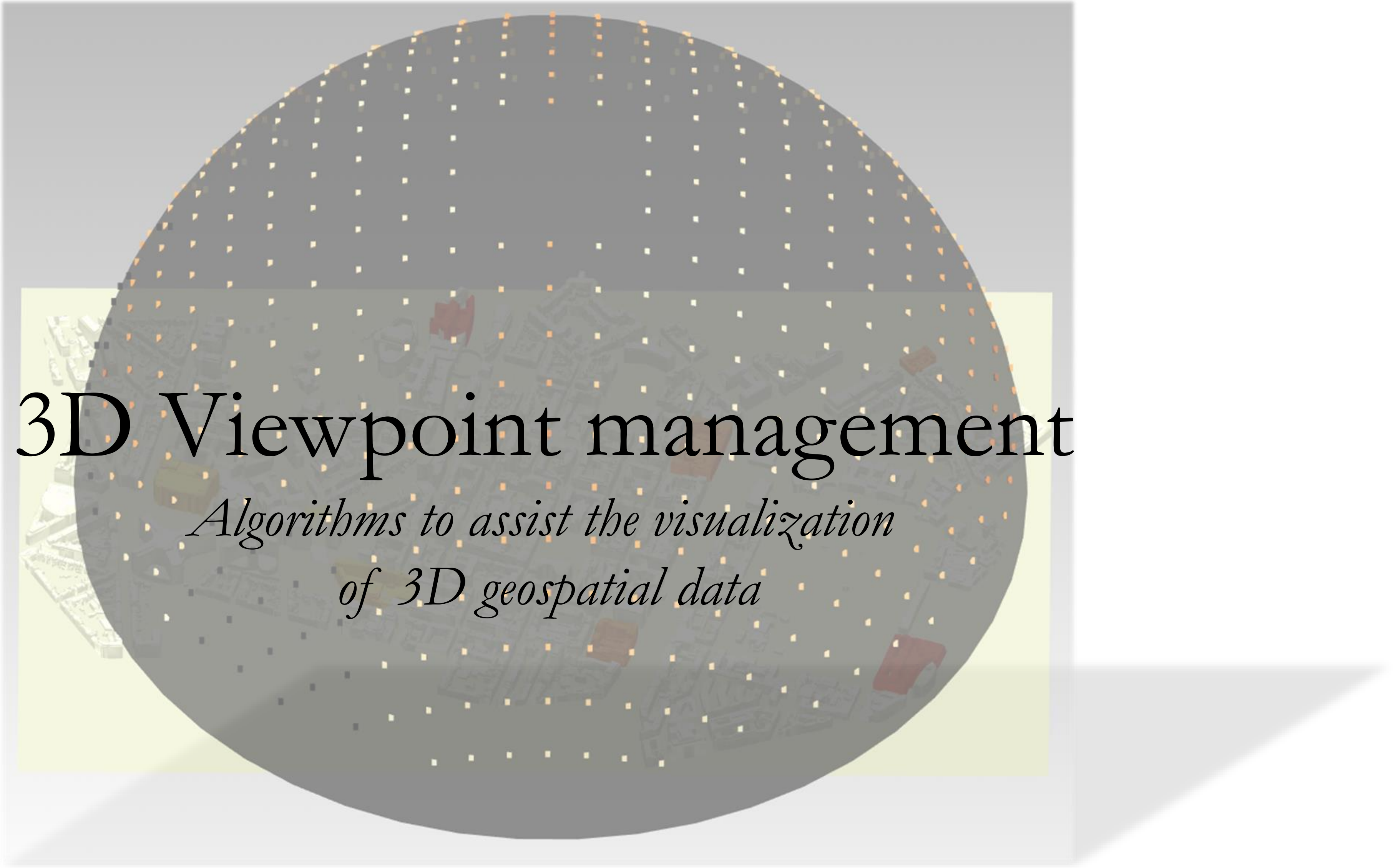


3D Viewpoint management

Algorithms to assist the visualization of 3D geospatial data

Context

Over years, modeling and visualizing the reality in three dimensions (3D) have become useful for an ever-increasing number of processes.

