NPM3D : TP1 Report : Basic operations and structures on point clouds

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1 A. Point clouds manipulations

1.1 Question 1

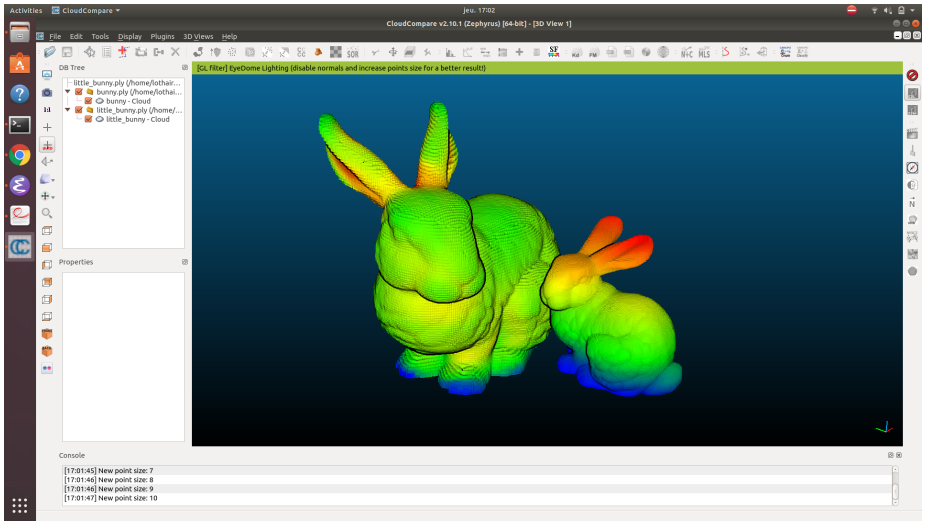

Figure 1: Transformed bunny

2 B. Structures and Neighborhoods

2.1 a. The concept of neighborhoods

2.1.1 Question 2

First method : 10 queries with brute force KNN (k=1000) took 221 seconds. Computing the neighborhood of the whole point cloud with KNN on my computer would take 18649 hours which is about 2,2 years.

Second method : 10 queries with spherical neighborhood (20cm radius) took 256 seconds. Computing the neighborhood of the whole point cloud with this method on my computer would take 21599 hours which is about 2,6 years.

2.2 b. Hierarchical structures

2.2.1 Question 3

Intuitively, the optimal leaf size is not one because this would mean that each leaf contains one point, thus, in order to compute the distance between pairs of points, we would need to run through the tree a lot of time, which is not what we want. If N is the number of neighbors we want then a good leaf size would be around N. For a radius of 20cm, we found the best leaf size to be 67.

2.2.2 Question 4

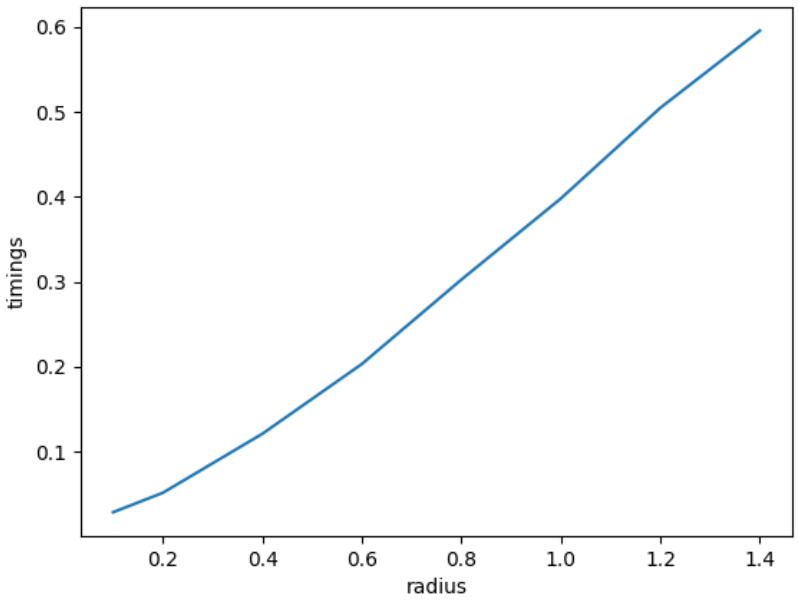

Figure 2: Timings as function of Radius

here the leaf size is 67, which was the optimal one we computed for a radius of 20cm. We can see that the time to compute the neighborhood is growing linearly in function of the radius, it would be better to find an appropriate leaf size for a given radius.

On my computer, it would take 168 seconds to compute the neighborhoods of the whole cloud point with an optimal leaf size of 67.

3 C. Sub-sampling methods

3.1 Question 5

Decimation has the advantage of being extremely fast, even instantaneous in our case, and due to the massive amount of points, this form of random sub-sampling can keep enough points to keep the original shape, however being a rough approximation. Grid sub sampling and Colored Grid sub-sampling took respectively 17 and 23 seconds on our setup. However the result is much smoother and closer to reality. Choosing between the two approaches is a dilemma between time efficiency, and quality/smoothness.

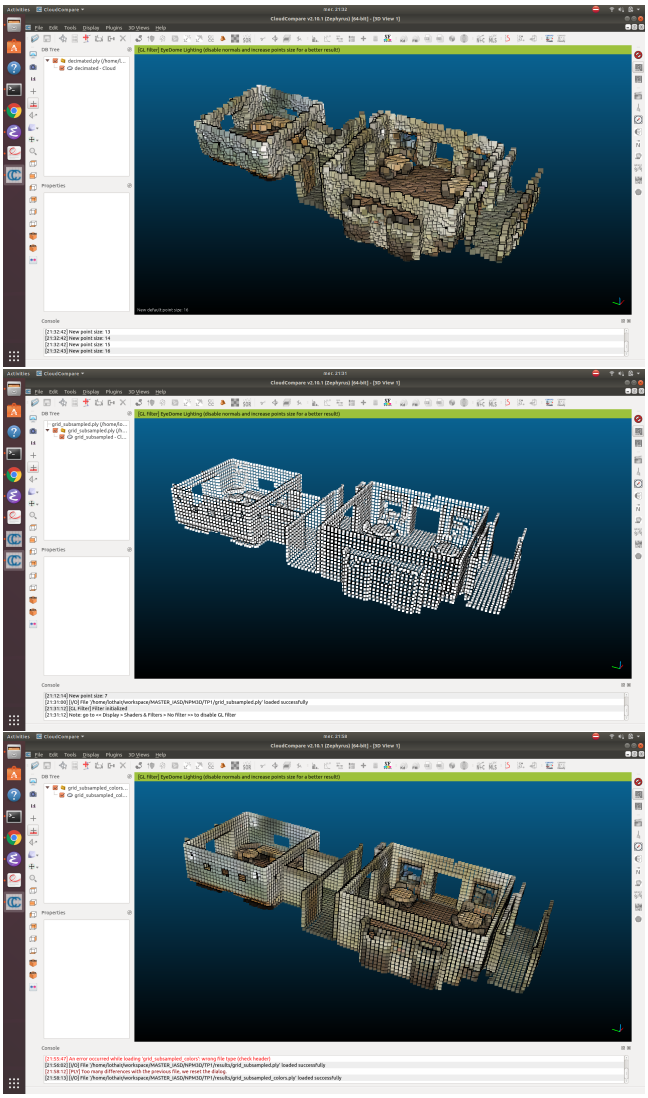

Figure 3: Visualization of three alternative methods for sub-sampling : Decimation, Grid sub-sampling and Colored grid sub-sampling, respectively.