A Fast and Efficient Projection-Based Approach for Surface Reconstruction

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Outline

- Algorithm Overview
  - Algorithm Parameters
  - Terminology
  - Point Pruning
  - Triangulation
- Demo

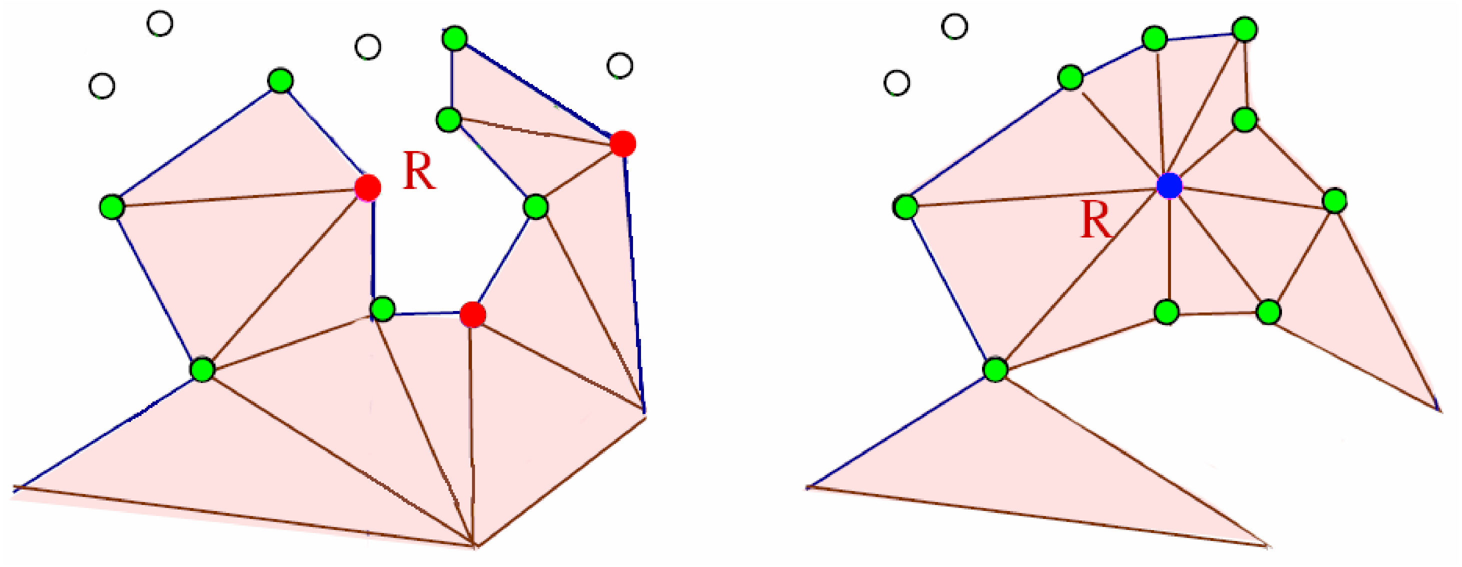
Algorithm Parameters

- *μ*, which quantifies a definition of *locally uniform sampling*
  - Let m be the minimum distance from any given point R to its neighbors
  - The farthest neighbor of R can be at most *μ*m away
- *α* is a large obtuse angle. Normally, we set *α* to be 120º
- *β* (optional) is a minimum angle parameter

Terminology

- We categorize the data points at any given stage of the algorithm as
  - *Free.* Free points have no incident triangles
  - *Reference.* Reference point is a point being processed
  - *Completed.* Completed points have all their incident triangles determined
  - *Boundary.* Boundary points have been chosen for triangulation but have some missing triangles due to the maximum allowable angle parameter α
  - *Fringe.* Fringe points have not yet been chosen

Example



- Two invariants during algorithm’s execution
  - No *free*, *fringe* or *boundary* point can be in the interior of a triangle
  - At the end of each iteration, the reference point becomes a *completed* or a *boundary* point

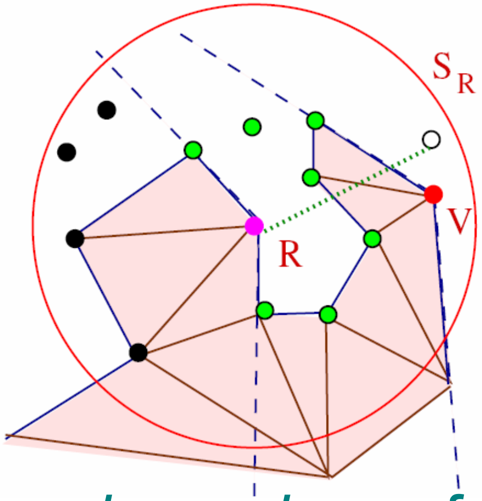
Point Pruning

- *dexel:* Orthographically projecting the data points onto the *dexel* data structure
- KD-Tree
- Find all neighbors (of the reference point R) residing inside a sphere of radius μm, where m is the minimum distance from R to its neighbors
- We call the sphere of radius μm centered at R as the *sphere of influence* (SR) around R

Point Pruning (Cont.)

