



High Quality and Efficient Direct Rendering of Massive Real-world Point Clouds

Hassan Bouchiba, Raphaël Groscot, Jean-Emmanuel Deschaud, François Goulette

► To cite this version:

Hassan Bouchiba, Raphaël Groscot, Jean-Emmanuel Deschaud, François Goulette. High Quality and Efficient Direct Rendering of Massive Real-world Point Clouds. EUROGRAPHICS 2017, Apr 2017, Lyon, France. hal-01692177

HAL Id: hal-01692177

<https://minesparis-psl.hal.science/hal-01692177>

Submitted on 19 Feb 2018

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

High quality and efficient direct rendering of massive real-world point clouds

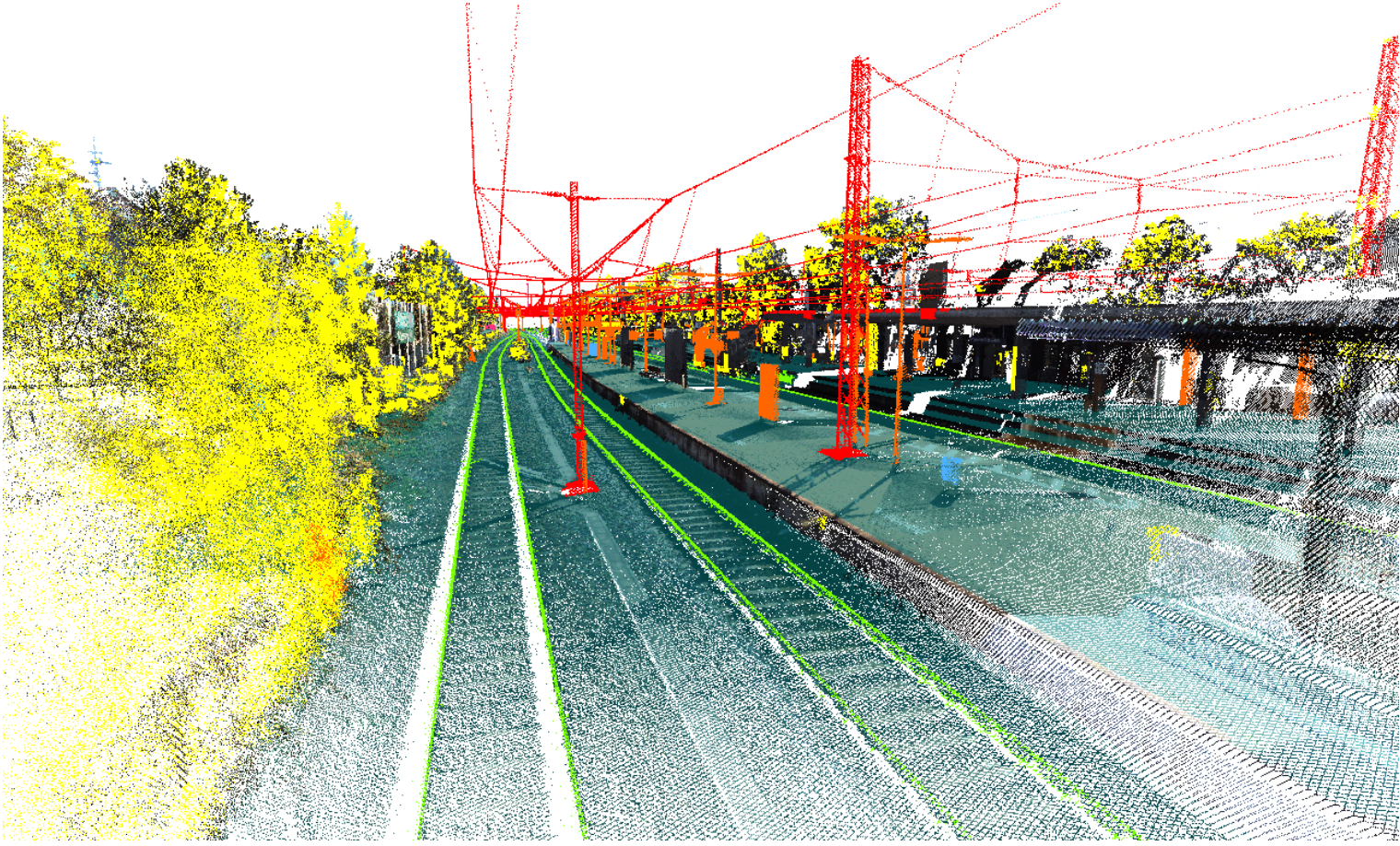
H. Bouchiba, R. Groscot, J-E. Deschaud, F. Goulette

