TP 3: Neighborhood descriptor - MVA 2023/2024

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February 1, 2024

1 Normals in CloudCompare

1.1 Question 1

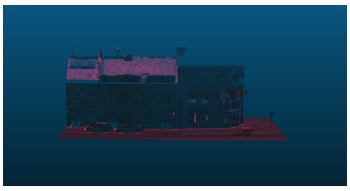

Figure 1: Step 1

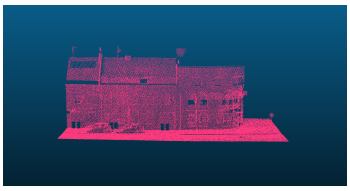

Figure 2: Step 2

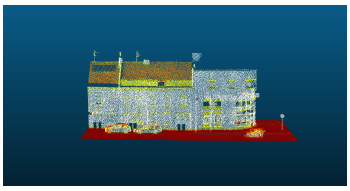

Figure 3: Step 3

Here are the results obtained for a radius of 0.5m

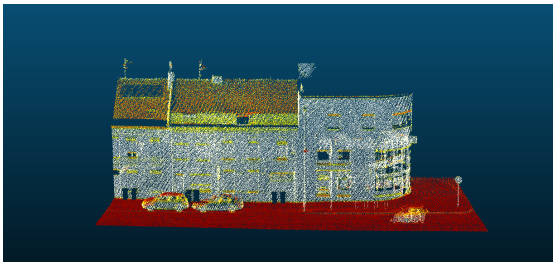

Figure 4: For a radius of 0.2m

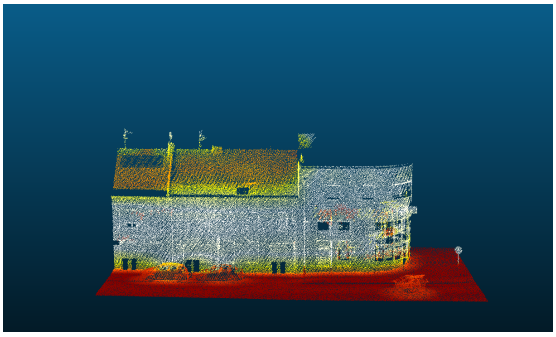

Figure 5: For a radius of 2m

Increasing the radius for normal calculation allows for more points to be averaged. This can be beneficial in reducing noise and making the normal estimation more robust. The

drawback, is that we violate the assumption that the surface is locally planar. Here we have average out surface details. This leads to a representation that takes less details into account. Overall, the reults that we obtain is oversmoothed the normals does not accurately reflect the true surface variations for the small scaled features as we can see it for the car.

Reducing the reduce we have less points, this makes the effect of the noise bigger. However we conserve the assumption that the surface is locally planar. On the pictures that we have produced this translates with an accurate representation of the surface of the small scalled figures and some unaccurate surface representation at the level of the roof.

1.2 Question 2

One way of dealing with this question is to do a grid sampling. After that we follow that by setting the radius estimation on the basis on the grid's spacing

2 Local PCA and normal computation in Python

2.1 Question 2

```
(env_name) hanafisahbi@MacBook-Air-de-Hanafi TP3_Nuage % python3 descriptors.py
[ 5.2504982  21.78931443 89.58924194]
```

Figure 6: eigenvalues

2.1.1 Question 3

The last eigenvector should is expected to be normal of the surface.

2.2 Question 4

Look at Figure 7 above

2.3 Question 5

Look at Figure 8 above

With the KNN we were able to recover more elements and more accurately than with the radius PCA. One way to understant that is that some points in the cloud are sparse. Meaning that they have their closest neighbors at a distance that is bigger than the radius. This lead to a representation of the surface that is lacking. The usage of the KNN allows

