Diplomarbeitspräsentation

FAKULTÄT FÜR !NFORMATIK

Faculty of Informatics

Local Reconstruction using Anisotropic Neighborhoods

Masterstudium:
Computergraphik &
Digitale Bildverarbeitung

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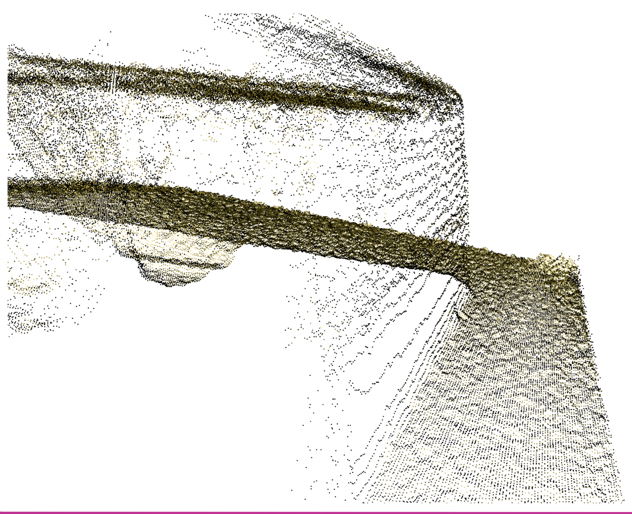
Motivation / Problem statement

Typical Input of a 3D scanner: (e.g. Kinect)



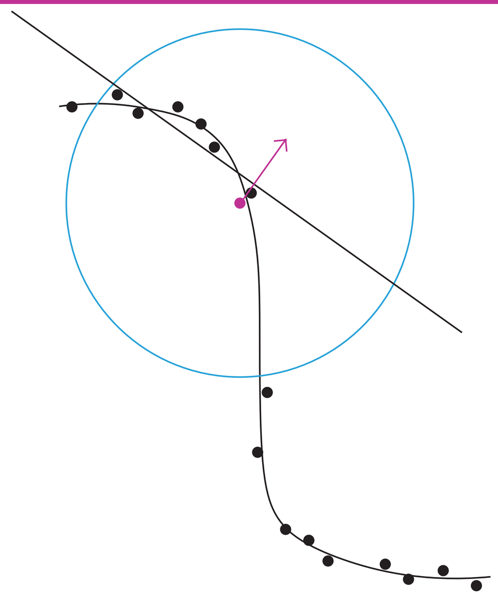
Surface reconstruction is difficult:

- points are not evenly distributed over the surface (non-uniform sampling)
- noise level is not constant

Common approach:

isotropic neighborhood (equal in all directions)

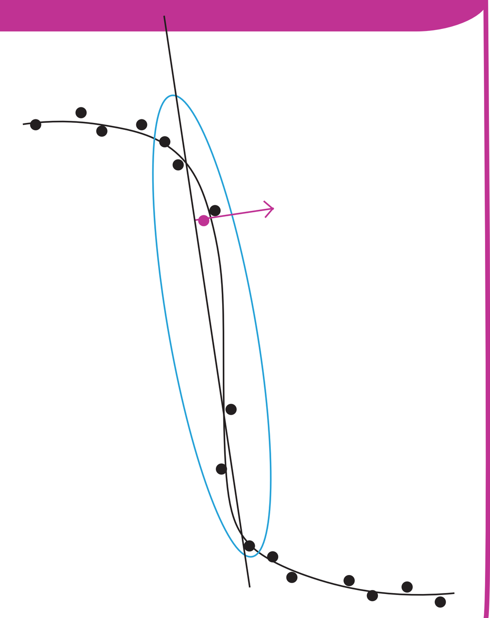
- Neighbors are chosen just based on their distance.
- Same radius for whole model
- Disregarding local sampling densities and noise levels



Goal:

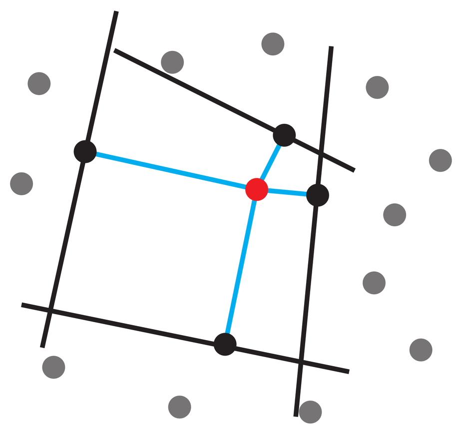
adaptive anisotropic neighborhood

- Neighborhood defined by spatial relation between the points
- Adapted to each point and its vicinity, considering local sampling and noise extent

