

A Tutorial on Volumetric Model Inner Distances (VMID)

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VMID implements an algorithm for Volumetric Model Inner Distances (ID) using visibility graph. The inner distance is defined as the length of the shortest path between landmark points within the shape boundary surface.

Availability

The binary executable program for Windows platform and tested database are available from <https://engineering.purdue.edu/PRECISE/VMID> .

System Requirements

Source code was written to perform computing the inner distance of a volume model, as well as visualizing the results.

The code was developed and tested using Microsoft Visual C++ 2005 on a Windows XP system.

REQUIRED INSTALLATIONS:

- Microsoft Visual C++ 2005
- MICROSOFT FOUNDATION CLASS (MFC) LIBRARY
- OpenGL

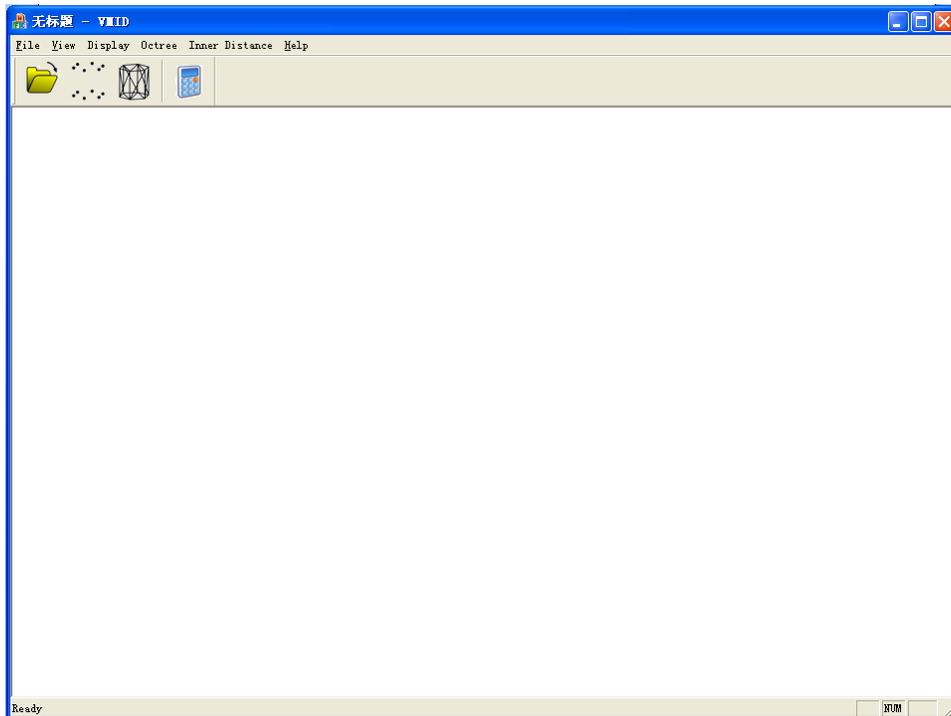
Data set

For showing how our algorithm works, we provided some examples. The full database and source code can be requested. The users can also convert the polygonal formats into volumetric forms (SOF/MRC) using the PolyMender software.

