3D INTERACTIVE MODELLING OF 3D CITY MODEL

CREATION OF A SEMI AUTOMATIC RECONSTRUCTION PIPELINE

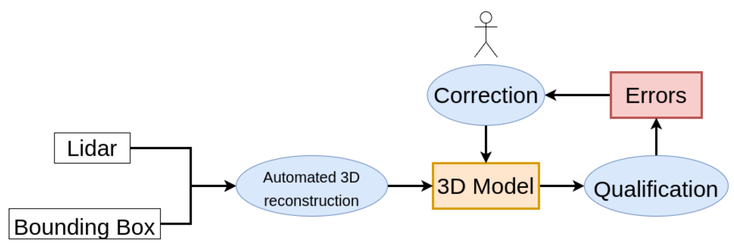
Florent GENIET
LASTIG

Context

- Reconstruction of 3D city model from aerial images and/or Lidar acquisitions.
- Human operators can produce high quality data but this is time consuming.
- Existing automatic reconstruction algorithms can process large areas automatically but they may be inaccurate, or even create some incorrect data.

Goal

This work aims to combine the speed of automatic reconstruction algorithms with the quality and controm of human operators by creating a semi-automatic pipeline.

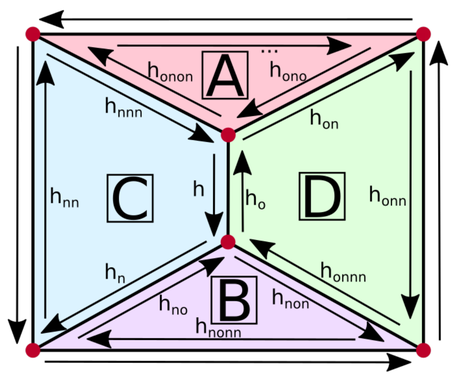


Method

1. We use a **plane arrangement** [1] algorithm to make the automatic reconstruction.
2. An error detector will be used to help the operators to detect where corrections are needed
3. We propose an interactive polyedral manipulator to allow an operator to efficiently correct the reconstruction errors while ensuring topological and geometrical consistency.

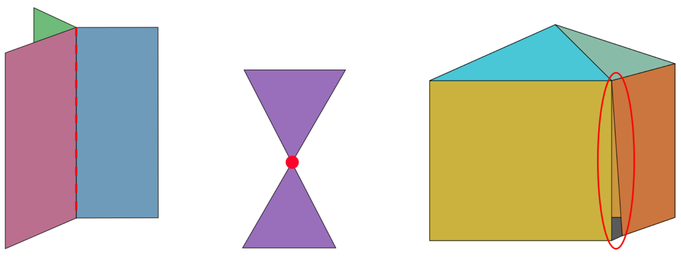
Topological structure

We use the half-edge data structure [2] to ensure that the topology of our objects stay consistent. This also allows us to describe the editing operations an operator may need very effectively.



Topological & Geometrical validity

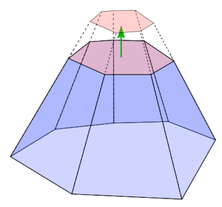
An object is considered as valid if and only if it is manifold, closed and with no borders. This prevents the resulting objects from having **more than one volume**, **auto intersecting faces**, or **non watertight surfaces**.



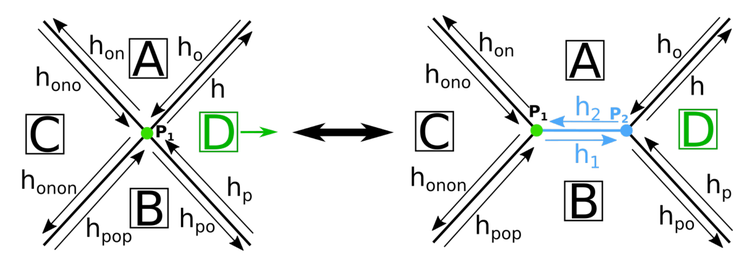
Editing Operations

We propose the following operators to modify the manipulated objects :

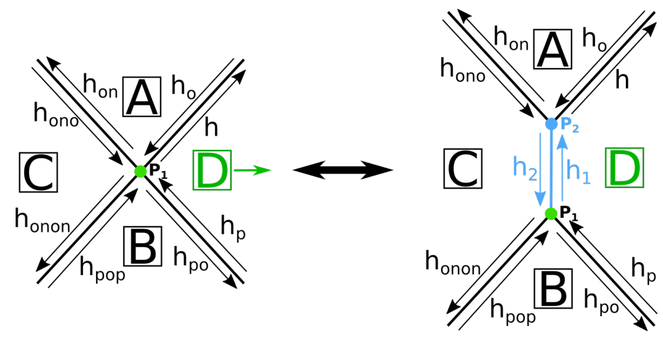
- **Face shift** : We change the plane equation of a face to move it along its normal.



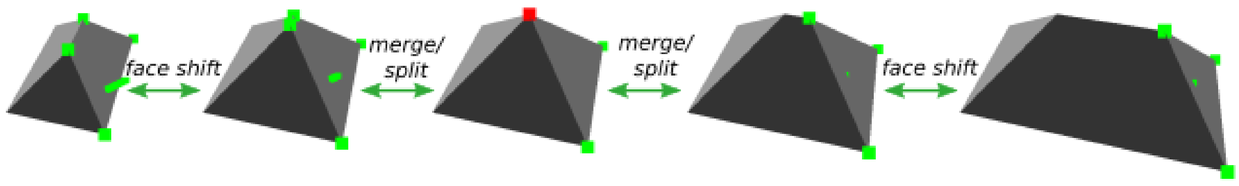
- **Vertex split**/ **Vertices merge** : When a point is adjacent to 4 or more faces, and when we shift one of its adjacent faces, the point is split into an edge. In the same way, if 2 moving points colide, they merge into one point adjacent to 4 or more faces.



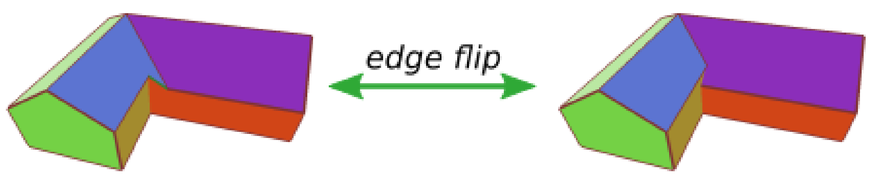
- **Edge flip** : We can change the definition of the points (the adjacent faces to these points) at the extremities of an edge, to flip this edge.



Results



The face shift is combined with the point split and the point merge to provide a more complete tool which deals with the choice of the most appropriate way to split a point when it is needed. If that choice is not satisfying, it might be changed with the flip edge tool.



The flip edge tool allows to correct some topological errors that might be done by the automatic algorithms.

Direction de thèse

- Co-directeur : Bruno Vallet, équipe ACTE
- Co-directeur : Mathieu Bredif, équipe GEOVIS

Bibliographie

[1] Jin Huang, Jantien Stoter, Ravi Peters, and Liangliang Nan. City3D: Large-Scale Building Reconstruction from Airborne LiDAR Point Clouds. *Remote Sensing*, 14(9):2254, January 2022. Number: 9 Publisher: Multidisciplinary Digital Publishing Institute.

[2] Lutz Kettner. Using generic programming for designing a data structure for polyhedral surfaces. *Computational Geometry*, 13(1):65–90, May 1999.

Journées de la Recherche IGN - 2023