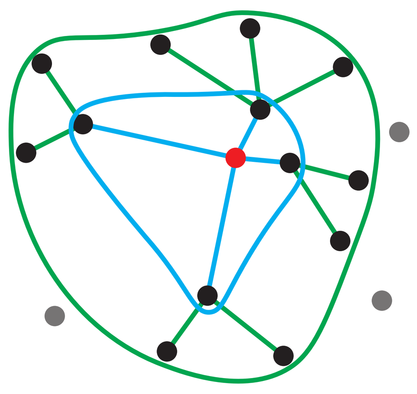


Contribution: Anisotropic N-ring Neighborhood

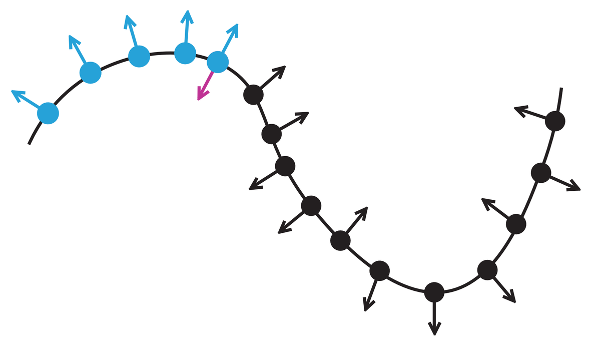
0-ring (immediate neighborhood): each neighbor defines a plane and occludes other possible candidates. Non-occluded neighbors form the 0-ring.



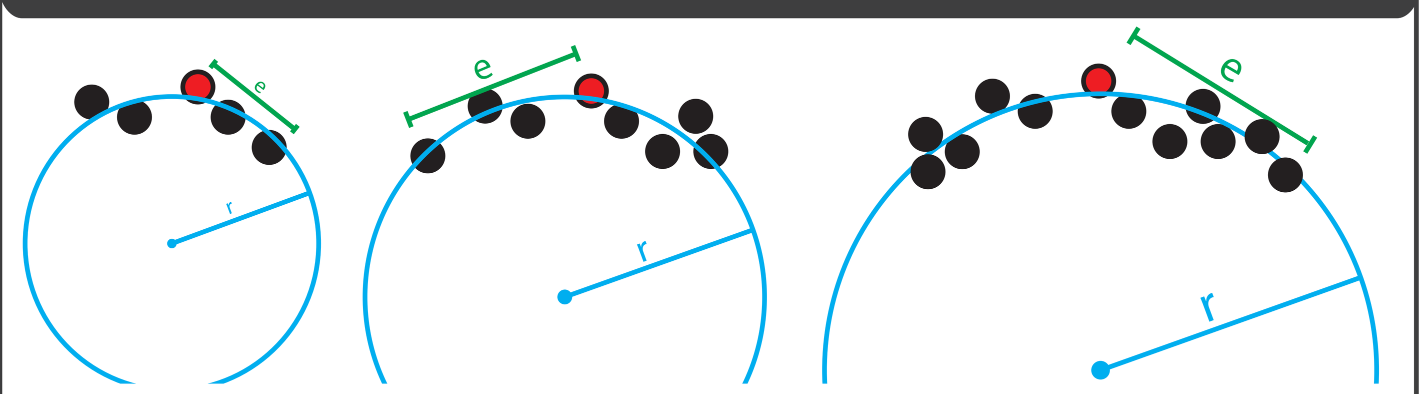
Subsequent rings are the union of the 0-rings of the current neighborhood. E.g.: 1-ring (green) is the union of the 0-rings of the points of the 0-ring neighborhood (blue).



Use neighborhood relation for normal vector orientation propagation. (no need for extra graph structure)