See <http://www.cs.wustl.edu/~taoju/code/polymender.htm>

Operation

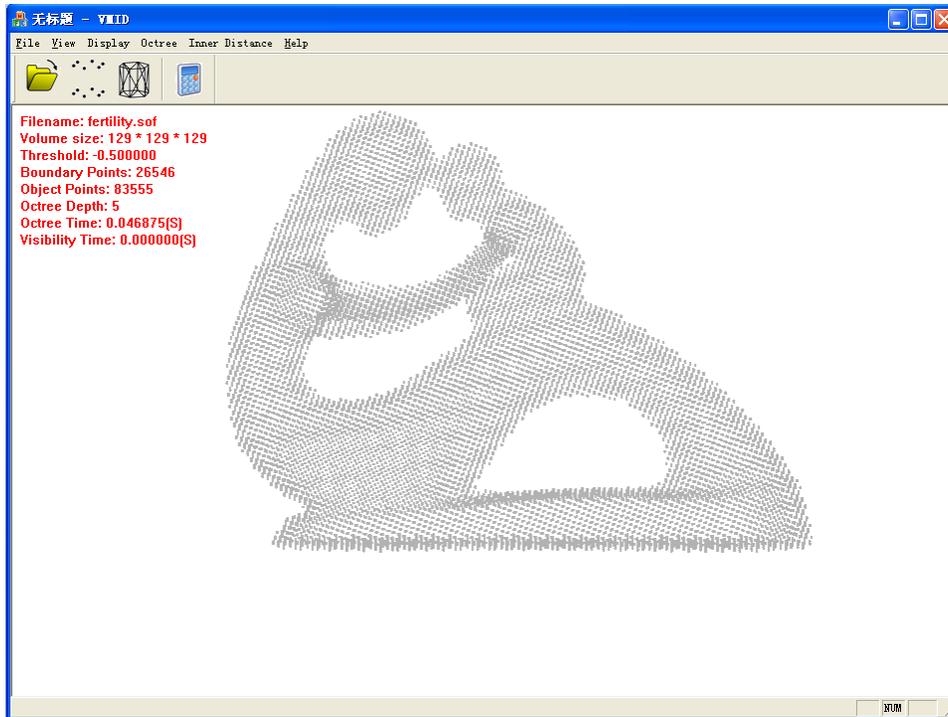
1. Execute VMID.exe



2. Open a SOF/MRC file.

Menu: File → Open.

Or click the button  for opening a SOF/MRC file.
For example, open a SOF file '**fertility.sof**' attached.



The left-top text shows the input model information as follows:

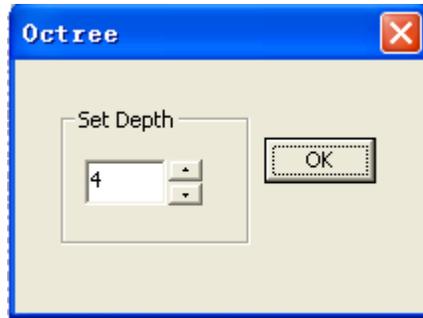
Filename: fertility.sof
Volume size: 129 * 129 * 129
Threshold: -0.500000
Boundary Points: 26546
Object Points: 83555
Octree Depth: 5
Octree Time: 0.515625(S)
Visibility Time: 0.000000(S)

where '**Filename**' is the input SOF/MRC file name, '**Volume size**' is the size of input volume model, and '**Threshold**' is the threshold of density map, '**Boundary Points**' is the number of boundary points of the input model, '**Object Points**' is the number of all points of the input model, '**Octree Depth**' is the depth of octree, '**Octree Time**' is the time to construct an octree, '**Visibility Time**' is the time of checking the visibility of all sample point pairs.

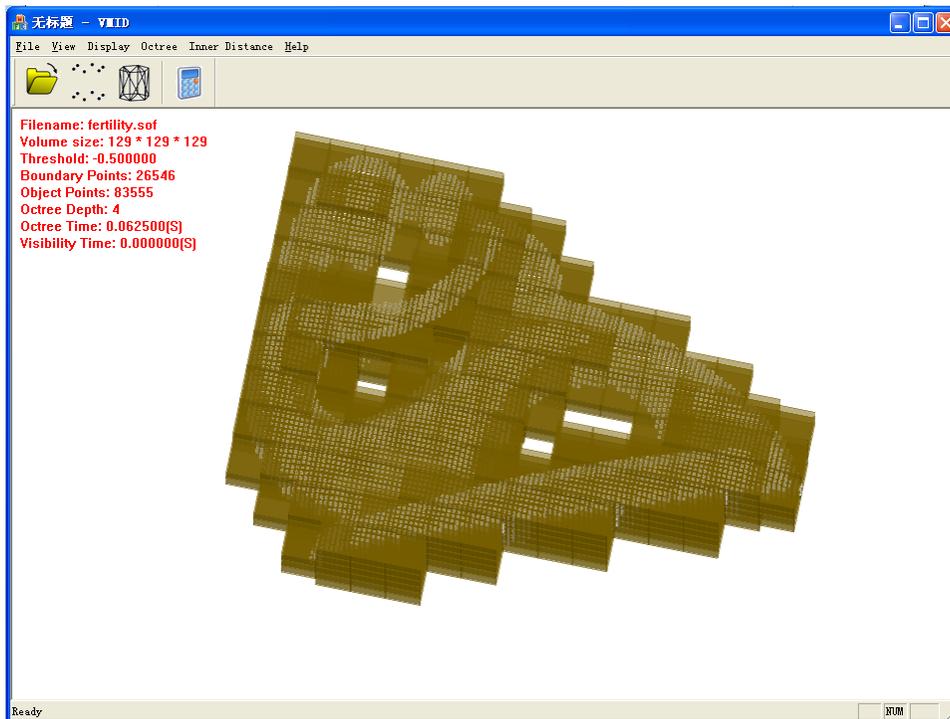
3. Construct an Octree.