→ **Education**

→ **Business applications**

→ **Decision making procedures**

Context

Moving from 2D to 3D leads to new visualization challenges, of which the most fundamental one is the occlusion management. To solve it, operational software solutions already exist, such as:

→ **Wireframe modeling,**

→ **Transparency,**

→ **Multiple viewports.**

Context

However, current software do not provide operational solutions yet to manage camera settings. Based on an attribute or spatial request, the user could wonder:

WHAT IS THE BEST 3D VIEWPOINT(S) TO VISUALIZE THE RESULT(S) OF MY REQUEST, AND SUBSEQUENTLY ANALYZE AND/OR PRESENT MY RESULT(S) ?

Context

The answer to this question is complex in 3D since the camera is located in space through a set of ***three*** *coordinates: X, Y and* ***Z*** *(i.e. the height).*

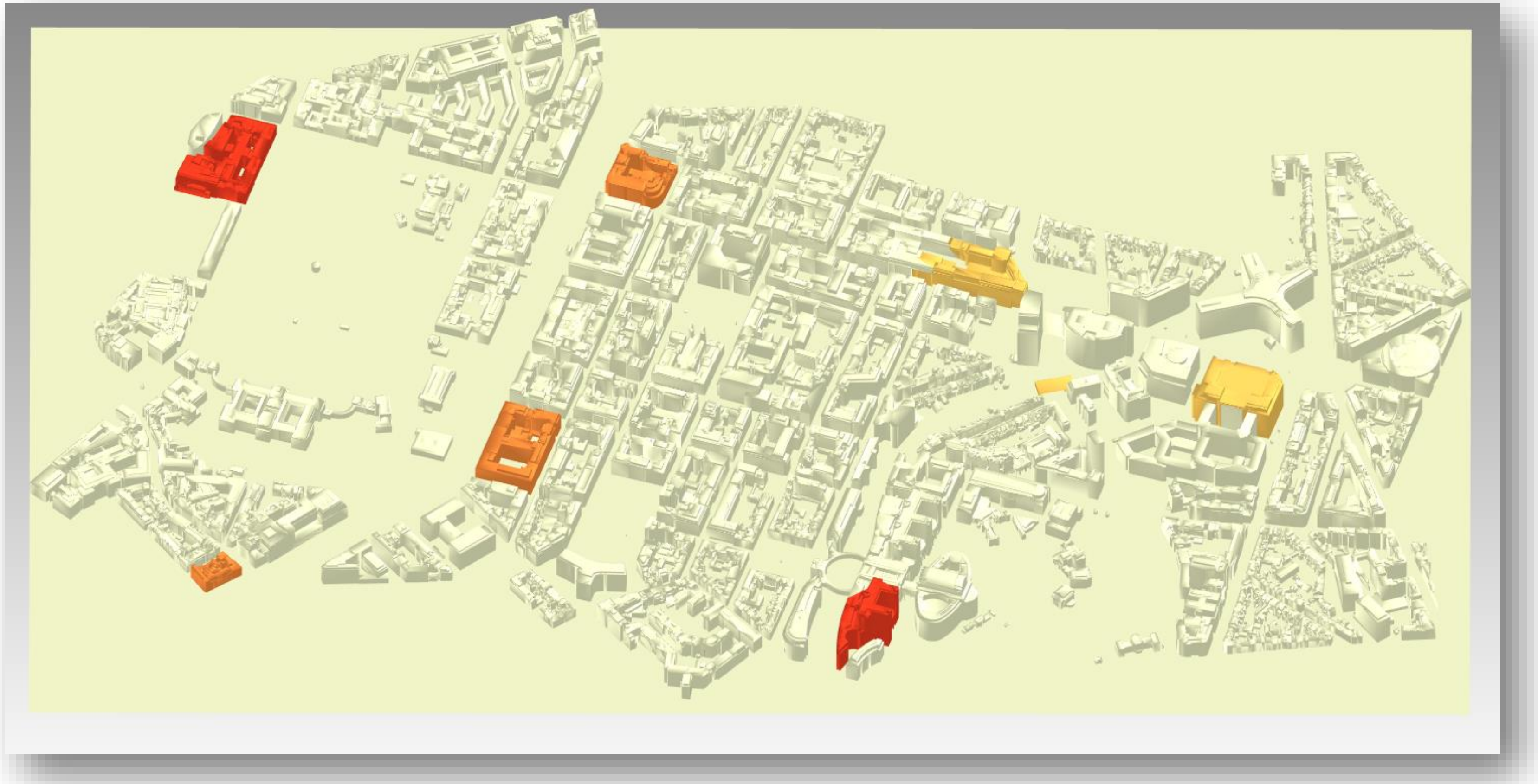
This is why we developed a new algorithm which automatically computes optimal static viewpoints, i.e. maximizing at best the visibility of a single or set of selected features within the 3D scene.

