Kinetic

Team member:

Demuth Axel
Geraldes Pereira Dorian

Supervisor :

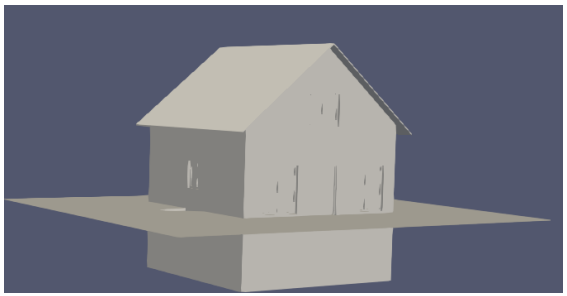
Pierre Alliez
Vincent Chabannes

Objectives

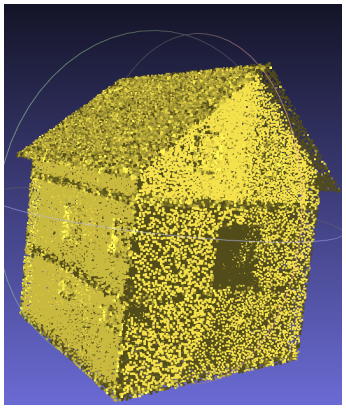
- **Reading Process and Mesh Conversion:** Convert data from stl file to ply and xyz file with normals on points
- **Application of the Kinetic Algorithm**
- **Recovery of Material Labels**
- **Utilization on City Modeling**

Challenges

- **Generating point cloud from stl file**



ACJasmin stl



ACJasmin point cloud

- **Parameter Optimization**

Cgal

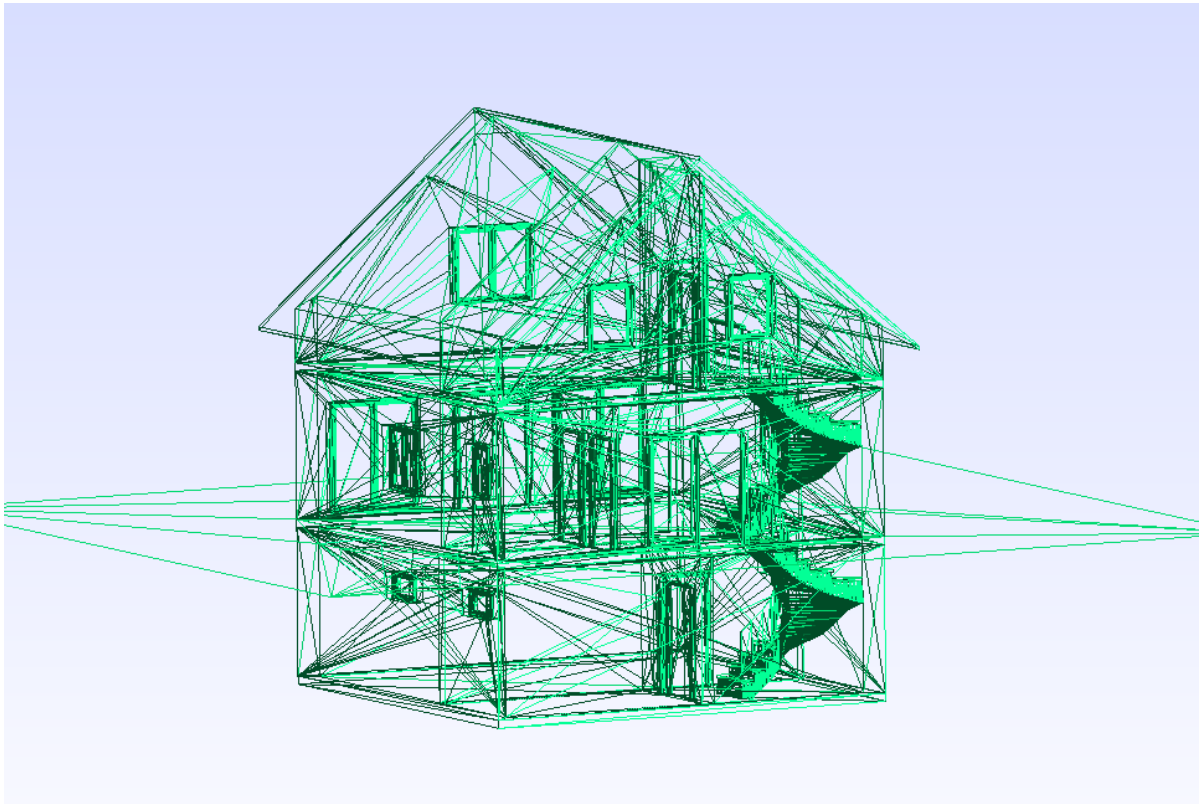
- C++ library for geometric calcul
- Provides data structures and algorithms for:
  - Mesh generation and processing
  - Geometry processing
  - Surface and volume manipulation
- For our usage Kinetic surface reparation algorithm, files readers

