Diplomarbeitspräsentation

FAKULTÄT FÜR !NFORMATIK

Faculty of Informatics

# Potree: Rendering Large Point Clouds in Web Browsers

Masterstudium:
Visual Computing

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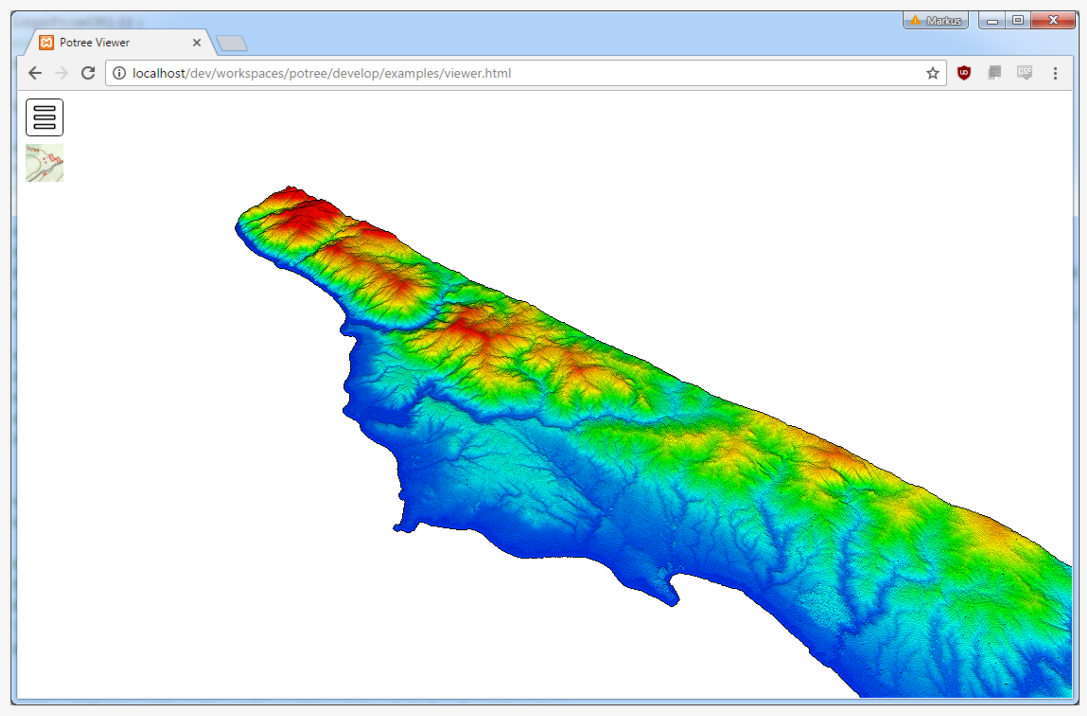
## Problem Statement / Motivation

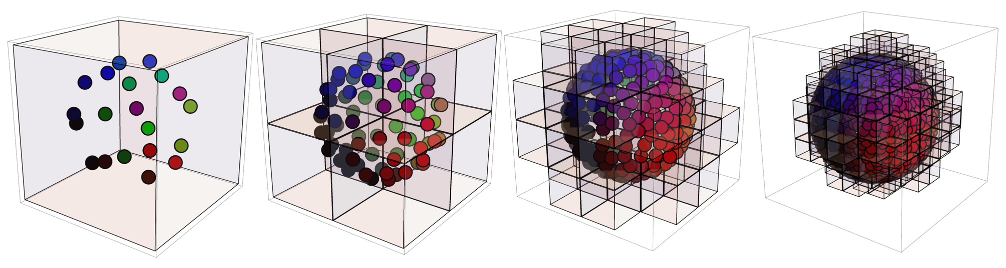
Point Clouds, three-dimensional models that consist of colored points, are often obtained as a result of scanning real-world environments and objects through laser scanners or photogrammetry. Billions, and even hundreds of billions of points, are not uncommon in point cloud models of vast landscapes.
The aim of this work is to make the viewing of point clouds as easy as visiting a web page, with the help of out-of-core algorithms and the use of WebGL, the counterpart of OpenGL for web browsers.



Contribution 1:

### Out-Of-Core Rendering

The out-of-core rendering of huge point clouds is achieved with an enhanced octree structure. Each node of the octree stores a subsample of the original point cloud. The root node contains a very coarse and low-resolution model of the whole data set and with each level, the resolution is doubled.



Contribution 2:

### Adaptive Point Sizes

Adaptive point sizes fill holes between points with as little overdraw as possible by adjusting the size of each point to the local level of detail.

*CA13 point cloud courtesy of Open Topography and PG&E*

Contribution 3:

### Interpolation

Rendering points as paraboloids instead of screen-aligned circles reduces occlusions between points and results in a nearest-neighbor-like interpolation [1].