Viewpoint Management Algorithm

A geocomputational method that uses the power of the graphics card to automatically calculate efficient camera settings (i.e., camera positions and orientations) for visualizing a single or set of features (e.g., buildings, MEP components).

Let's take an example with the public transport services accesses in the European quarter of Brussels (Belgium).

Viewpoint Management Algorithm



A virtual 3D LOD2 city model of the European Quarter (Brussels). The subway and railway stations are colored from yellow to red, respectively for small to large areas of influence.

Viewpoint Management Algorithm

What is the best global viewpoint, i.e. the most efficient point of view for visualizing all subway and railway stations ?

What is the best local viewpoint for each subway and railway station, i.e. the most efficient point of view that maximizes its visibility ?

Viewpoint Management Algorithm

The algorithm first generates a set of viewpoints to be processed based on the configuration defined by the user.

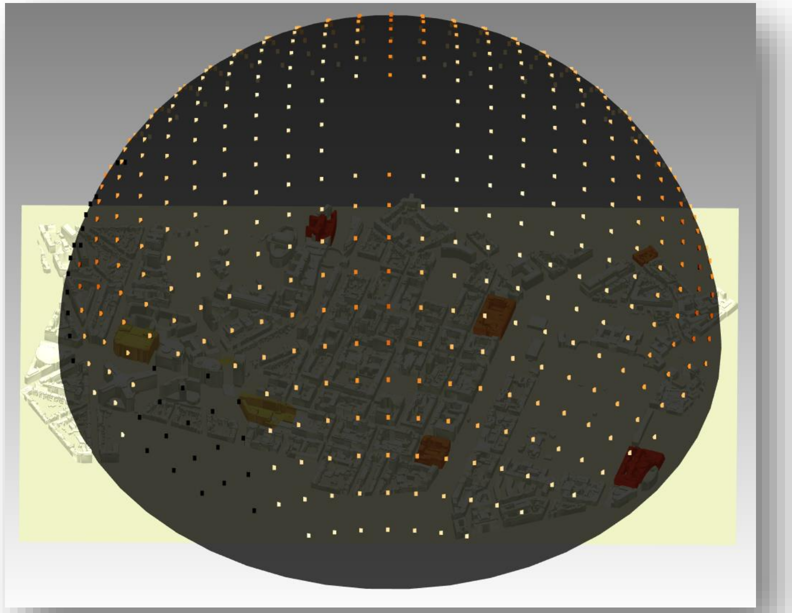
→ **Minimum and maximum azimuths**

→ **Minimum and maximum elevations**

→ **Number of points of view to be processed**

Viewpoint Management Algorithm

Then, the algorithm assigns an overall score to each processed viewpoint regarding the visibility of the objects of interest, i.e. subway and railway stations in the example.



