrix} & \text{if } p_{i,2} < \mathit{bottom} \\ \tilde{v} & \text{otherwise} \end{cases} \\
\tilde{p} &= \begin{cases} \begin{pmatrix} p_{i,1} \\ \mathit{bottom} \\ p_{i,3} \end{pmatrix} & \text{if } p_{i,2} < \mathit{bottom} \\ p_i & \text{otherwise} \end{cases} \\
\tilde{x} &= \tilde{p} + \tilde{v}\Delta t
\end{aligned}
$$