Contribution: Adaptive Resampling

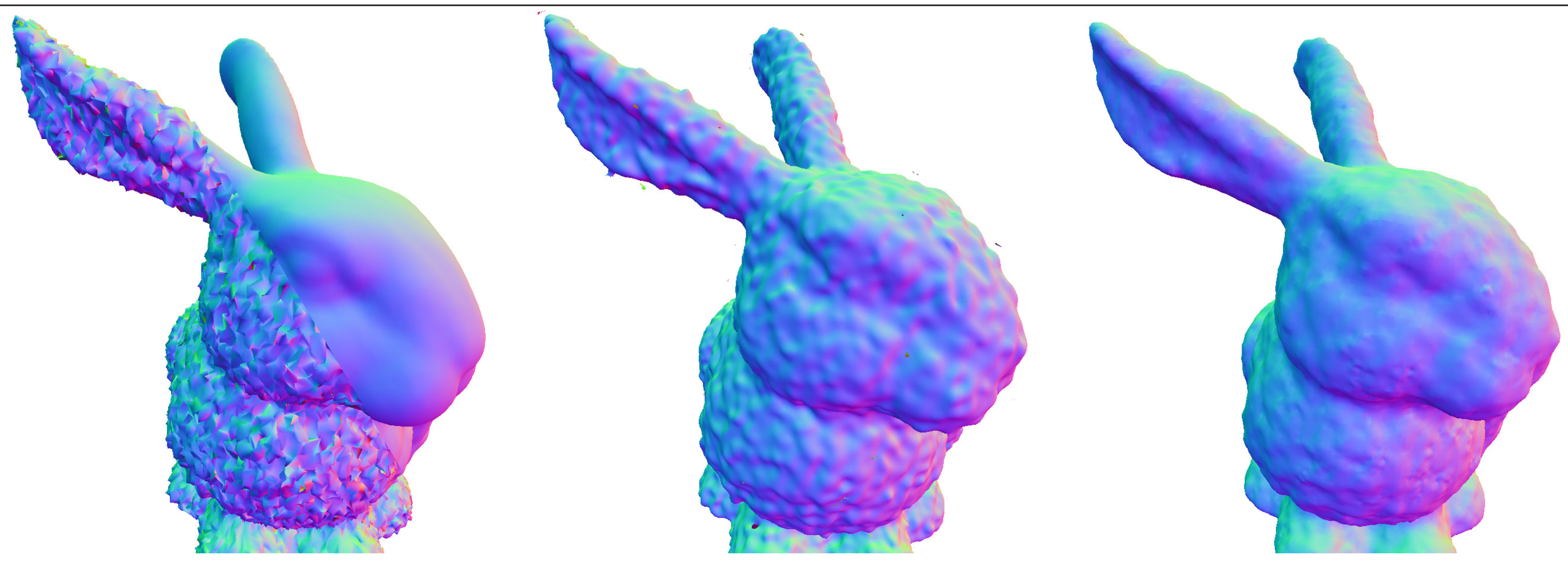


Initialization:
Algebraic sphere fitting to 0-ring neighborhood

Evaluation:
Criterion function compares curvature and neighborhood sampling

Extension:
If criterion is not met, next points of the N-ring neighborhood are added and the local surface is re-fitted