Contribution

New real-time screen-space rendering algorithm for real-world raw 3D scanned datasets

- Scenes with high depth differences
- Datasets with linear patches
- Higher efficiency

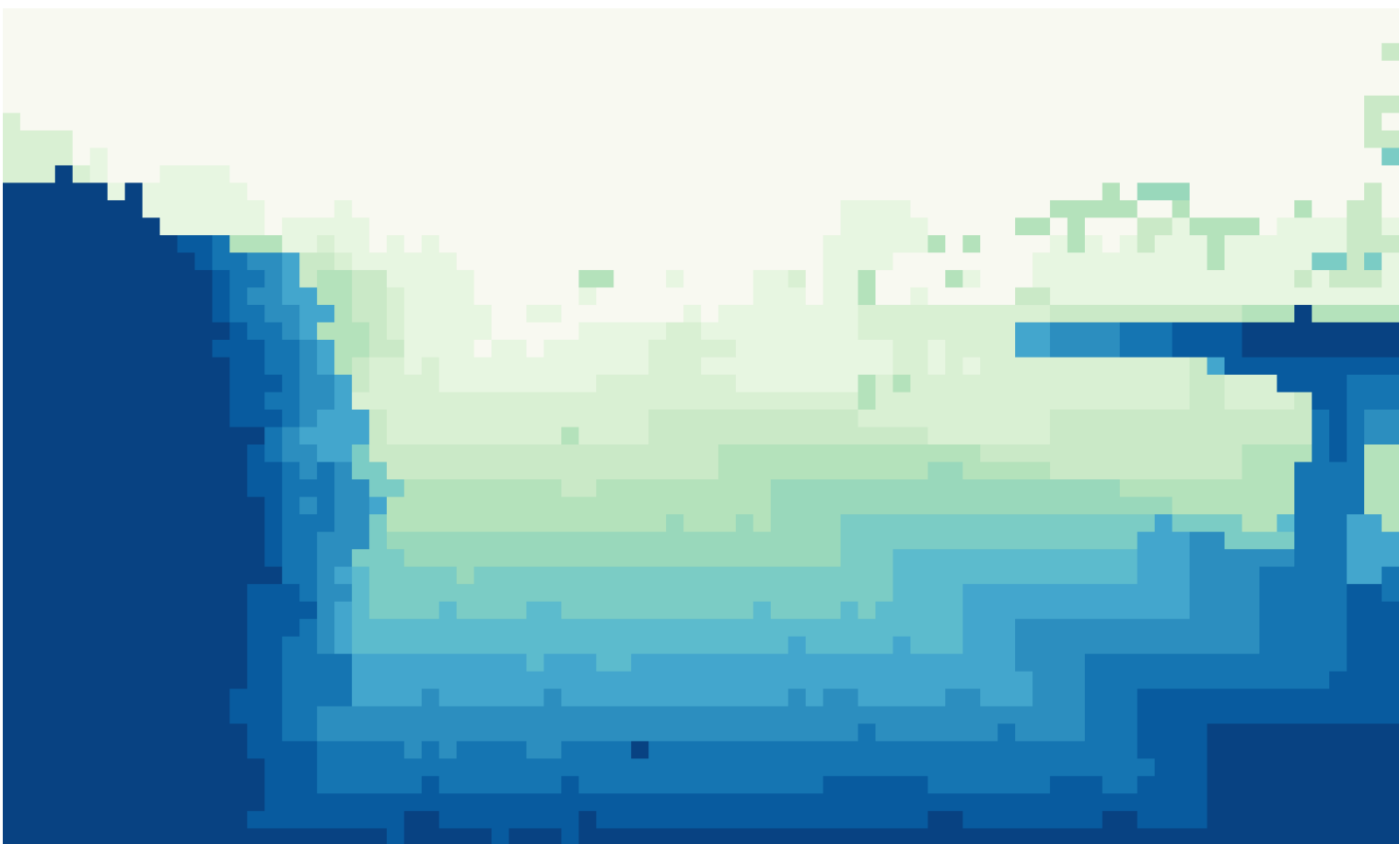
Linear Patches Segmentation



