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| ENSTA Bretagne |
| UV5.4 Status Report |
| Pierre Jacquot – SPID/ROB |

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Summary

[Introduction 2](#_Toc443902007)

[Context 2](#_Toc443902008)

[1. Pre-processing 2](#_Toc443902009)

[1.2 Point Cloud Artifact 3](#_Toc443902010)

[References 4](#_Toc443902011)

[Figure 1 - Graphical representation of the different forms of point cloud artifacts (3) 4](#_Toc443904521)

# Introduction

Computers are constantly increasing in term of power, efficiency and capacity. This quick evolution allow us to manage more and more data at the same time. This ability to deal with a large amount of data permit now to deal with what we called cloud points. This cloud point are the results of laser scans, and basically contain the coordinates and sometimes the color of what the laser is scanning. This ability to represent our world using cloud points have many application. We can for example use this to recreate architectural site, or to recreate an environment in prevision of a future operation(1).

However when we talk about recreating a monument, or an object using data cloud, this also mean that we have to create a 3D version of this model. To do so we have to do a surface reconstruction of the object or monument. This surface reconstruction imply to link each point, in a logical way with each other in order to obtain an accurate 3D reproduction of the desired object.

As you can imagine such a task imply many pre-requisites. Among them we first need to understand how the 3D points cloud has been acquired, what king of object we want to reconstruct (an exterior, an interior, a simple object?). Linking a points cloud also need pre-treatment, so we can obtain the most accurate representation. We’ll therefore need to clear the cloud point of any noise or misplace points and simplify it if it contains too many points, so we can have a light mesh (a mesh is a collection of vertices, edges and faces that defines a shape (2). Here it will be the final 3D representation of the building we’re trying to recreate). Furthermore linking the points between them in not trivial as there is not necessary a right order to do it, and the computer certainly don’t know in advance which order will be the best. Therefore, the main goal of this status report is to find, describe and analyze the best methods to clean and reconstruct a cloud point.

# Context

This project is collaboration between les Phares et Balise (a department of le parc marin d’Iroise) and the ENSTA Bretagne. Les Phares et Balises are currently trying to put forward some of the lighthouses of the Finistère’s coast. These lighthouses are for most of them too far away from the coast and despite their strong cultural interest cannot be visited. To tackle this issue, les phares et balises have organized several laser scans of these lighthouses so that people could visit them. The main idea is to present a 3D representation of these lighthouses (focusing on the lighthouse of Kereon) during the Brest 2016 festival. As meshing a cloud point is not trivial they ask for the ENSTA Bretagne expertise to create a 3D mesh of the lighthouse of Kereon.

# 1. Pre-processing

As I mentioned before, meshing a cloud point require some pre-requisite such as treating the point cloud artifacts (3), find or/and reorganized the normal (4) and adapt your treatment to the class of shapes contained in the scene your trying to reconstruct.

## 1.2 Point Cloud Artifacts

Laser scanning an area often comes with many non-wanted features appearing in our input point cloud. These unwanted features are called artifacts. The most impactful on the surface reconstruction are: the sampling density, the noise, the outliers, the misalignment and the missing data. All of these artifacts will be explained in the next parts and I will give some solutions to clear the artifacts that are currently present in the cloud point I’m working with.

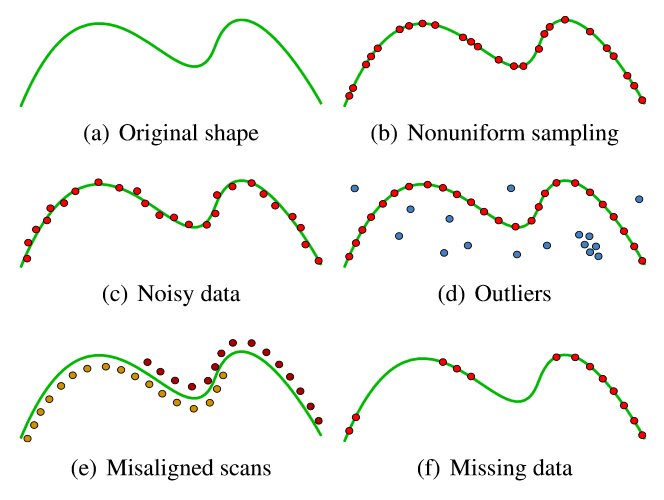


Figure 1 - Graphical representation of the different forms of point cloud artifacts (3)

# References

1. **Bey, Aurélien.** *CNRS.* [En ligne] 25 Juin 2012. http://liris.cnrs.fr/~rchaine/EDF\_A\_BEY/These-Aurelien-Bey.pdf.

2. **Wikipedia The Free Encyclopedia.** Polygon Mesh. [En ligne] https://en.wikipedia.org/w/index.php?title=Polygon\_mesh&oldid=706022466.

3. **Berger, Matthew, Andrea Tagliasacchi, Lee Seversky, Pierre Alliez, Joshua Levine, Andrei Sharf Claudio Silva.** State of the Art in Surface Reconstruction from Point Clouds. [En ligne] 2014. http://lgg.epfl.ch/publications/2014/reconstar/paper.pdf.

4. **Hugues Hoppe, Tony DeRose, Tom Duchamp, John McDonald, Werner Stuetzle.** Surface Reconstruction from Unorganized Points. [En ligne] http://research.microsoft.com/en-us/um/people/hoppe/recon.pdf.