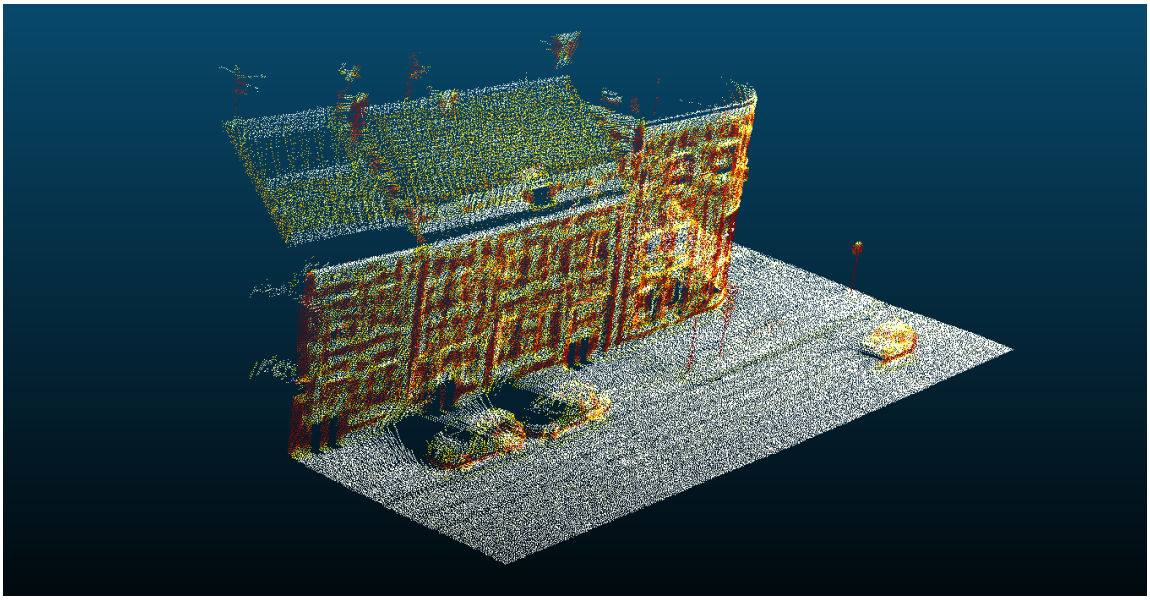

Figure 7: Small Lille street with a radius of 50cm

to adress this issue because even if a point is quiet far away we will still find its closest neighbor.

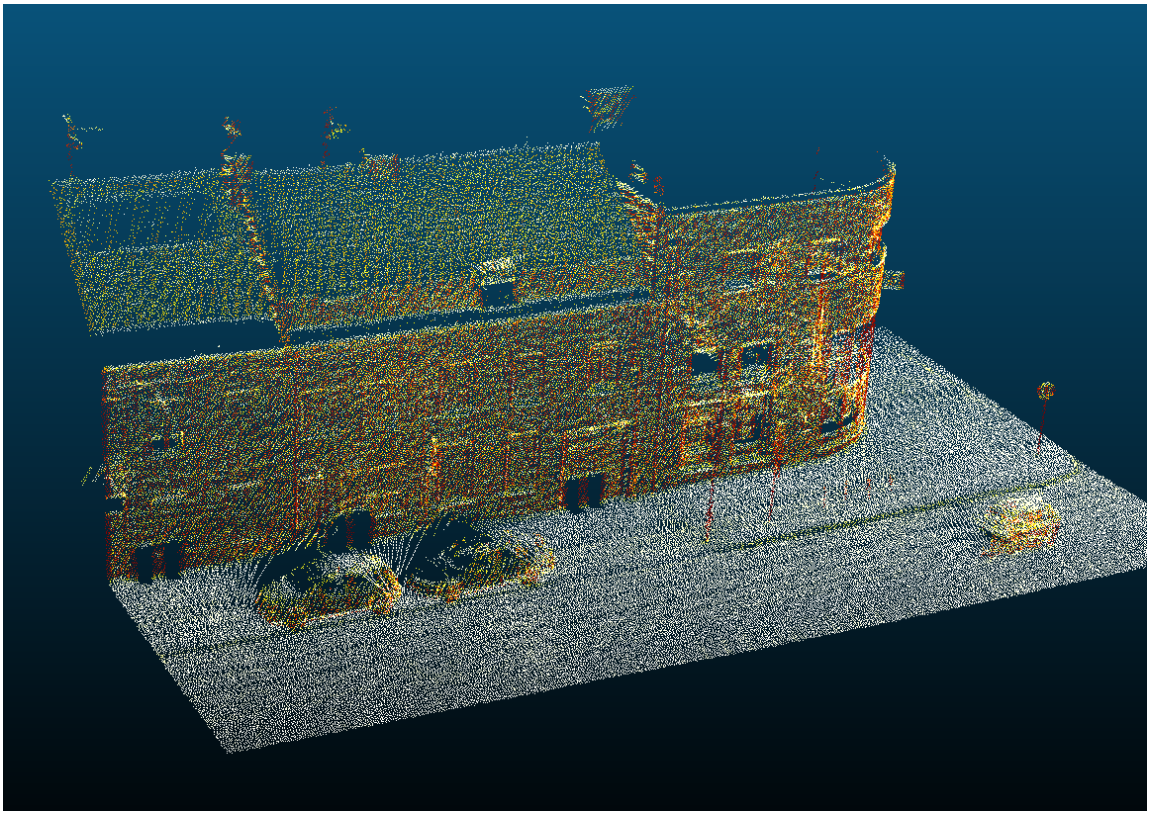

Figure 8: Small Lille street with the KNN to get the number of neighbours

3 Going Further

3.1 Question 3

verticality

- Blue would indicate normals that are more vertical.
- Red would indicate normals that are nearly horizontal.