- Optional pass [RDG16]
- Does not add topological information
- Separate the linear parts from the rest
- 143.5s for 35 M points

Adaptive visibility operator

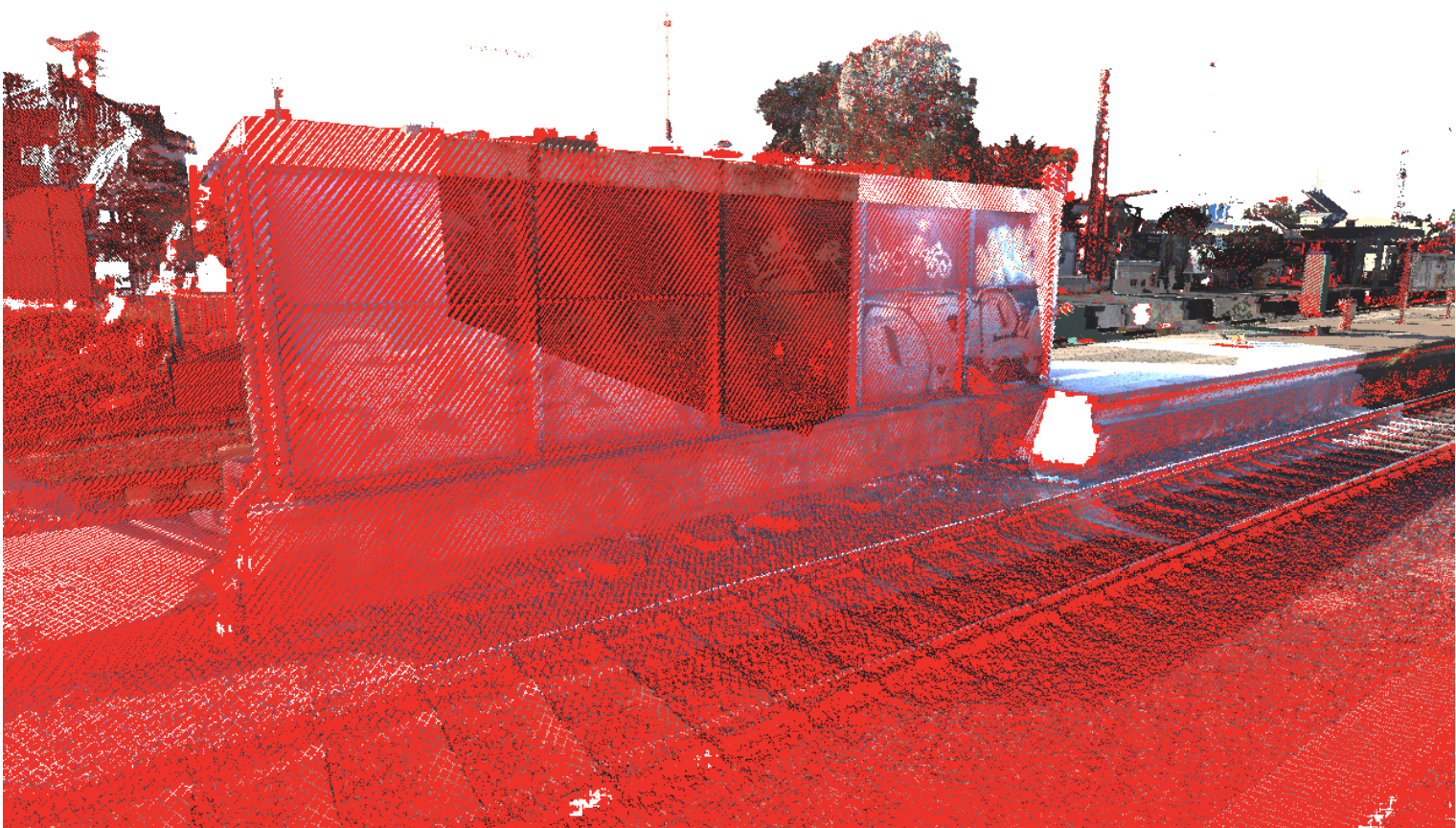
Screen-space adaptive Hidden Point Removal (HPR) operator.