User's configuration

Minimum azimuth: 0°
Maximum azimuth: 360°

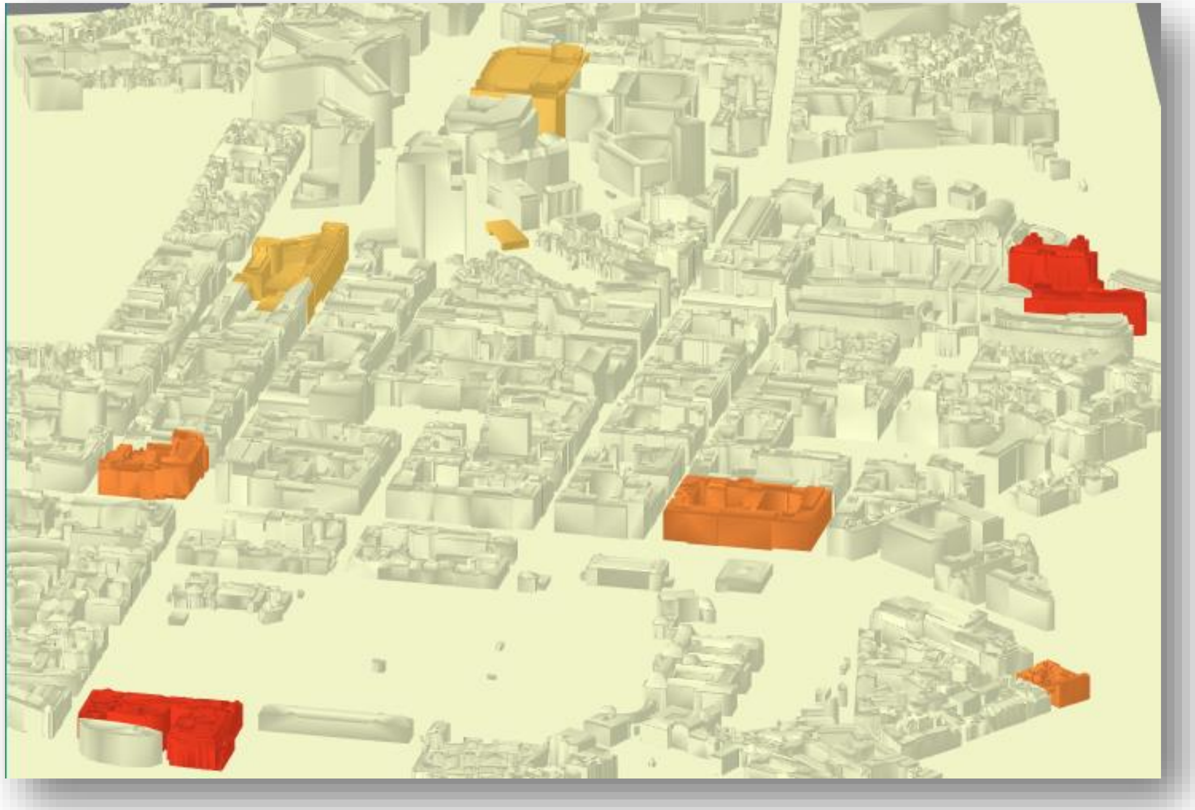
Minimum elevation: 0°
Maximum elevation: 80°

Number of viewpoints: 500

Visibility sphere. Viewpoints in black do not allow an overview of all stations. The other points of view are categorized with an equal interval ranking method.