- Find the tangent plane of R by computing the normal from its neighbors
  - Eigen vector of the covariance matrix
  - Average normals of existing triangles incident (an alternate cheaper approach)
- Project R and its neighbors on this plane
- Use the *projected* R as an origin of the plane and order the neighbors by the angle around R

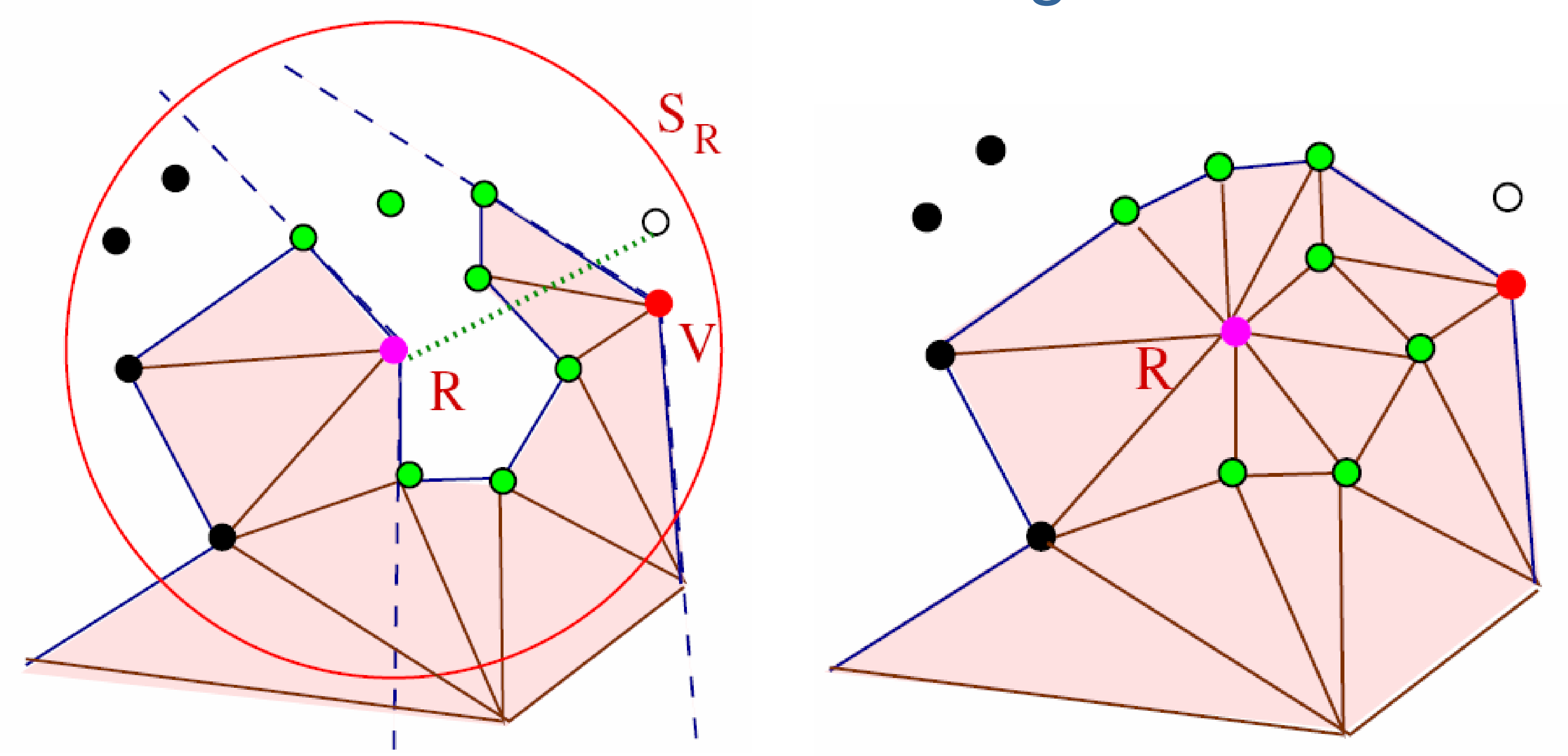
Triangulation



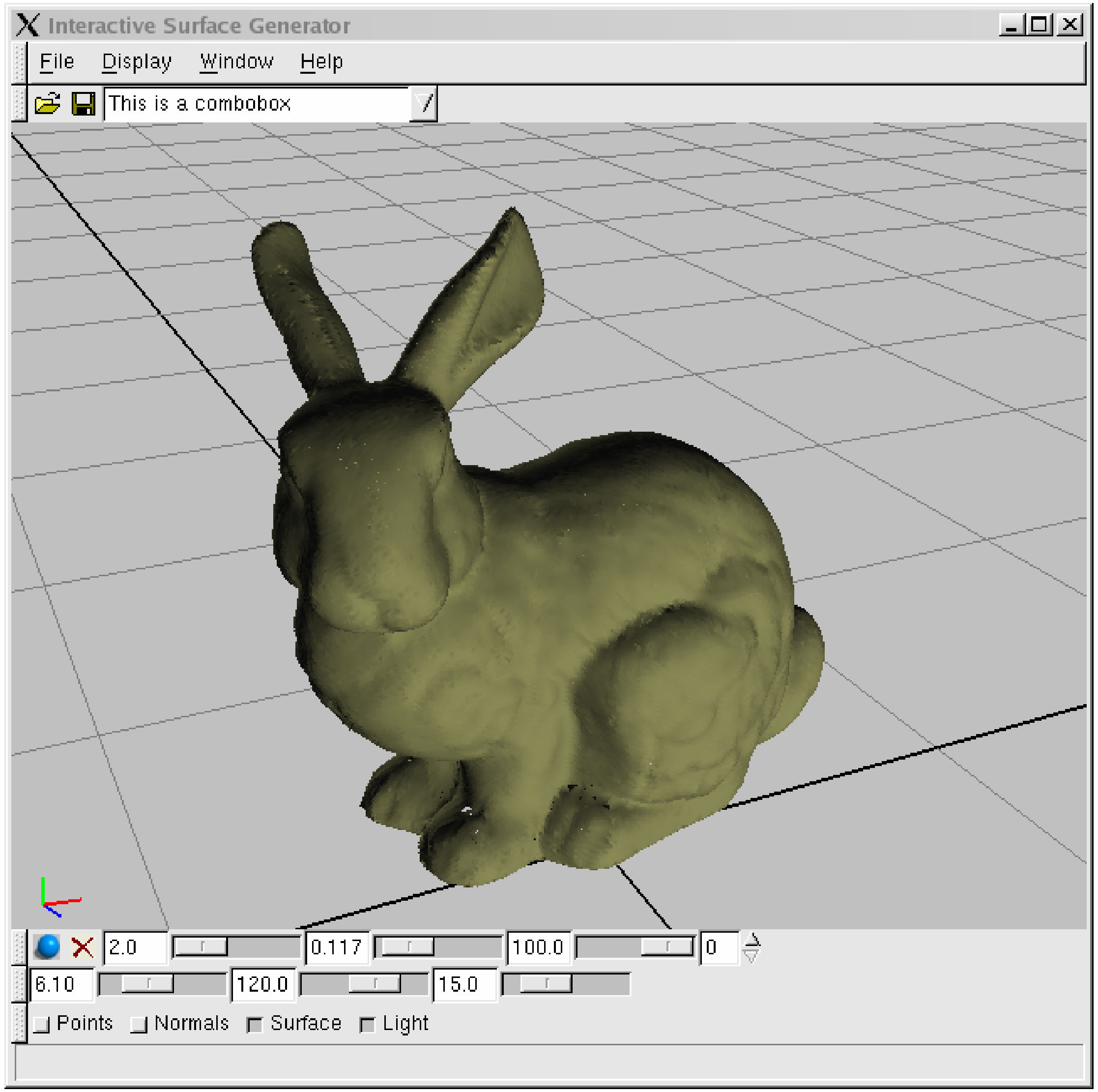
- Points occluded from R are determined as follows
  - All the points between consecutive *boundary edges* of R are removed as they cannot be visible from R (for example, the black points)
  - Similarly, points are removed which have R in their invisible region (for example, point V)
  - Finally, we eliminate points that are occluded from R because of an existing edge in the mesh (for example, the white point)

Triangulation (Cont.)

- The remaining points are connected in order around R to complete the triangulation



Demo



Interactive Surface Generator
File
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Help
This is a combobox
2.0
0.117
100.0
0
6.10
120.0
15.0
□ Points
□ Normals
☑ Surface
☑ Light