This algorithm uses an Octree to accelerate computation. In default, we construct an octree at depth 5. We can also reconstruct an octree with different depth by clicking Menu: Octree→SetOctree.

After clicking it, the following dialog box appears with one extra parameters: '**Set depth**' for setting the depth.



After click 'OK', finish Octree construction. Then, we will see that the constructed octree.



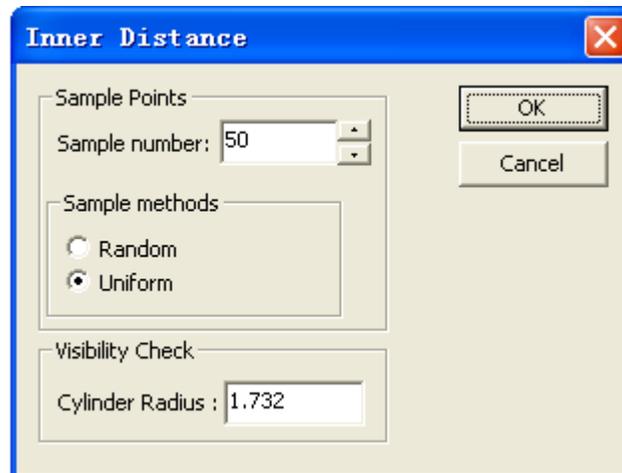
Menu: Display→Show Octree: show/hide the octree.

4. Compute the inner distance of a model

Menu: Inner Distance → **Compute Inner Distance**,

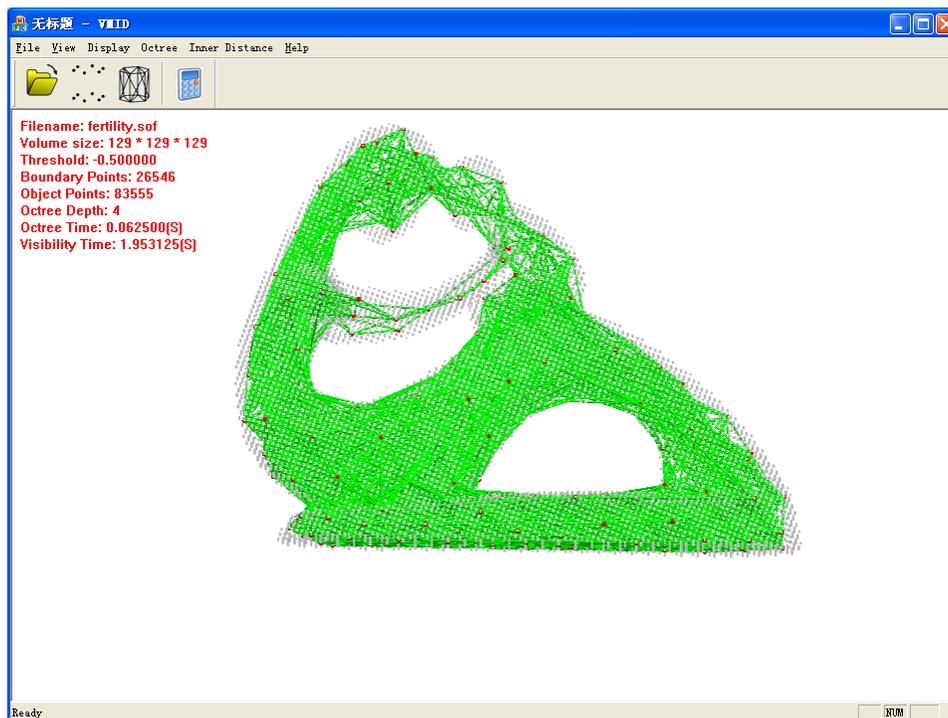
Or click the button  for computing the inner distance.