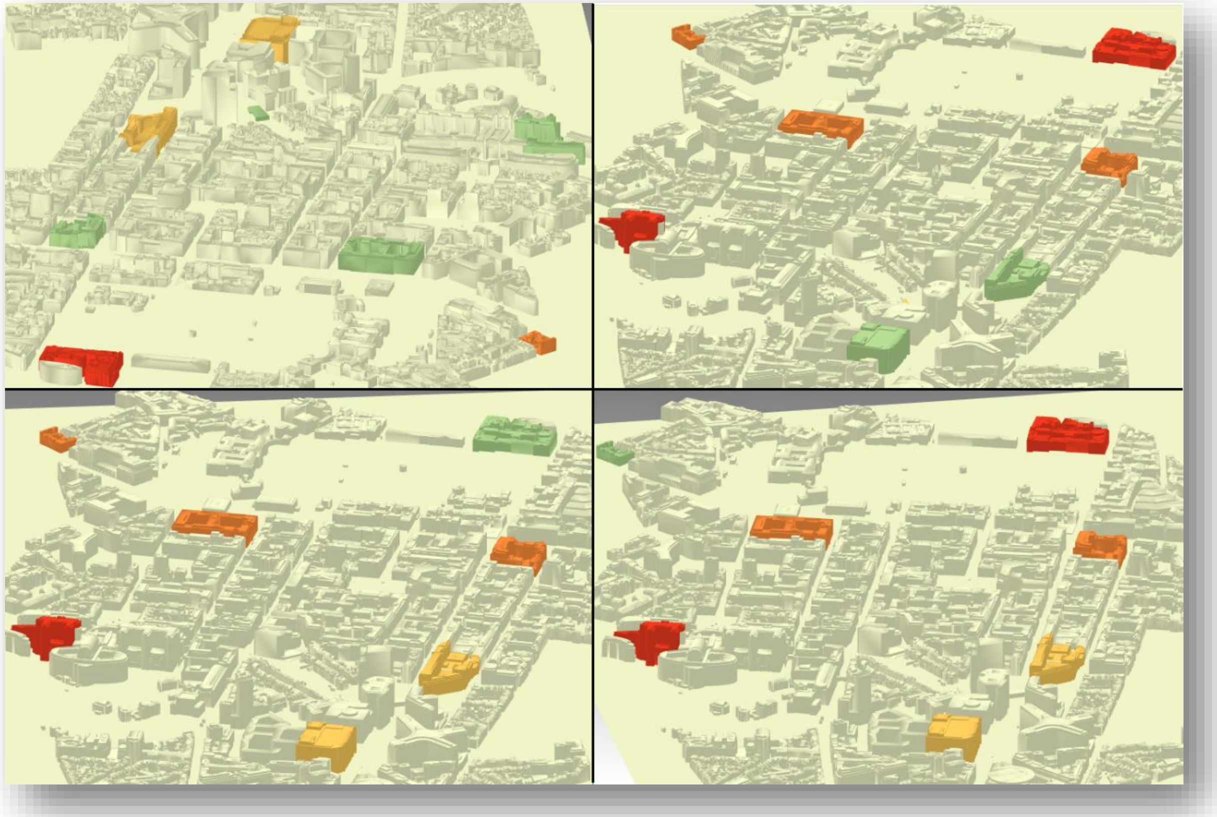
Viewpoint Management Algorithm

The best global viewpoint for the whole set of subway and railway stations.



Viewpoint Management Algorithm

The best local viewpoints (optimally viewed stations are highlighted in green within each figure).



Viewpoint Management Algorithm

The best provided viewpoints can then be used for analyses and presentations.

But, what if we combine these viewpoints to produce an automatic computer animation within the virtual 3D city model?

Indeed, the precomputed viewpoints could be incorporated into a navigation process for exploration, discovery and/or spatial knowledge acquisition.

Flythrough Creation Algorithm

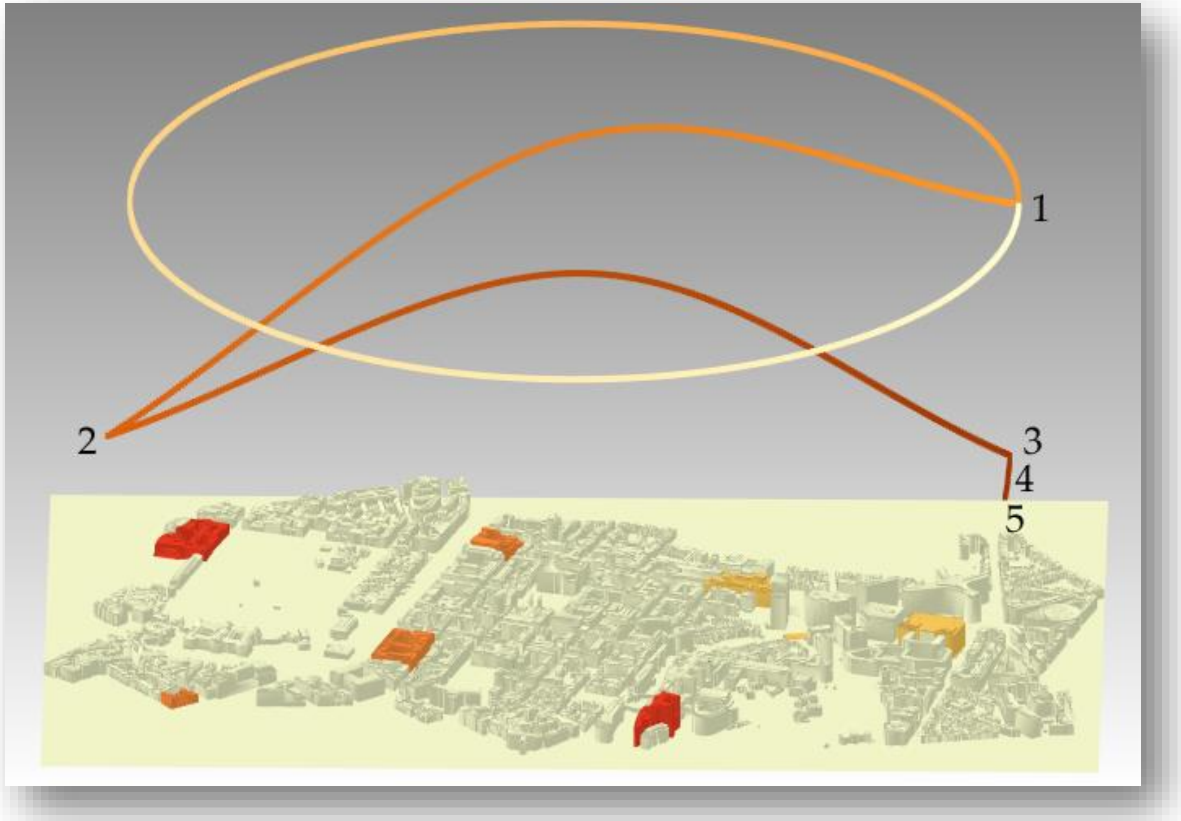
The algorithm combines the precomputed static viewpoints and defines a camera path for exploring the virtual 3D city model.

