Compare mesher

2017 年 5 月 8 日

Implicit surface meshing

Marching Cubes algorithm

Delaunay based implicit surface meshing

Experiment

This experiment compared the running time of different meshing algorithms that applied mesh algorithm used sphere of 174 vertices, 344 faces. When sphere is input, we create sphere with different resolution using marching cube. This can create spheres with different number of vertices and different number of faces. As the marching cube grid size increases, the number of vertices increases, so we use it to create spheres with different vertices. The mesh algorithm with different number of vertices. Our Delaunay is a Delaunay algorithm that based on CGAL. CGAL Delaunay meshes to the whole of the object. Our Delaunay is trying to speed up by detecting only the surface of the object and meshing it. The number of vertices and the number of faces in the marching cube of closed approximation hrbf may increase, but the execution time is not affected. The reason is that the spline is compact. There is no effect on execution time, because the function on the regular grid in the marching cube. CGAL Delaunay has increased the number of vertices and the number of faces. CGAL Delaunay is adding samples based on some condition

number of vertices: 480
number of faces: 956
Marching cube grid resolution: 16^3
Closed-form approximation hrbf

Mesh algoritms	Marching cube	Our Delaunay	CGAL Delaunay
Time[ms]	40	30	4936
Number of vertices and faces after mesh	552, 1096	480, 954	2102, 4196

Poisson

Mesh algoritms	Marching cube	Our Delaunay	CGAL Delaunay
Time[ms]	7	25	1034
Number of vertices and faces after mesh	480, 956	480, 930	1719, 3434

number of vertices: 1992

number of faces: 3980

Marching cube grid resolution: 32^3

Closed-form approximation hrbf

Mesh algoritms	Marching cube	Our Delaunay	CGAL Delaunay
Time[ms]	646	80	21669
Number of vertices and faces after mesh	2736, 5464	1992, 3970	4769, 9530

Poisson

Mesh algoritms	Marching cube	Our Delaunay	CGAL Delaunay
Time[ms]	40	87	2118
Number of vertices and faces after mesh	2004, 4004	1992, 3628	3887, 7766

number of vertices: 8376

number of faces: 16748

Marching cube grid resolution: 64^3

Closed-form approximation hrbf

Mesh algoritms	Marching cube	Our Delaunay	CGAL Delaunay
Time[ms]	24407	360	622310
Number of vertices and faces after mesh	13944, 27880	8376, 16754	21143, 42274

Poisson

Mesh algoritms	Marching cube	Our Delaunay	CGAL Delaunay
Time[ms]	221	256	16276
Number of vertices and faces after mesh	8378, 16752	8376, 14665	20876, 41748

number of vertices: 33696

number of faces: 67388

Marching cube grid resolution: 128^3

Poisson

number of vertices: 136224

number of faces: 272444

Mesh algoritms	Marching cube	Our Delaunay	CGAL Delaunay
Time[ms]	1332	1133	73303
Number of vertices and faces after mesh	33696, 67388	33696, 55877	76641, 153278

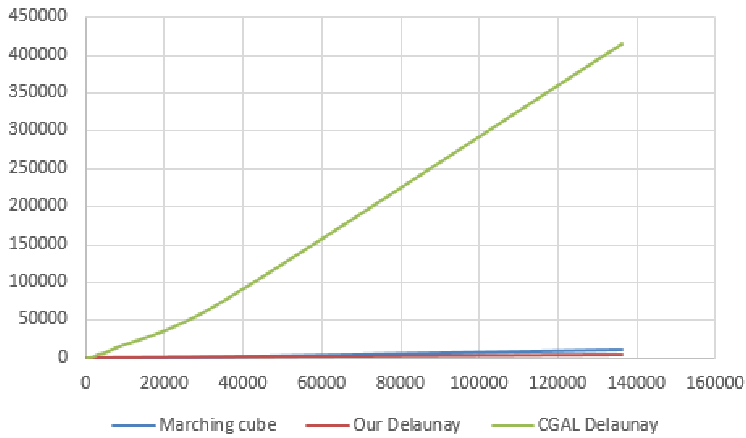
Marching cube grid resolution: 256^3

Poisson

Mesh algoritms	Marching cube	Our Delaunay	CGAL Delaunay
Time[ms]	9763	3695	408205
Number of vertices and faces after mesh	136222, 272440	136224, 185169	343567, 686970

Graph showing time complexity for meshing algorithms.
The horizontal axis represents vertices and the vertical axis represents time in this graph.
Used reconstruction algorithm is Poisson.

Marching cube, Our Delaunay and CGAL Delaunay time



Poisson surface reconstruction algorithm is O(log v) where v is the number of points in the input point-cloud. Marching cube time complexity is $O(n^3 logv)$. n is grid resolution. When the number of vertices is small, it is faster than other meshers. The more vertices the more it will take more time.

Our Delaunay's time complexity is $O(v^2 logv)$. However, A paper of Attali and Boissonnat suggests that the time complexity in Delaunay triangulation is linear when points are sampled in 3D on the surface of the object. Thus, we should expect in practice a complexity of O(v log v). When the number of vertices is small, it is slower than the Marching cube, but as the number of points increases, it becomes the fastest meshing algorithm.

Time complexity is $O(V^3)$. CGAL Delaunay is adding samples based on some condition. The increase in time when the number of vertices is increased is large, this was the slowest algorithm.

Conclusion

Our Delaunay based implicit surface mesher is the fastest. If the number of vertices a few, it will not be a problem even with Marching Cube, but as the number of vertices increases, it is faster to use our Delaunay.