After choosing '**Compute Inner Distance**', the following dialog box appears with three extra parameters: (a) '**Sample number**' is the number of sample points and (b) '**Sample methods**' contain '**Random**' and '**Uniform**'. (c) '**Cylinder radius**' is the radius of the cylinder for obtaining sufficient intersection points and less time. The default radius value is chosen as 1.732.



Note: VMID computes all inner distances between all sample point pairs. We suggest you choose a small number, such as 20~100 for showing the fast demo. We have pre-computed the descriptors of all models in the database with 500 sample points using a console program.

After click 'OK', finish the **Inner Distance** computation.



Note: the red points are the sample points and the green lines are inner distances between all sample point pairs.

5. Mouse:

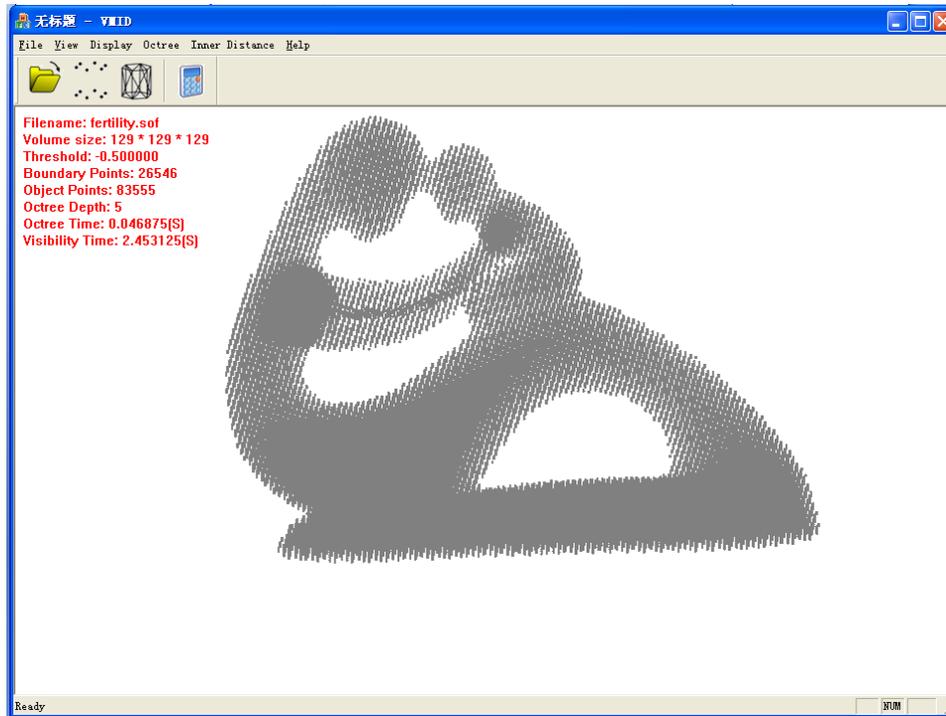
Left: Rotation

Right: Zoom in/out

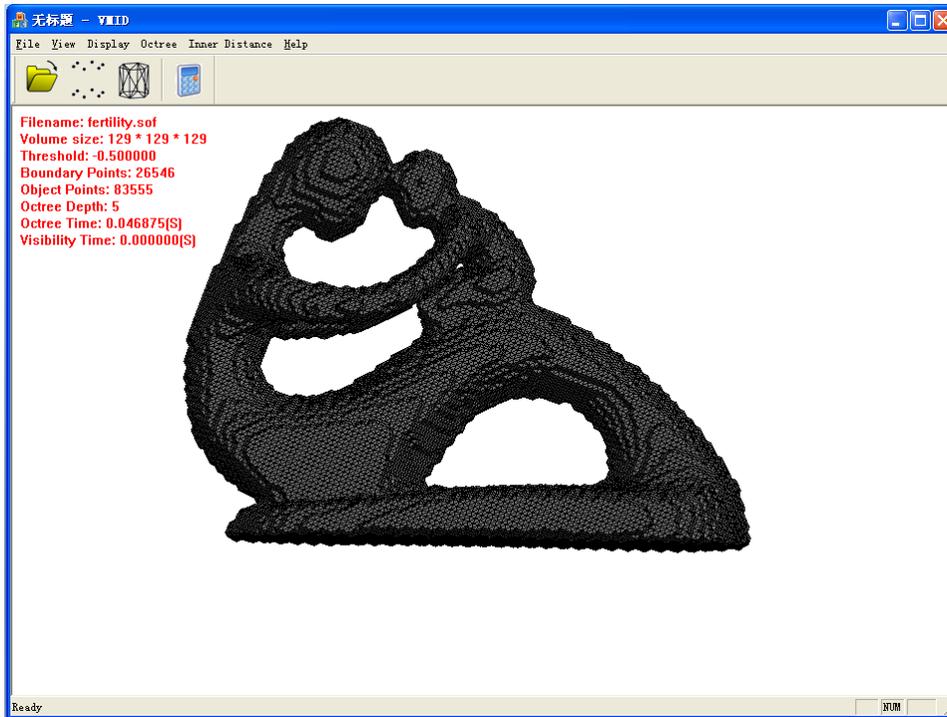
6. Menu → Display for assistant displaying

For example: Menu → Display → Border Points: show border points of volume (default).

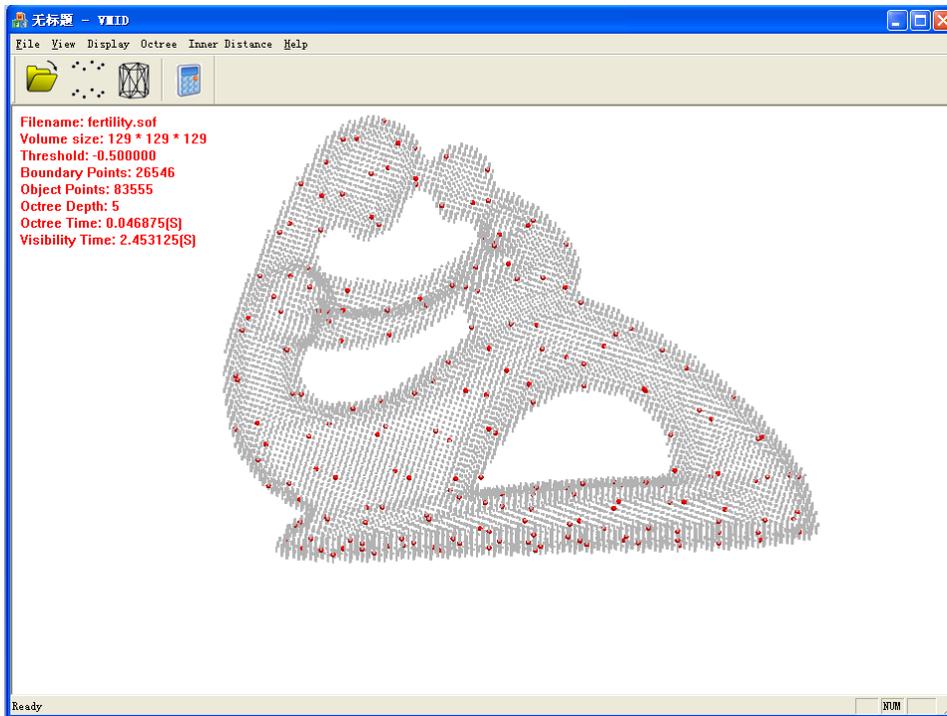
Menu → Display → Full Points: show full points including border and inside points.



Menu: Display → Iso-surface: show the iso-surface of volume based on the Marching Cube algorithm.



Menu: Display→Sample Points or click the button  : show/hide the Sample Points.



Menu: Display→Line Visibility or click the button  : show/hide the Inner Distance.