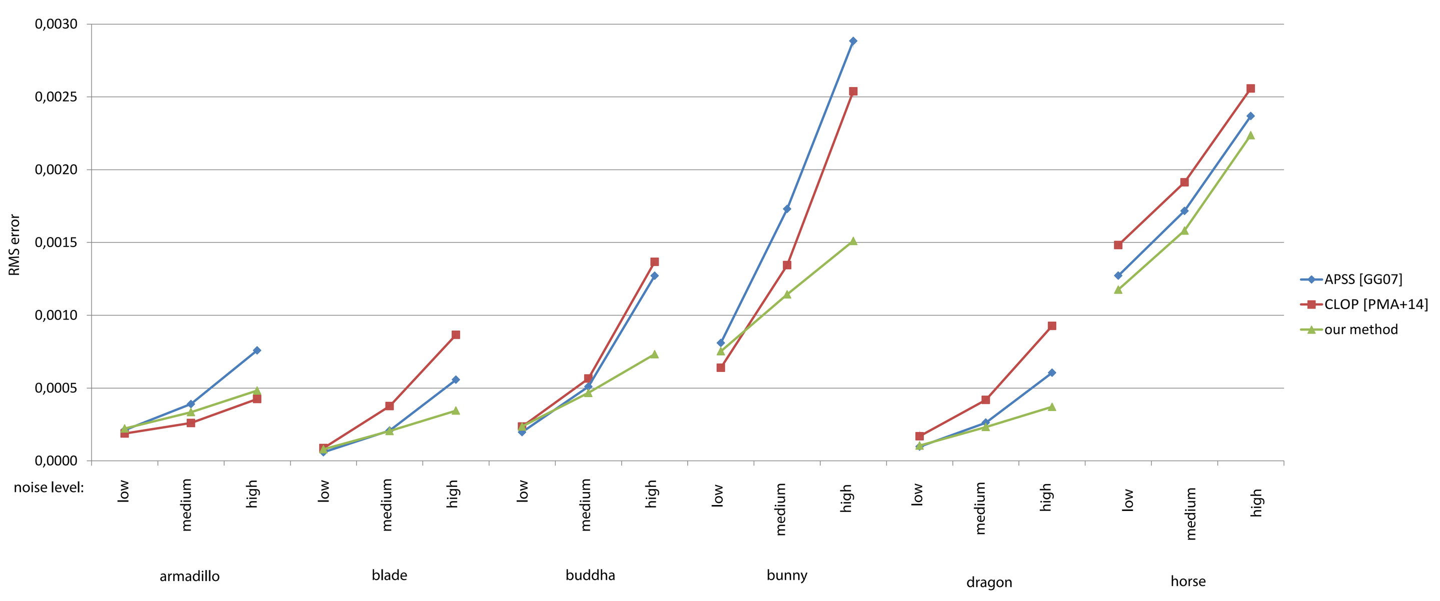
Results & Conclusion



Original/noise APSS [GG07] Our method

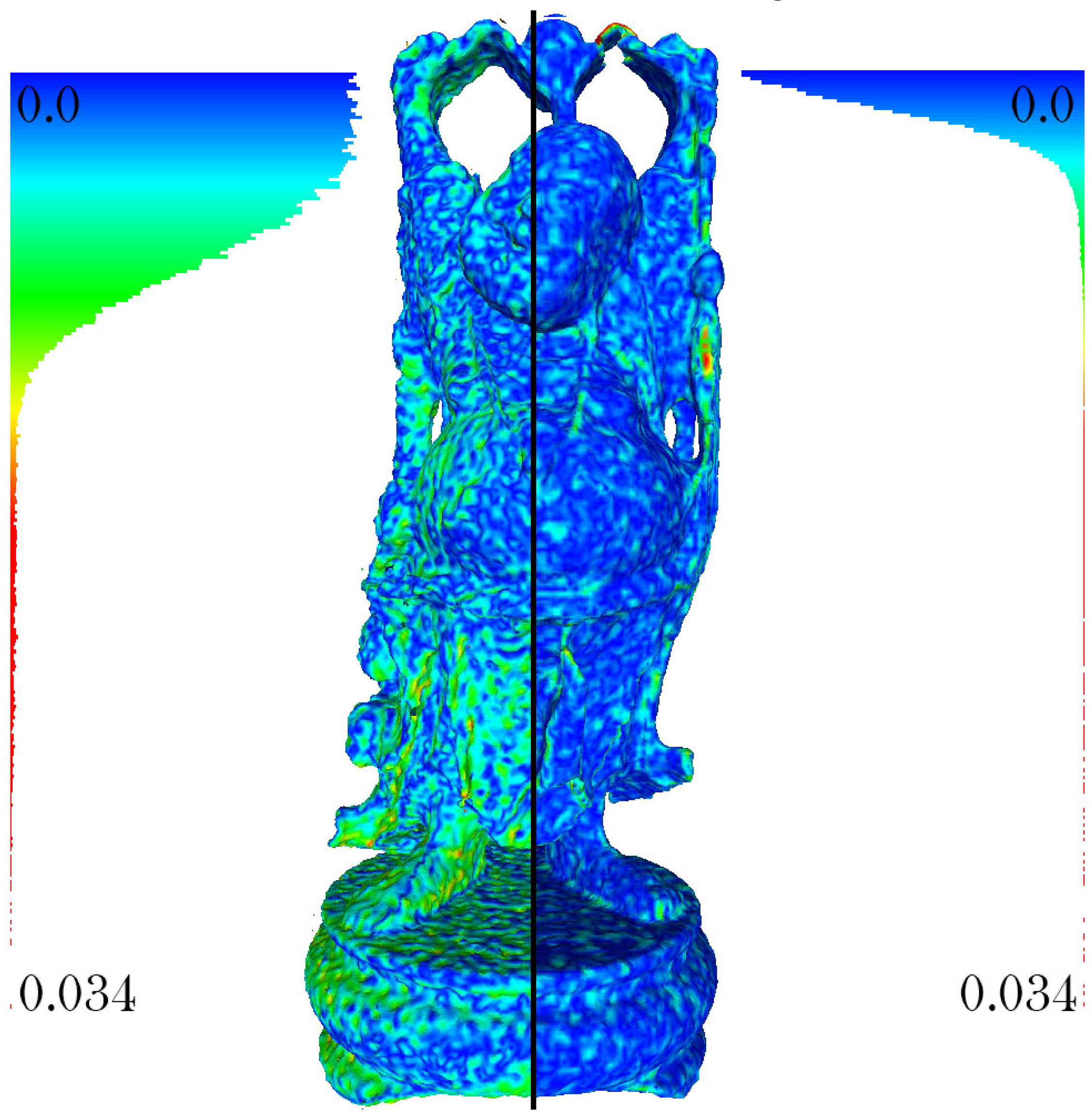
- better noise reduction
- details are preserved