First, the navigation starts with an overview of the 3D model at 45 degrees of elevation.

Then, the camera moves to the best global viewpoint before visualizing each station to its best point of view.

Flythrough Creation Algorithm

An automatic camera path for exploring the railway and subway stations within the European Quarter.



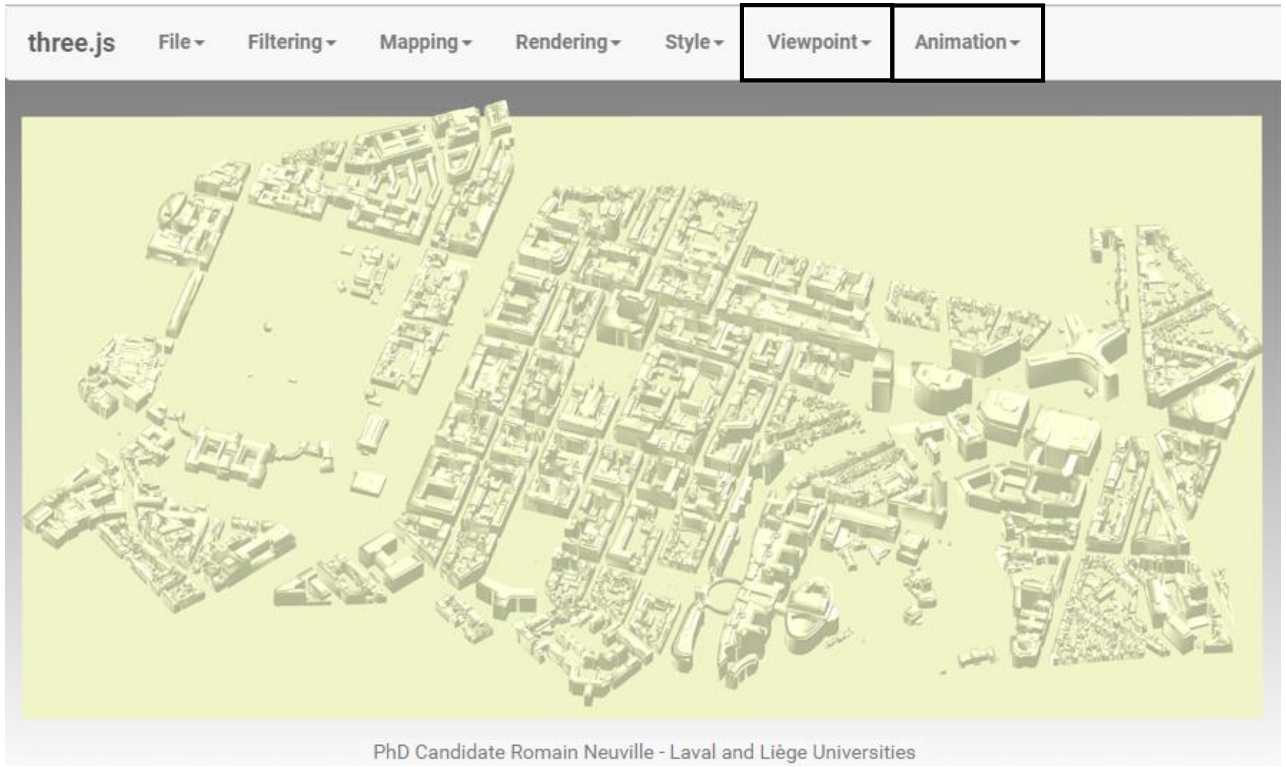
The time flow is displayed with a hues gradient, from white to red.

Flythrough creation algorithm

An automatic precomputed camera path.

Future

Incorporating the algorithms as plugins into 3D current viewer !