Linearity (reflects how linear the structure is):

- Blue would indicate less linearity.
- Red would indicate a high degree of linearity.

Planarity (reflects how planar the structure is):

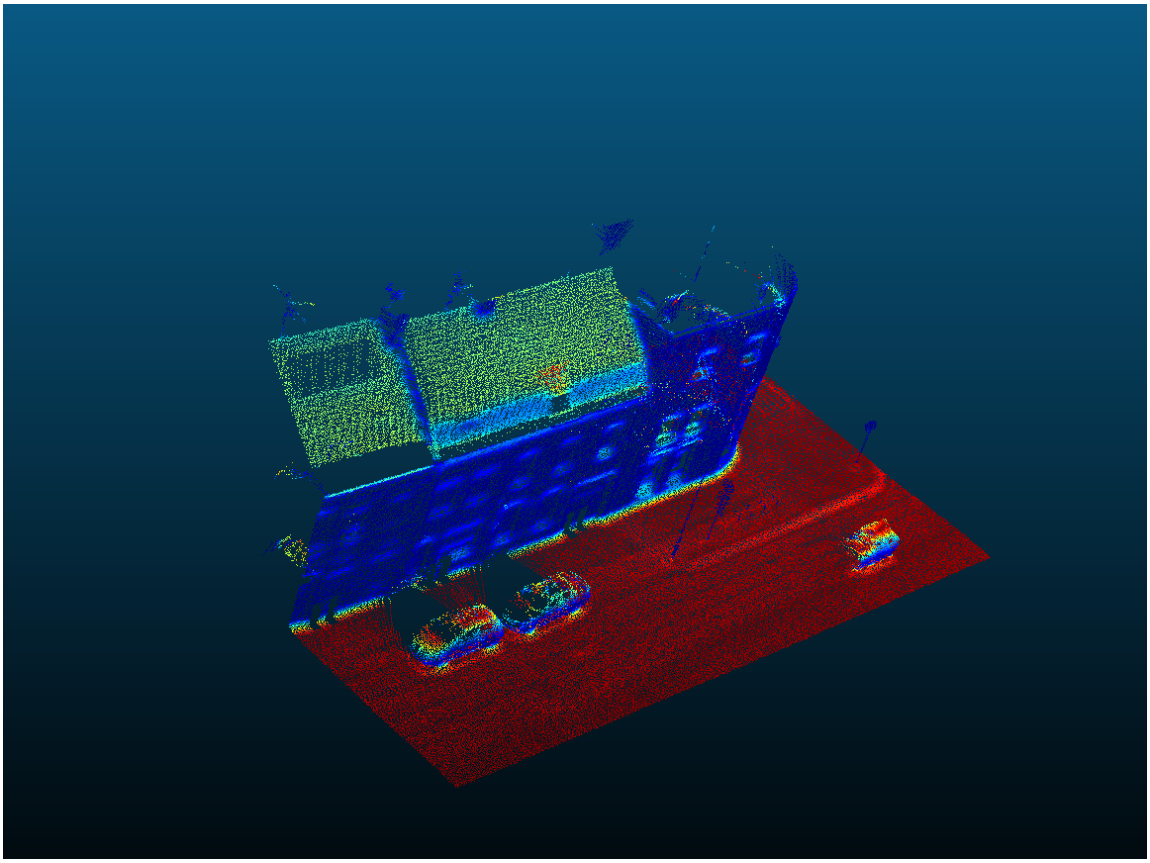

Figure 9: Representation of the Verticality field

- Blue would indicate less planarity.
- Red would indicate a high degree of planarity.

Sphericity (reflects how spherical or isotropic the structure is):

- Blue would indicate less sphericity.
- Red would indicate a high degree of sphericity.