Comparison of the resampling quality



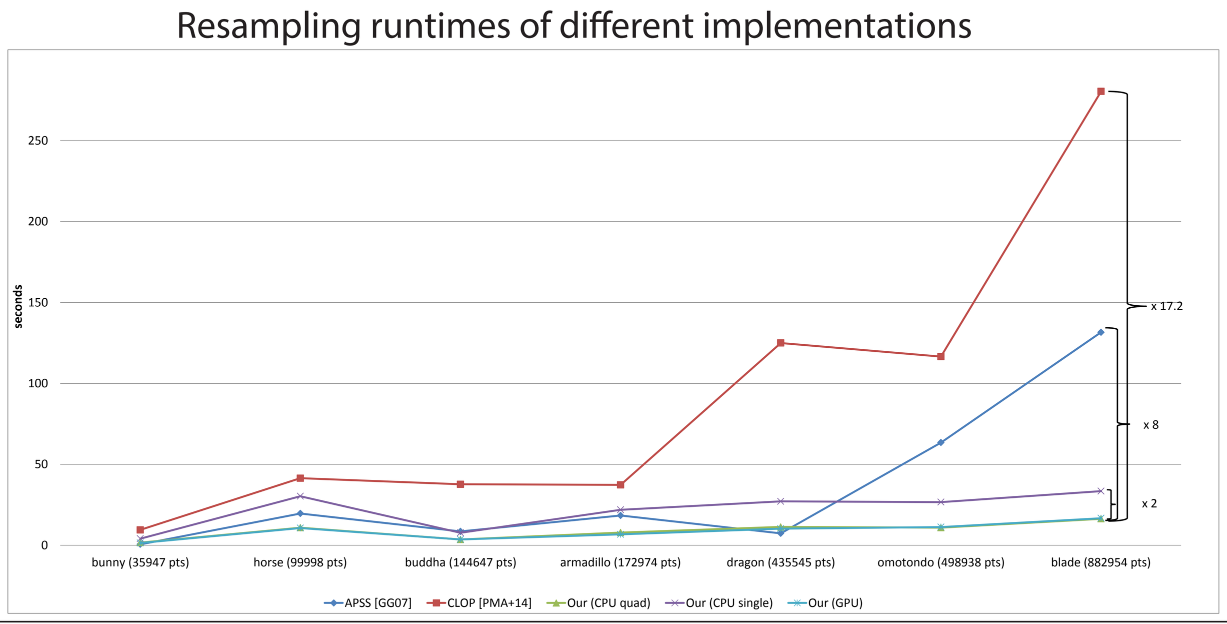
- better resampling quality on most tested models
- better results especially with higher noise levels
- no user-specified parameter required

Visualization of the (one-sided) Hausdorff-distance between the original and the reconstructed mesh.
Left: APSS [GG07] Right: our method