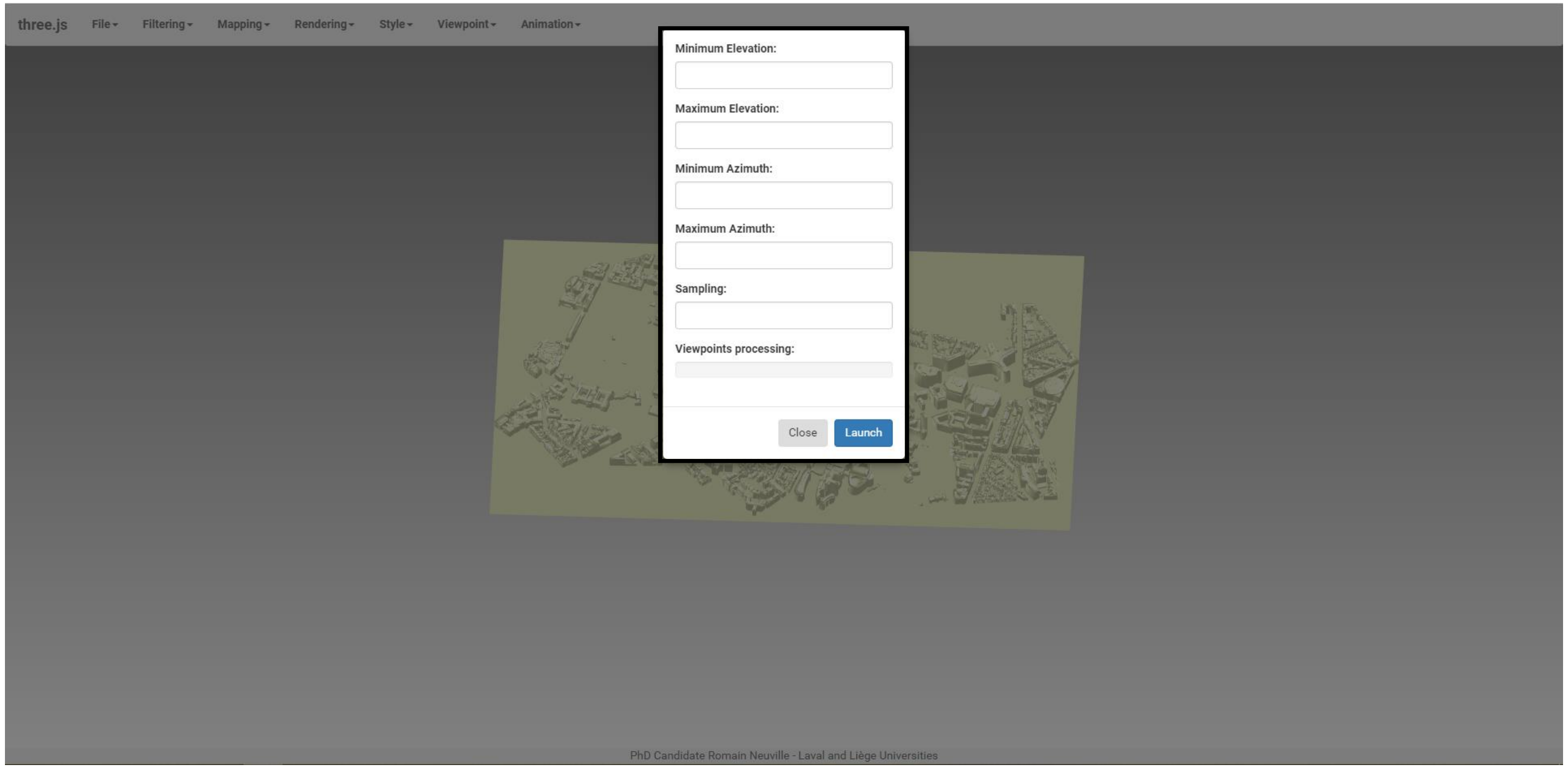

three.js
File
Filtering
Mapping
Rendering
Style
Viewpoint
Animation
PhD Candidate Romain Neuville - Laval and Liège Universities

Prototype of a 3D viewer with two additional tabs for managing occlusion!

Viewpoint: Viewpoint Management Algorithm
Animation: Flythrough Creation Algorithm

Future

Example of the graphical interface for the viewpoint management algorithm



Minimum Elevation:

Maximum Elevation:

Minimum Azimuth:

Maximum Azimuth:

Sampling:

Viewpoints processing:

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Still improvements to be made

Perspective projections

Image and geometric descriptors in the utility function

Navigation

…

Thank you for your attention