We use an adaptive size of the kernel computed from the coarse depth buffer:

$$s(z) = \text{clamp}(K/z, r_{\min}, r_{\max})$$

The algorithm labels the holes for the subsequent filling pass:



In red: the points that are not visible

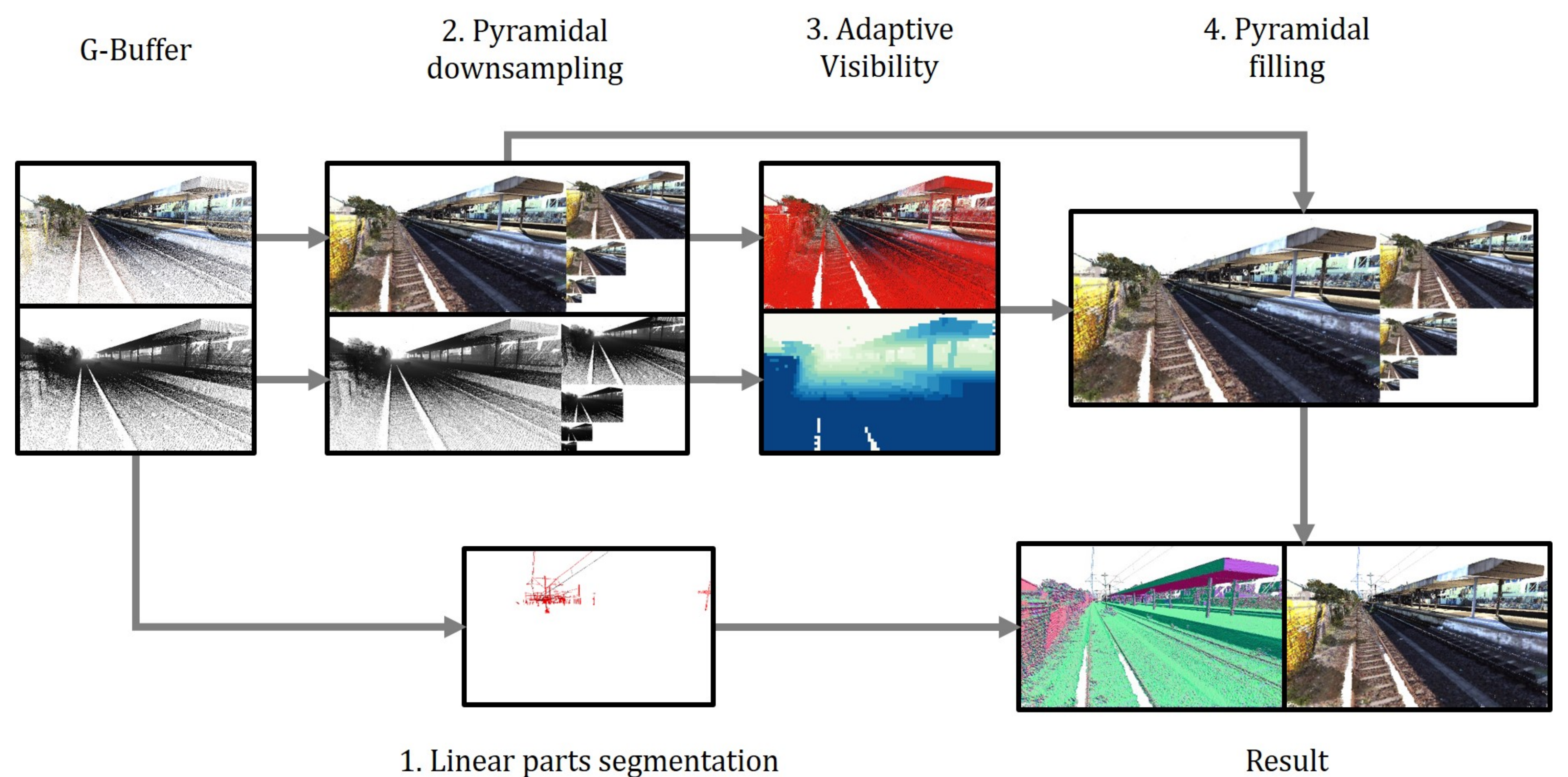
Pyramidal operators

- Down-sampling: push phase (we only keep the closest pixel to the camera)
- Filling: pull phase [MKC08]

References

- [MKC08] MARROQUIM R., KRAUS M., CAVALCANTI P. R.: Efficient image reconstruction for point-based and line-based rendering.
- [PGA11] PINTUS R., GOBBETTI E., AGUS M.: Real-time rendering of massive unstructured raw point clouds using screen-space operators.
- [RDG16] ROYNARD X., DESCHAUD J. E., GOULETTE F.: Fast and Robust Segmentation and Classification for Change Detection in Urban Point Clouds.

Rendering pipeline



Results

We illustrate our work on two real-world laser scanned datasets:

- Railway MLS dataset: 600m long railway, **35 million points**.