IFC and ply,xyz Files

- IFC : An initiative from buildingSMART (BIM), to standardize files for 3D modeling,similar to an object-oriented code
- xyz : File format to stock a point cloud
- ply : File format to stock a point cloud with normal associated

STL (STereoLithography)

- File format for 3D modeling we convert IFC object to this format
- Stock a collection of triangle with normal associated composing the mesh without any other information



Visualization

There is different software for Visualization :

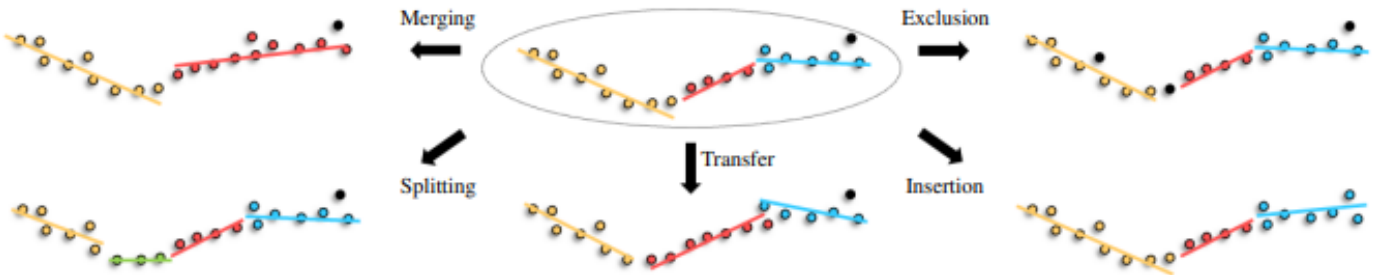
- cloudcompare
- Meshlab
- Paraview
- GMSH

Kinetic

We get information from a INRIA report [1] Kinetic algorithm is an geometric algorithm generate 3D mesh from a point clouds,it uses geometric primitive with an energy based model to fit the primitives to the model.
Energy formule:

$$U(x) = w_f U_f(x) + w_s U_s(x) + w_c U_c(x)$$

to calculate the best primitive to fit the mesh. then we have a list of geometric operation on each primitive



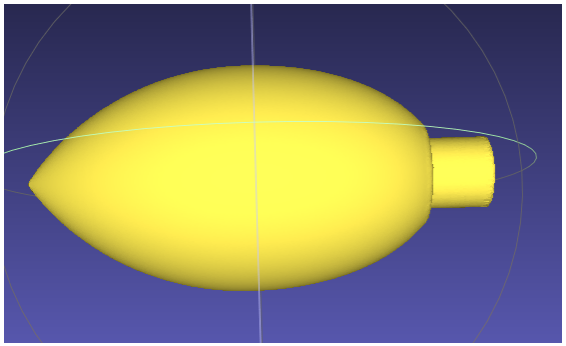
Here the speudo code of the application of geometric application :