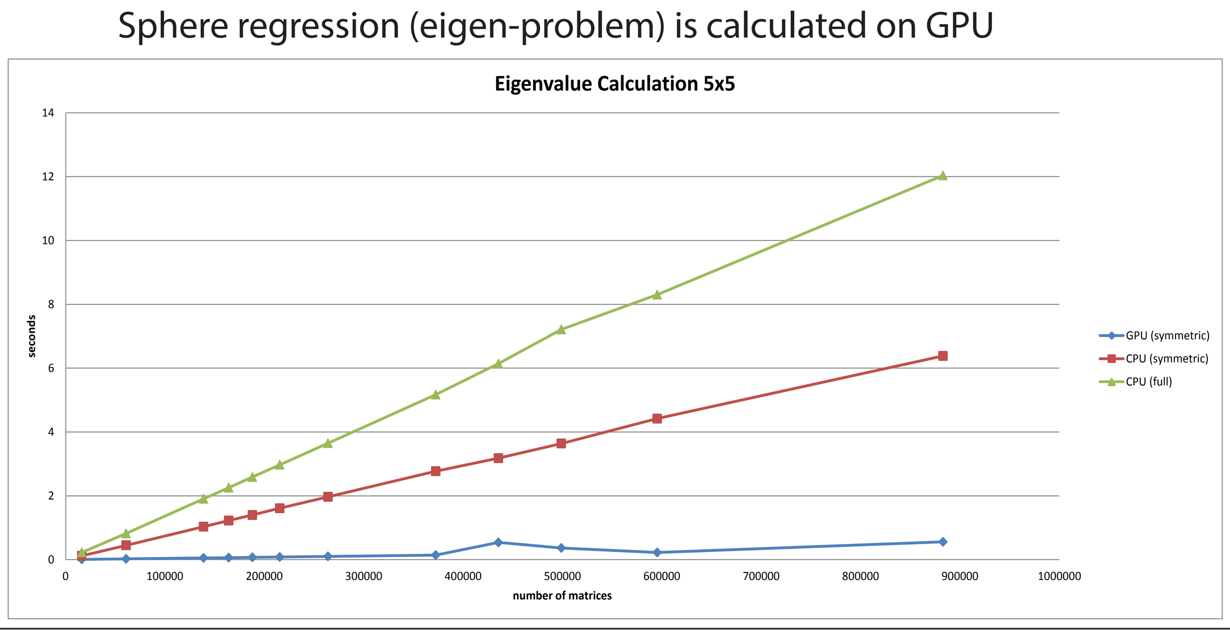


- each point is handled individually, can be implemented in parallel
- adaptive method (multiple iterations) still faster than APSS [GG07]
- regression calculations (5x5 eigen-problem) handled by GPU

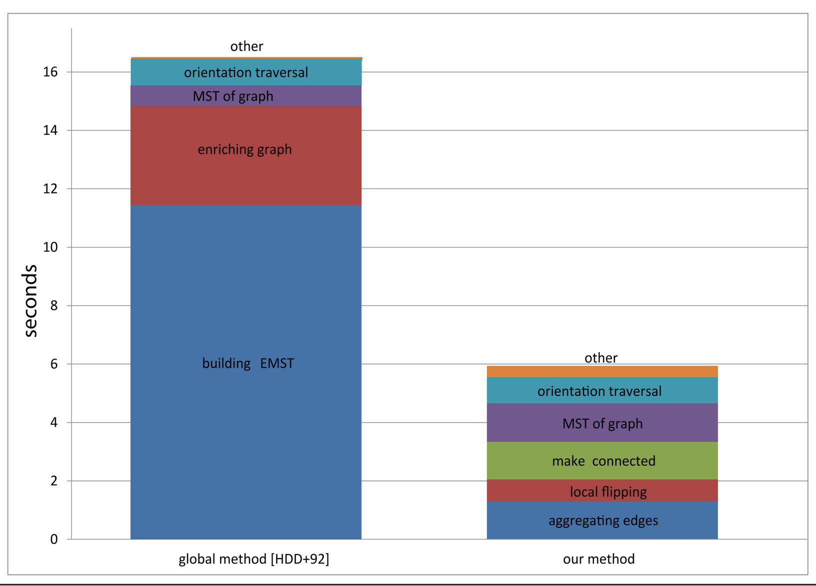
Resampling runtimes of different implementations



GPU-assisted implementation:
Sphere regression (eigen-problem) is calculated on GPU



Listing of the single stages of the normal vector orientation.
Left: building a global data-structure [HDD+92]
Right: Our method of reusing the neighborhood data



References:

[GG07] Gaël Guennebaud and Markus Gross. Algebraic point set surfaces. In *ACM SIGGRAPH 2007 Papers*, SIGGRAPH '07, New York, NY, USA, 2007

[PMA+14] Reinhold Preiner, Oliver Mattausch, Murat Arikan, Renato Pajarola, and Michael Wimmer. Continuous projection for fast l1 reconstruction. *ACM Transactions on Graphics (Proc. of ACM SIGGRAPH 2014)*, 33(4):47:1– 47:13, August 2014.

[HDD+92] Hugues Hoppe, Tony DeRose, Tom Duchamp, John McDonald, and Werner Stuetzle. Surface reconstruction from unorganized points. In *Proceedings of the 19th Annual Conference on Computer Graphics and Interactive Techniques*, SIGGRAPH '92, pages 71–78, New York, NY, USA, 1992

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