- School of Mines TLS dataset: 14 rooms, 9 facades, **2.1 billion points**

All the images have been rendered at 1248 x 768 on a 3.4 Ghz Intel Core i7 with an Nvidia GT 640.

Adaptive HPR reduces the mean computational cost of the algorithm:

HPR kernel size (px)	[PGA11]*	our method*
9×9	17.4	27.4
15×15	9.1	25.6
25×25	4.2	24.4

* frame rates in FPS



Railway dataset: (a) One pixel per point. (b) [PGA11] algorithm. (c) Our method.

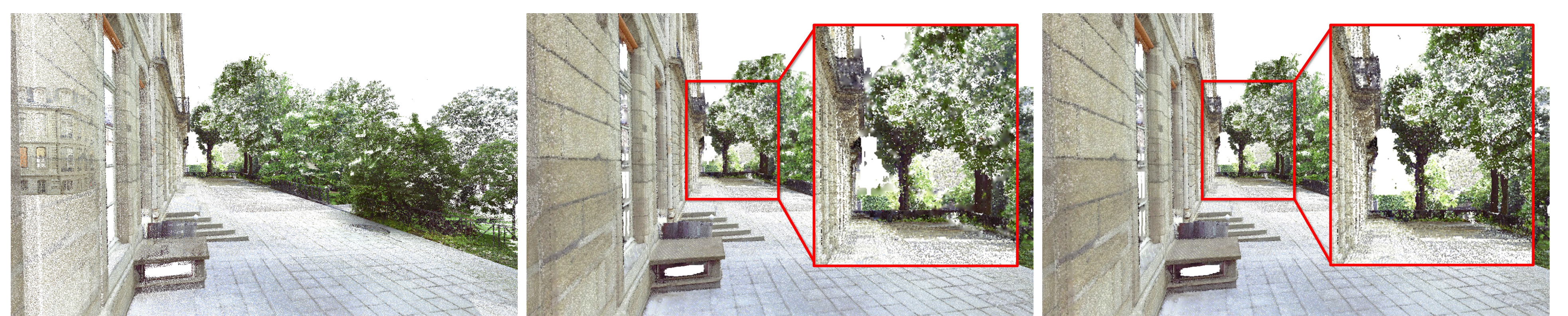


Railway dataset: (a) One pixel per point. (b) [PGA11] algorithm. (c) our method.

Our adaptive visibility HPR does not over-detect holes in the model: the gap between the ground and the bridge is detected as a hole with [PGA11] whereas it is not with ours.



Railway dataset: Recovering a filled surface in low density regions.



School dataset: (a) One pixel per point. (b) [PGA11] algorithm. (c) our method.

The part of the building seen by transparency on the left is well filled by both algorithms. Our algorithm gives better results on tree edges.