*Point cloud courtesy of Weiss AG.*

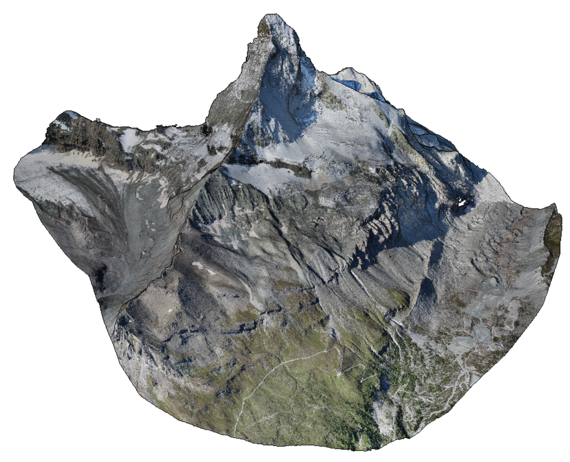
### Point Budget

Low Point Budget
High Performance

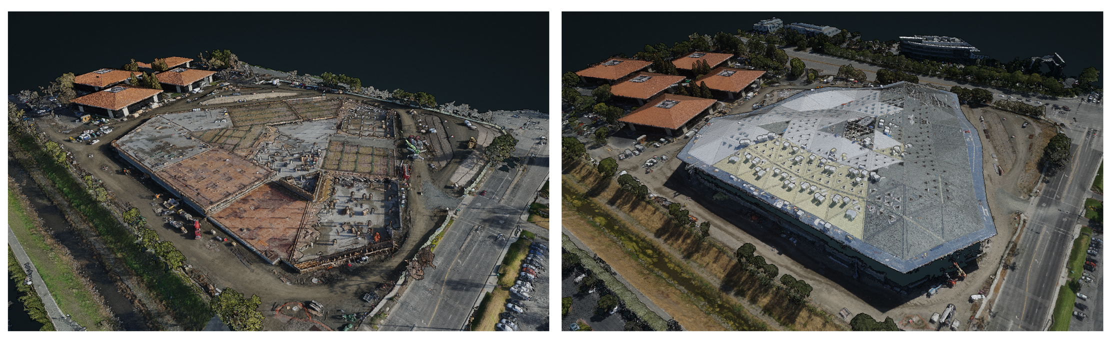
High Point Budget
More Details

*Heidentor point cloud courtesy of LBI ArchPro*

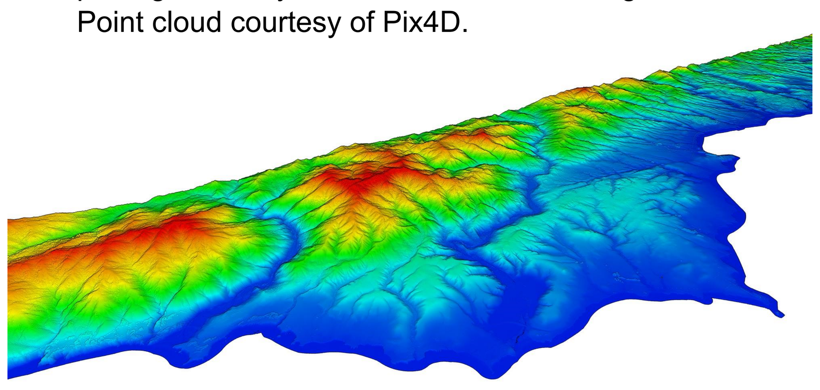
### Examples



The Matterhorn, Switzerland.
300 million points, created by the Pix4D photogrammetry software out of 2188 images.
Point cloud courtesy of Pix4D.



Building Site of NVIDIA's new Headquarter, Santa Clara, California
Exterior is captured daily with drones and photogrammetry. The interior is scanned monthly with terrestrial laser scanners. Point cloud courtesy of NVIDIA.

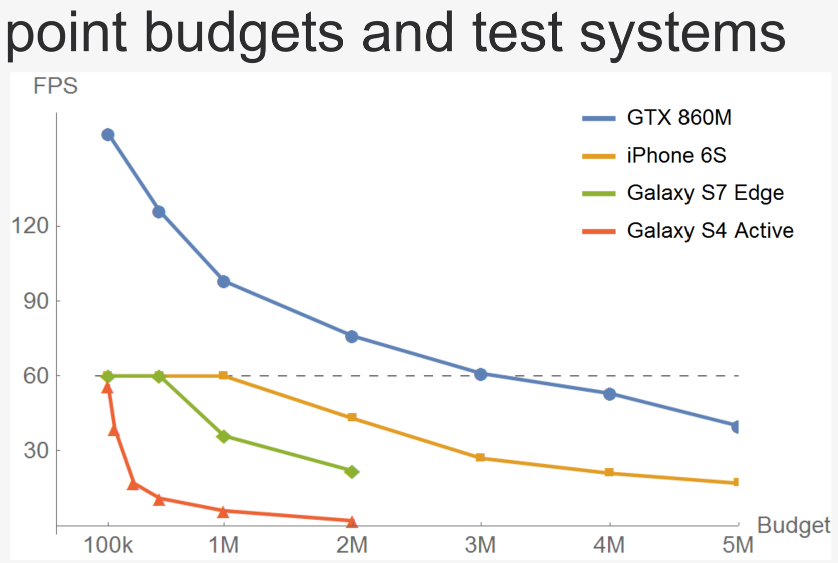


CA13, San Luis Obispo County coast, California.
A LIDAR survey over 801km² with a total of 17.7 billion points. Courtesy of Open Topography and PG&E.

Arènes de Lutèce, Paris, France.
60 million points, created out of 1456 images. This point cloud was captured as part of the Harvest4D [2] project.

## Performance

Frames per second on different point budgets and test systems




## Results

The result of this work is an open source and web-based point cloud viewer, Potree, that is capable of rendering billions of points in standard web browsers. The viewer is accompanied by a converter that builds-up the required octree structure in a preprocessing step.

## References

[1] "High-Quality Point Based Rendering Using Fast Single Pass Interpolation", Schuetz M., Wimmer M.
[2] Harvest4D - https://harvest4d.org

Source code and demos are available at:
- https://github.com/potree
- http://potree.org/wp/demo/

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