Particle System based on Eikonal Solver

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So far...

Eikonal solver for unstructured triangle meshes:

Only local connection information available... no natural, global ordering

Use seed points

Update each vertex based on the speed of its 1-ring adjacent faces (local solver)

Goal: To get \( T_c = f(\alpha) \)

\[
\begin{align*}
D &= \alpha(B - A) \\
T_D &= \alpha(T_B - T_A) \\
\Delta T &= |CD| \ast s(ABC)
\end{align*}
\]

\[
\begin{align*}
T_C &= T_D + \Delta T \\
T_C &= \alpha(T_B - T_A) + |CD| \ast s(ABC)
\end{align*}
\]

\[
T_C = \alpha(T_B - T_A) + |C - \alpha(B - A)| \ast s(ABC)
\]

... it works, it works!
Problems...

Vertex ordering:
mixed ordering of vertices – trouble! (trimesh::across_edge does strange things)
re-orient mesh to get consistent ordering

Obtuse angles:
recursively flip edges to split face into non-obtuse triangles

old face: ABC
new faces: \{ABE, EBD, DBC\}
Applications

Particle systems*

LiveWire segmentation**

* work in progress with Ross Whitaker and Josh Cates

**Source: Livewire Segmentation Technique - Wikipedia
Particle System

Pre-compute distances using local solver:

... not the best representation, but we'll live with it for now!
Particle System

Vertex based greedy scheme to move particles on surface
Iterate to find location such that energy of particle pair is minimized
Here, energy is inverse-distance-square

... preliminary scheme works :)

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... preliminary scheme works :)
Particle System

Can extend previous scheme to multiple particle-pairs to populate the surface

... but this isn't a representative system yet!
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... but this isn't a representative system yet!
Next steps...

Extend greedy scheme from current particle-pair configuration
- will need to solve a system at each iteration
Introduce anisotropic speed function (include curvature ?)

Further on...

Move away from existing vertices to 'real' particles
Investigate other update schemes (centroidal voronoi diagrams)

... will get there eventually !