Algorithm 1 Pseudo-code of the exploration mechanism

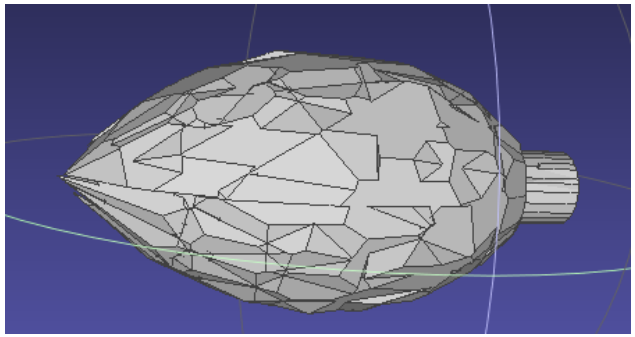
```
1: Initialize the primitive configuration x
2: repeat
3:     Initialize the priority queue Q
4:     while top operation i of Q decreases energy U do
5:         Update x by operation i
6:         Update Q
7:     end while
8:     Update x by the global transfer operator
9: until no update modifies x any more
```

first result

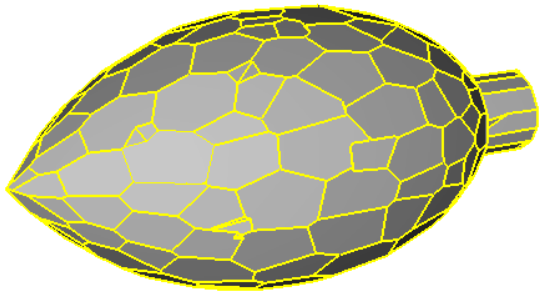
First we can show you what KSR algorithm is capable of:



point cloud

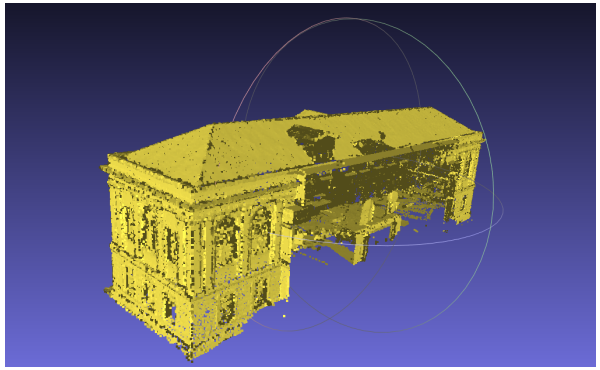


cgal result

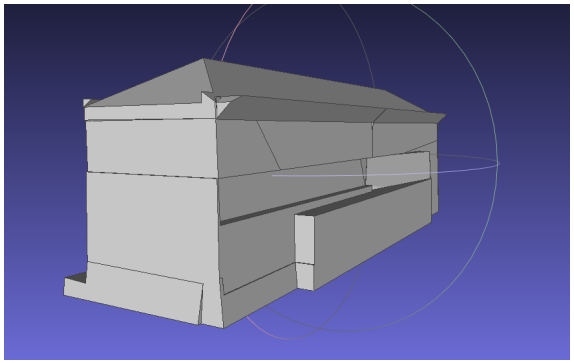


inria result

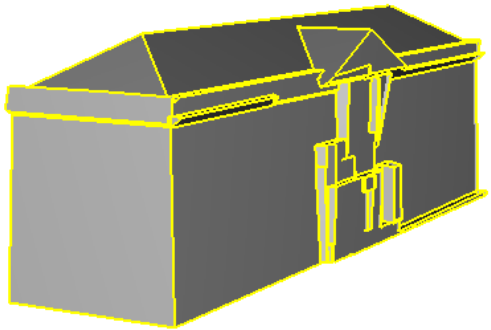
first result



point cloud

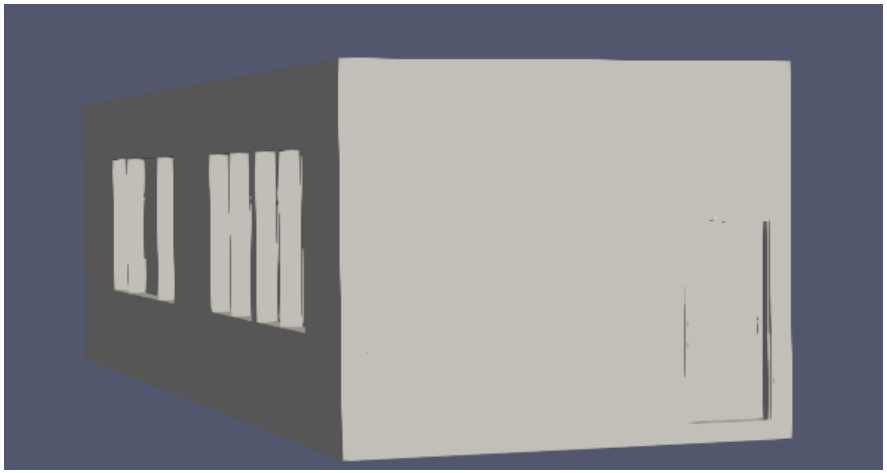


cgal result

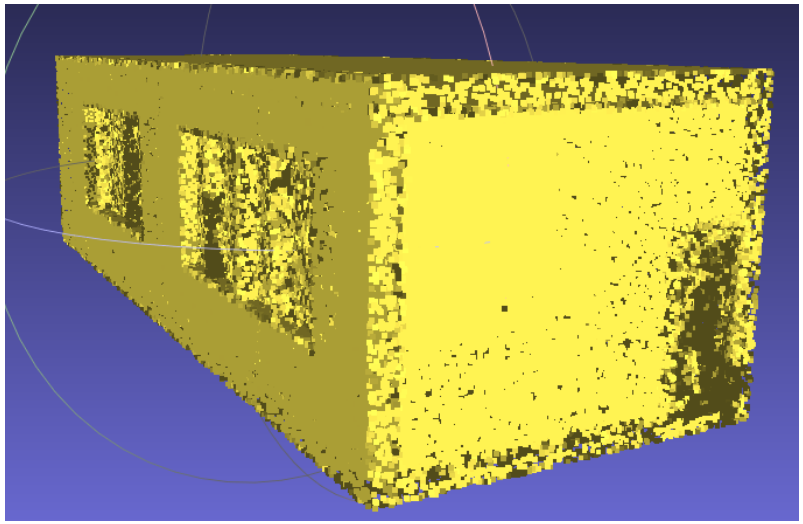


inria result

3zones example