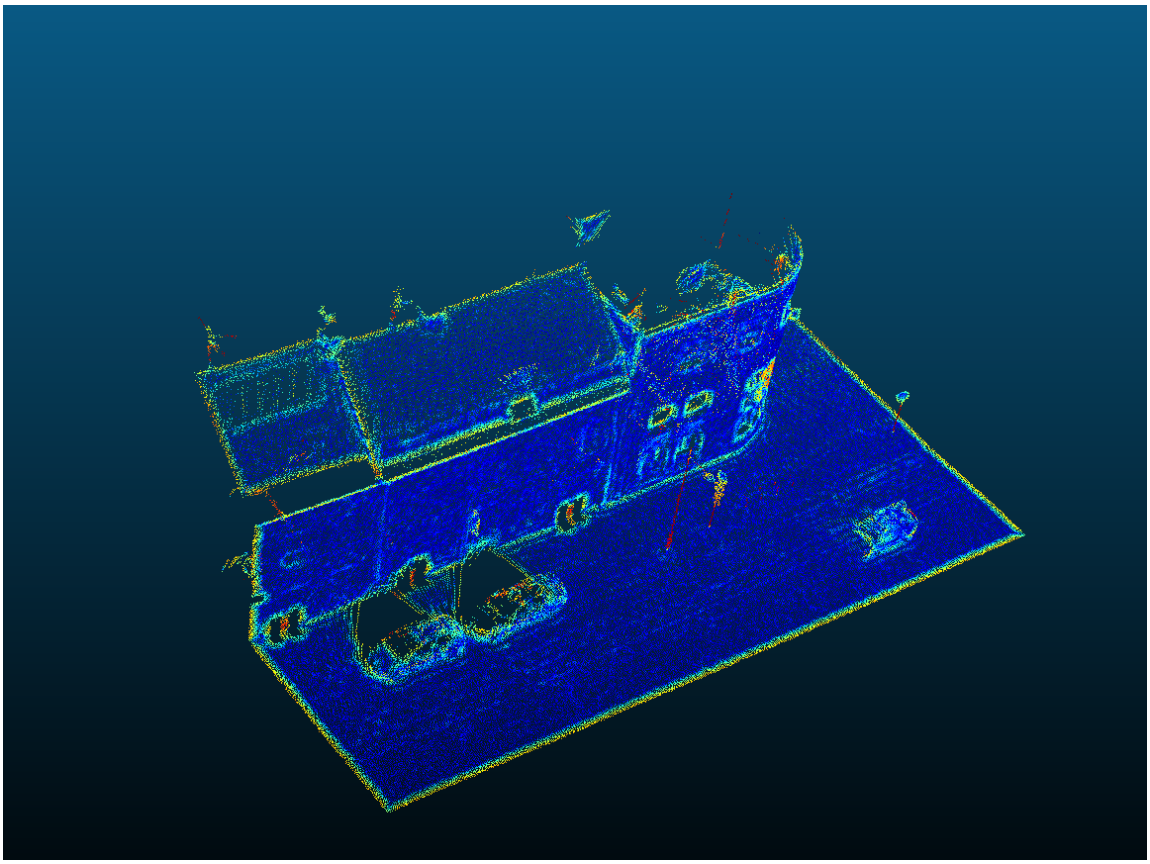

Figure 10: Representation of the linearity field

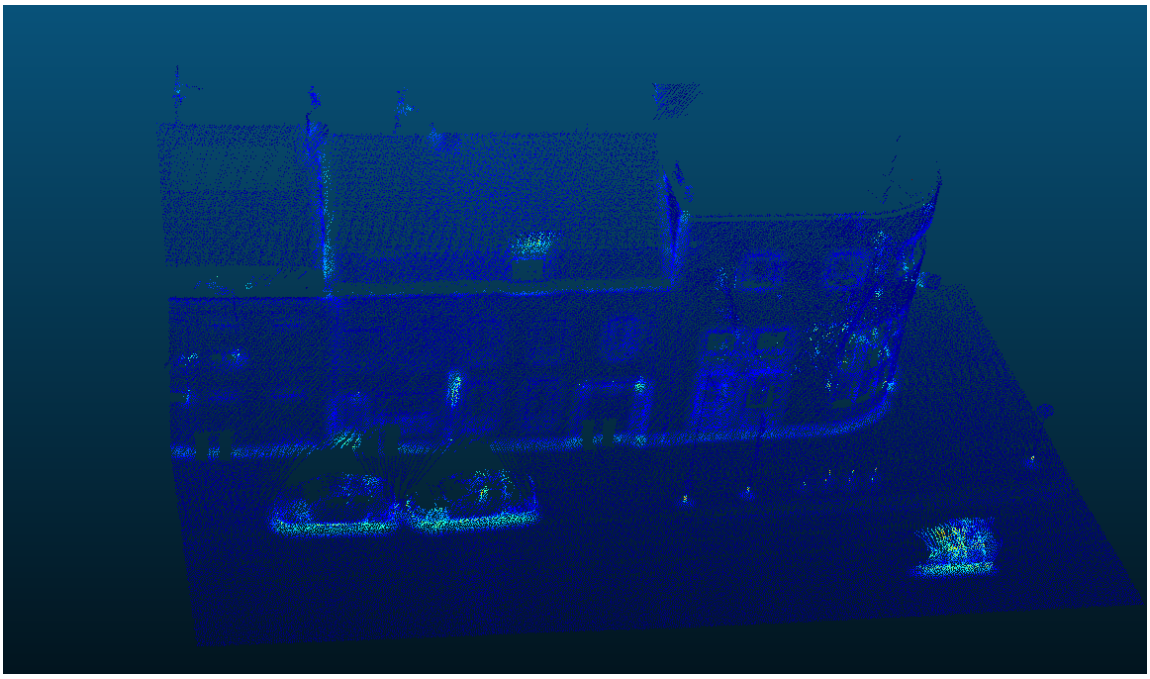

