Urban Horizon - Executive Summary

Group 1: Sky View Factor

Vasileios Bouzas	4744772	V.Bouzas@student.tudelft.nl
Geert Jan (Rob) de Groot	4076125	G.J.deGroot@student.tudelft.nl
Melika Sajadian	4708032	S.Sajadianjaghargh@student.tudelft.nl
Nikolaos Tzounakos	4744268	N.Tzounakos@student.tudelft.nl
Teng Wu	4721020	T.Wu-3@student.tudelft.nl

This report strives to provide the reader with a concise overall picture of the purpose, method of approach, and final product that were the subject of study of a MSc student team during the Geomatics Synthesis Project of TUDelft.

Project Subject/Purpose

Our project's subject is the creation of a web application, which allows the user to calculate the Sky View Factor (SVF) on a certain spot, within the extent of the municipality of The Hague. The SVF is an indicator which shows how open (or obstructed) the view of the sky is at a certain point, related to the surrounding environment acting as vision obstacles. This is useful at many fields, such as -but not restricted to- urban planning.

For this purpose, both online and offline processes are utilized, with the final result being the calculated SVF number, together with a visual representation that geometrically imitates the properties of a fisheye lens' image.

Methodology / Analysis

The currently used methodology is based on the research conducted by An et al. (2014) on processing 3D point clouds for SVF calculation. According to this research, a 3D hemispherical dome is formed around a given location for which SVF needs to be estimated. This dome usually has an 100-meter radius and a resolution of 2 degrees horizontally and 1 degree vertically (totalling over 16 thousands sectors to be accounted). Points of the cloud are then projected on the dome surface and occupied sectors are considered as obstructed - either by vegetation or buildings. The dome is then converted to a 2D polar grid by means of orthogonal projection.

Finally, SVF results as a proportion of the area of non-obstructed sectors to the total area of the dome.

For the purposes of our application, preliminary data consists of AHN3 point cloud tiles corresponding to the study area, accessible through the PDOK web service. Furthermore, formation of tiles of 100 x 100 meters out of the original datasets is conducted in order to improve computational speed. These tiles are produced by an open-source program developed by us that clips points according to the boundary of the study area and generates the required tiled.

The tiles formed during preprocessing are used - along with the horizontal coordinates of a point of interest (viewpoint) lying within the study area - to calculate the SVF at a given location. First, the tile in which the viewpoint lies is identified, along with its eight neighboring ones. After this, the elevation values of tile points within one-meter radius are processed to assign elevation to the viewpoint and the 3D dome. Finally, the dome is formed and reprojected in 2D to calculate the SVF. The resulting value is accompanied by a visualisation of the 2D projection with the sectors unobstructed or obstructed by points.

Moreover, our application offers a dynamic calculation approach by reporting how changes in the urban environment reflect to SVF. This is accomplished by allowing the user to add or remove buildings - this translates to removal and addition of points in the point cloud. The removal of a building deletes all the points within the footprint of the building. The adding of a building is initiated by removing all points within the given footprint, after this the points are generated by a rectangular grid within the bounding box of the footprint of the building newly defined by the user.

Results

The final product of our labor is a fully functional web portal that contains all necessary functionalities, as well as the needed information to accompany them. Apart from the application page, the portal also contains additional informative pages. One page contains a tutorial that can prove helpful to users that are unfamiliar with the interface. There is also a page dedicated to the documentation relevant to the application, present for anybody that wants to take a look on how things work behind the scenes, also providing useful links to the full report about this project, our constructed code and useful site(s).

Conclusions

Overall, the results of the application have been very satisfactory. After many hours of work, a fast and accurate process of calculating the SVF of a point has been achieved. The option of applying this on multiple points at the same time exists. A regular calculation for a single point takes about one second. The factor's calculation accuracy is also no more than 1%, which provides a result of good quality. The website is quite intuitive and the visual results greatly helps get the calculated information across to the user, so it can easily be understood.

Recommendations

Some discussed recommendations include:

- Enabling the application to work for any place within (or even the whole of) the Netherlands, since it can handle the nationwide existing data.
- Instead of saving necessary point cloud dataset to the server, it could be possible to retrieve and handle the PDOK data directly from the server.
- The application can be adjusted to facilitate other applications. One example could be the calculation of GPS measurements' DOP values at a certain point.

Limitations

As with any other application, this one also proved to have minor drawbacks.
One concern is that running the web-application server requires that we store a lot of data, both pre-processed (point cloud datasets) and later produced (fisheye image plots). As such, a better way to manage big data should be found.
Also, the calculation process disregards the ground as an obstruction, which would present awkward results for mountainous/hilly areas, or generally areas with rough terrain.