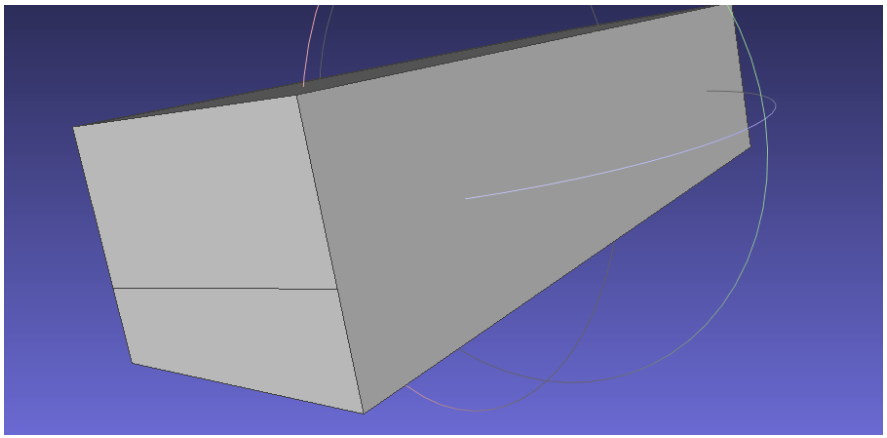
3zones



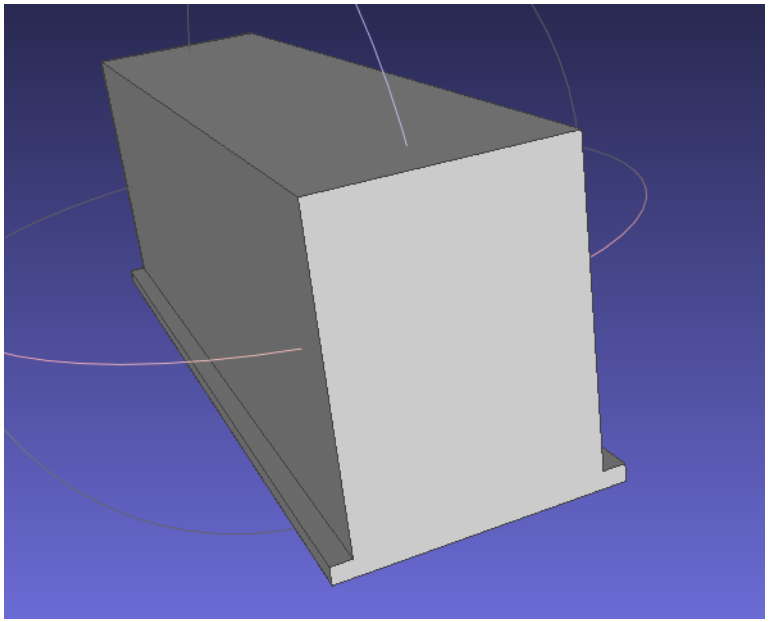
3zones point cloud

Figure: point cloud conversion

result



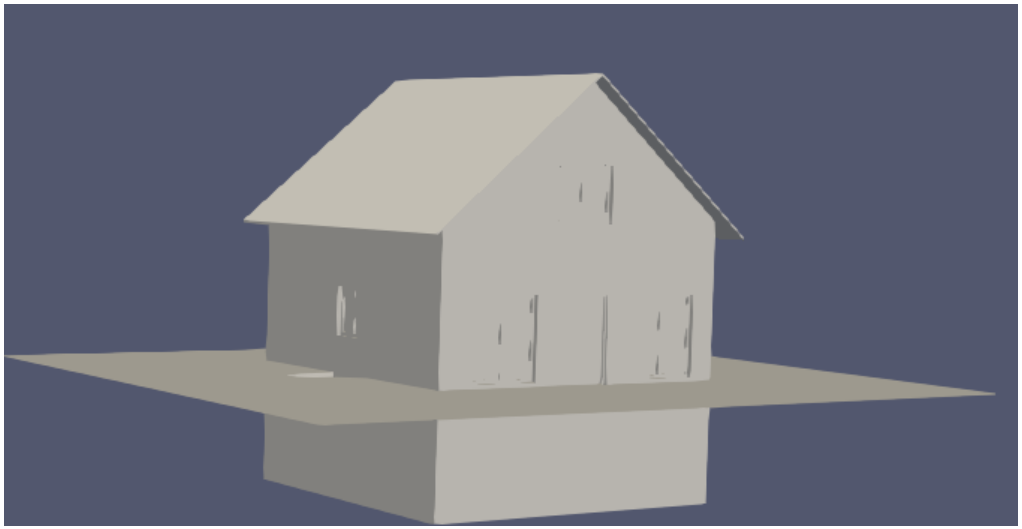
normal by Meshlab



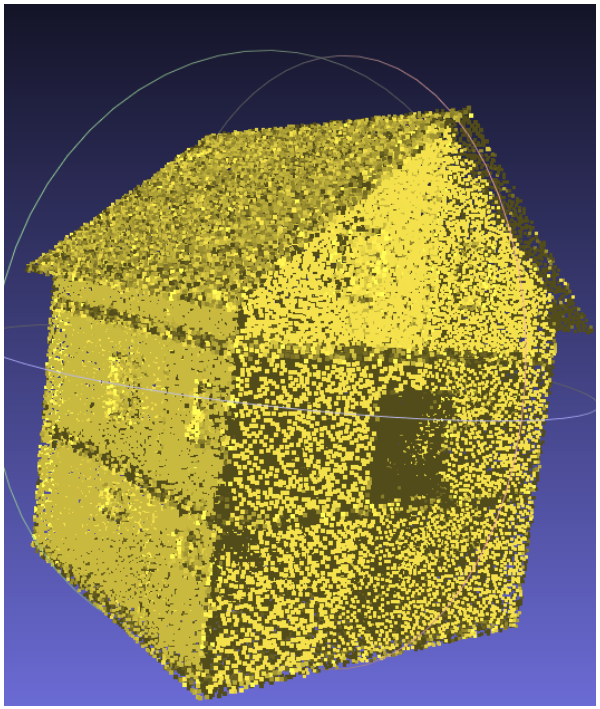
normal by Cgal

Figure: result on 3zones example

ACJasmin example