Figure 11: Representation of the Spheracity field

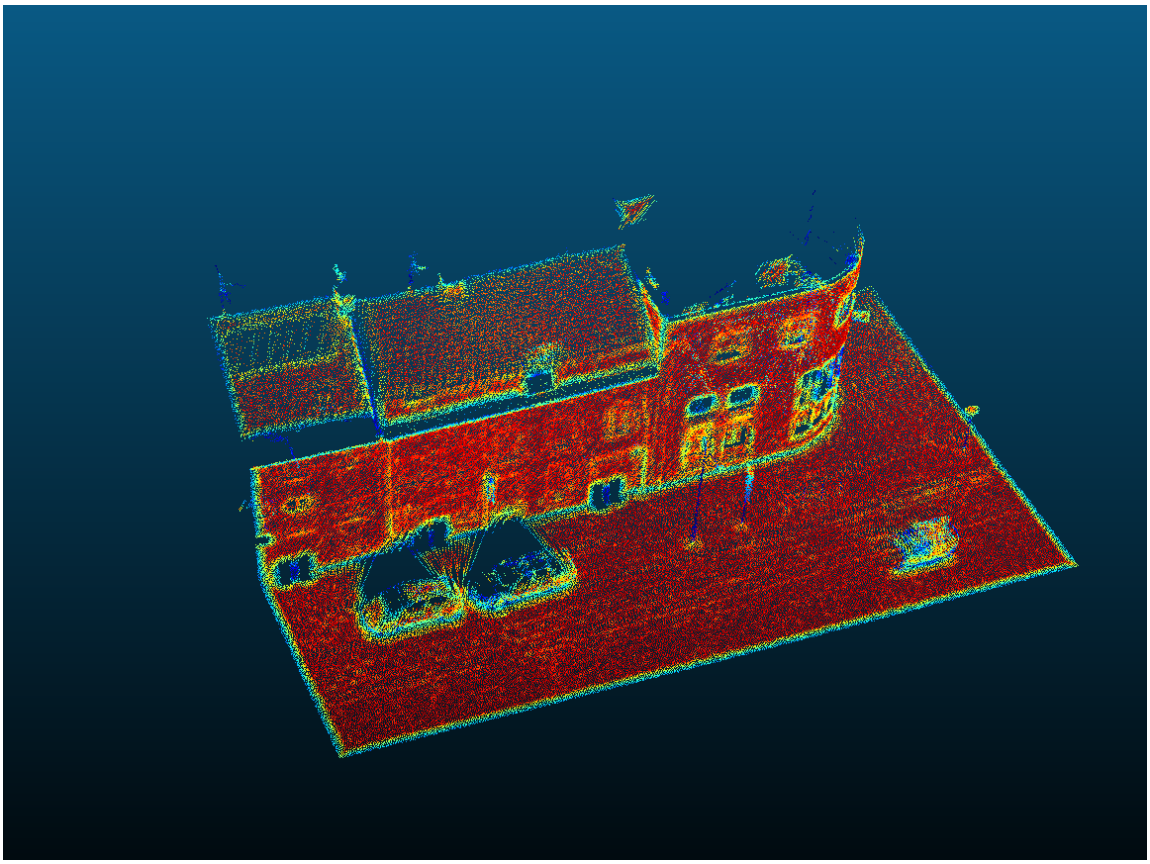

Figure 12: Representation of the Planiarity field