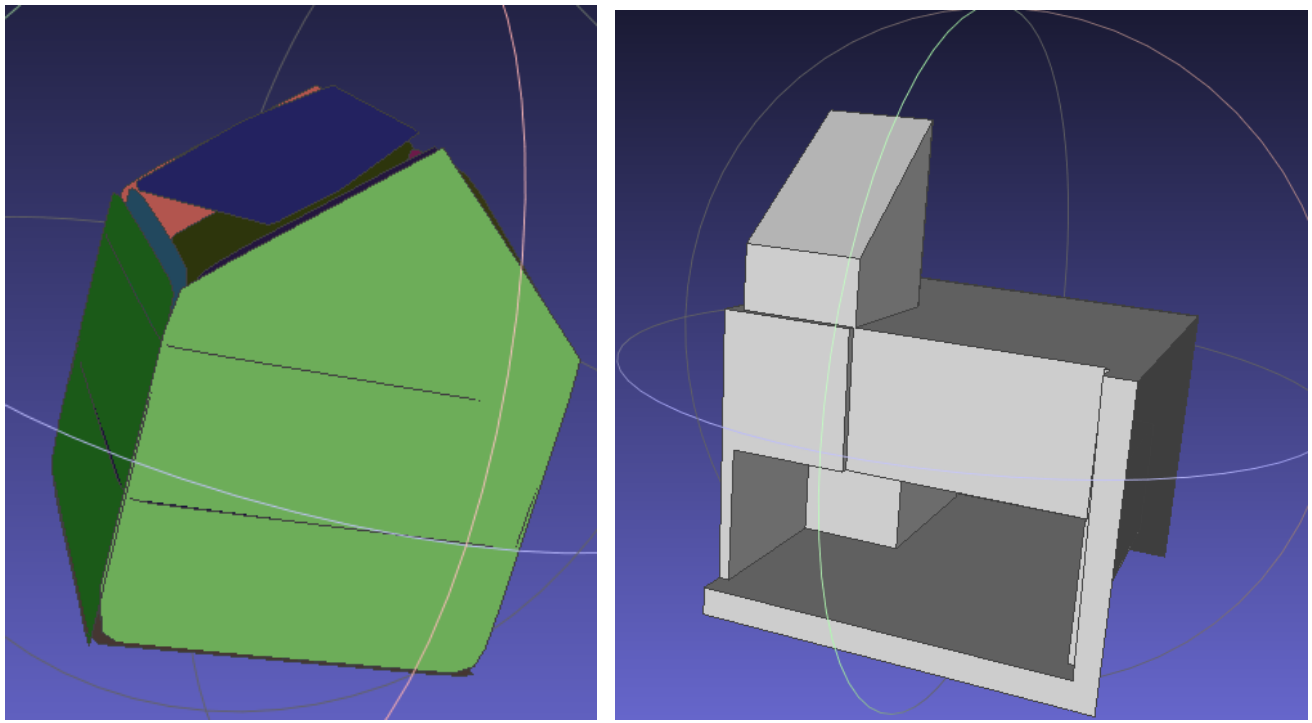
ACJasmin



ACJasmin point clouds

Figure: point cloud conversion

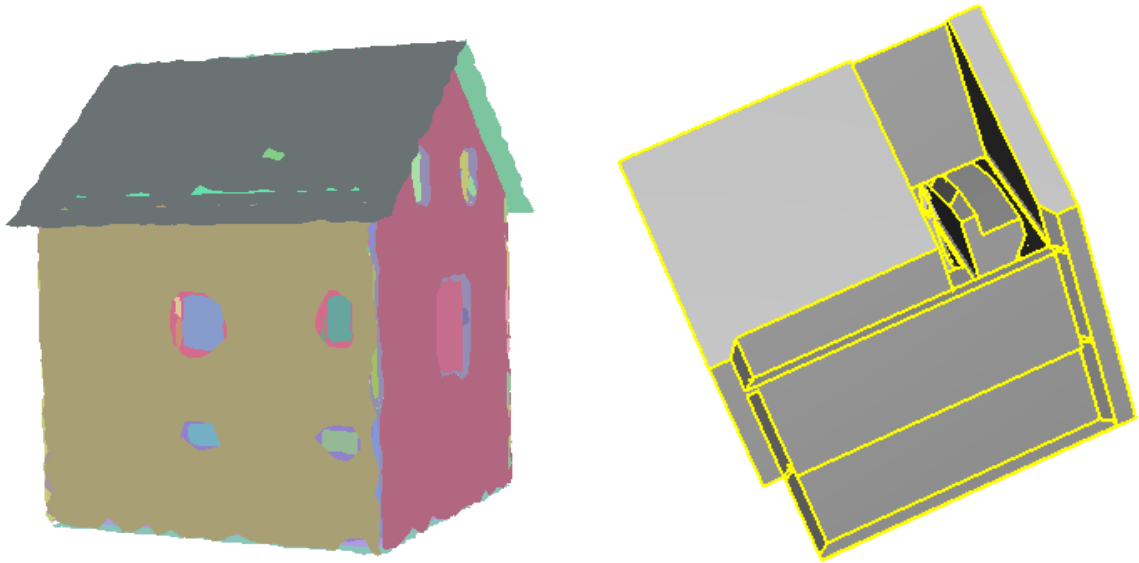
cgal kinetic result



primitives result

Figure: result on ACJasmin example using cgal algorithm

INRIA kinetic result



primitives result

Figure: result on ACJasmin example using INRIA algorithm

Why it does not work? We have few idea

- Error can be generate when we have not enought point in our point cloud
- If the mesh is badly oriented mesh can have problem to generate
- When we have IFC files, we could use a better extractor to obtain cleaner surfaces for rendering later

better result

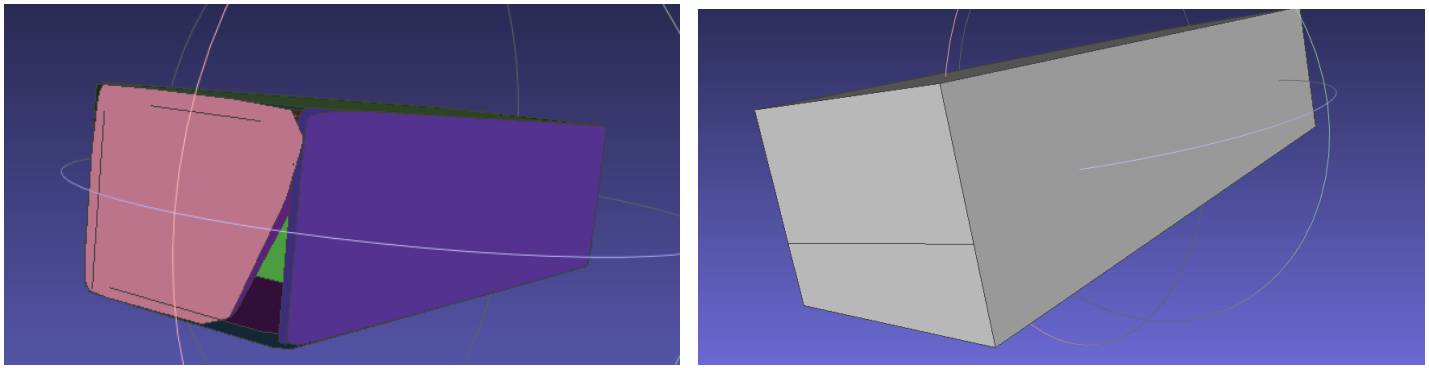


Figure: old 3zones with KSR cgal, dist=0.2,minp 500

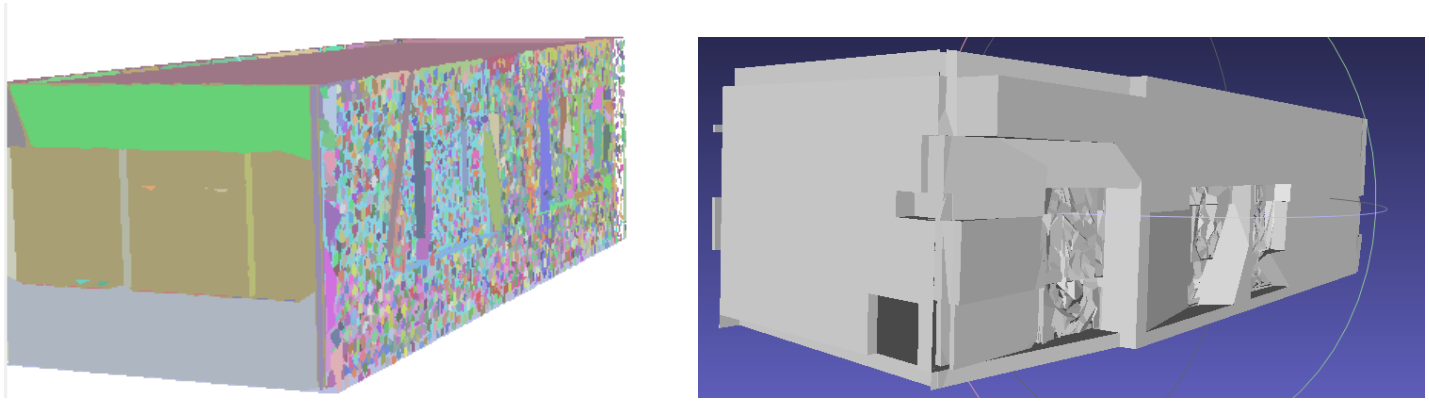


Figure: new 3zones with KSR INRIA, minp=20, epsilon=0.119, Lambda=0

Conclusion

The kinetic algorithm serves the purpose of upgrading meshes and making them watertight, even if some details are lost in the process. However, there are still many limitations regarding its application, and there may be significant preprocessing of the mesh required before executing the algorithm.

reference I


Mulin Yu and Florent Lafarge.
Finding Good Configurations of Planar Primitives in Unorganized Point Clouds.
In *CVPR 2022 - IEEE Conference on Computer Vision and Pattern Recognition*, La Nouvelle-Orléans, United States, June 2022.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Repairing geometric errors in 3D urban models with kinetic data structures.
ISPRS Journal of Photogrammetry and Remote Sensing, 192, October 2022.


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Kinetic Shape Reconstruction.
ACM Transactions on Graphics, 2020.

reference II


The CGAL Project.
CGAL User and Reference Manual.
CGAL Editorial Board, 5.6.1 edition, 2024.


Ktirio - construction et immobilier.


Cloudcompare - 3d point cloud and mesh processing software.