

Simplification of digital terrain models using feature-based three-dimensional methods

Hugo Ledoux, Ravi Peters and Jantien Stoter

2nd user committee meeting

2014/09/11

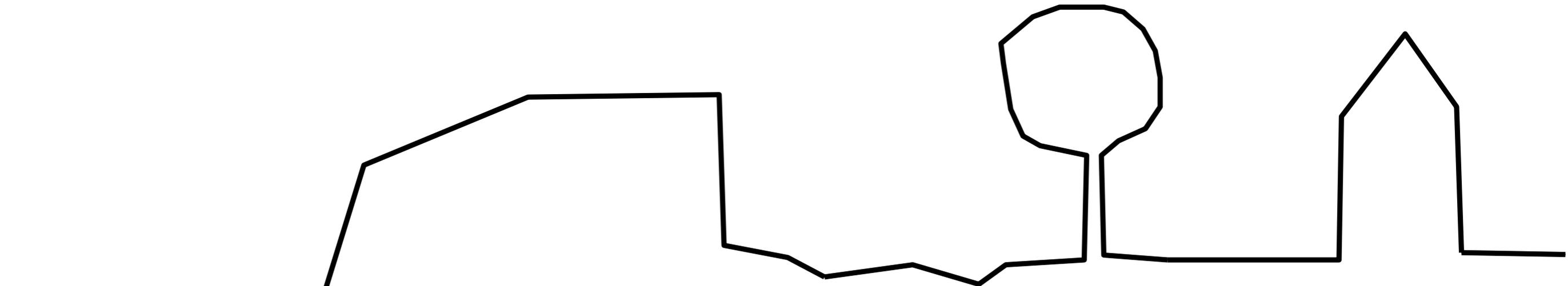
Rotterdam

What was the project about again?

dike

tree

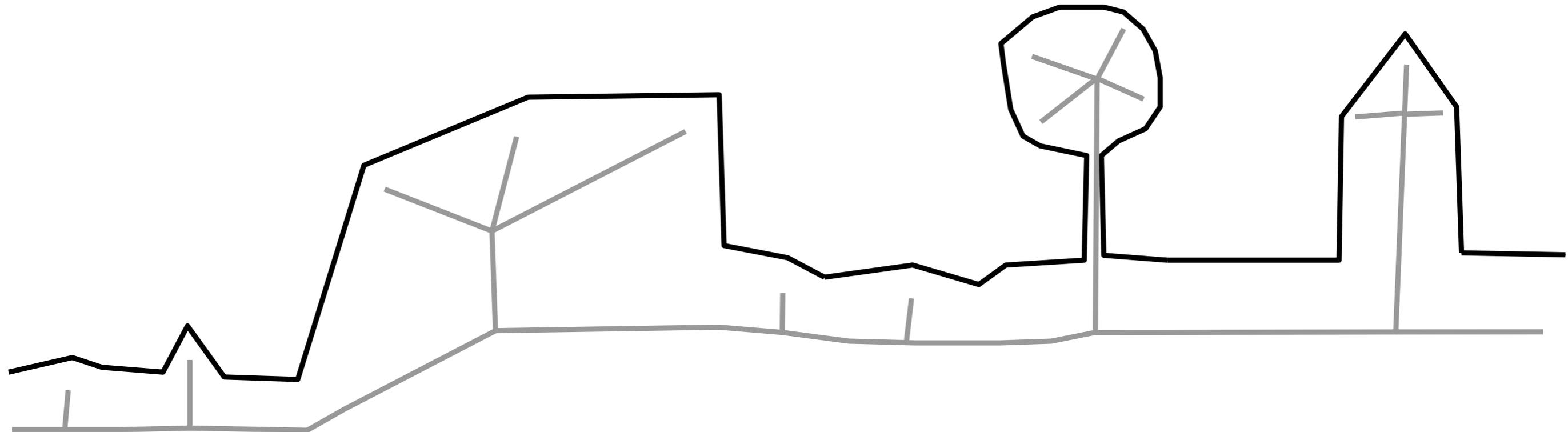
house



dike

tree

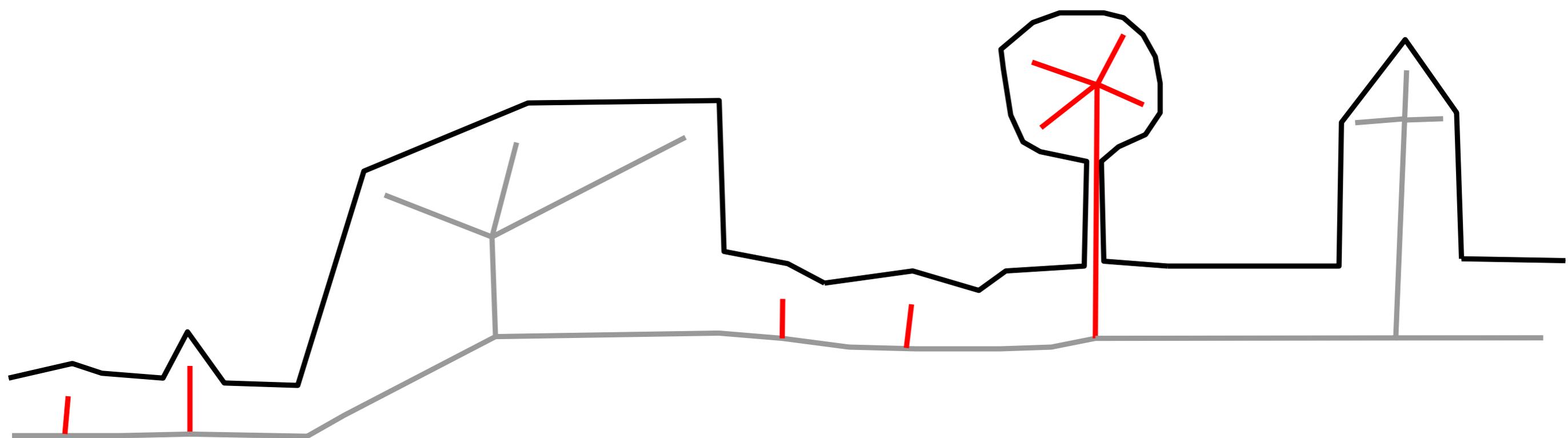
house



dike

tree

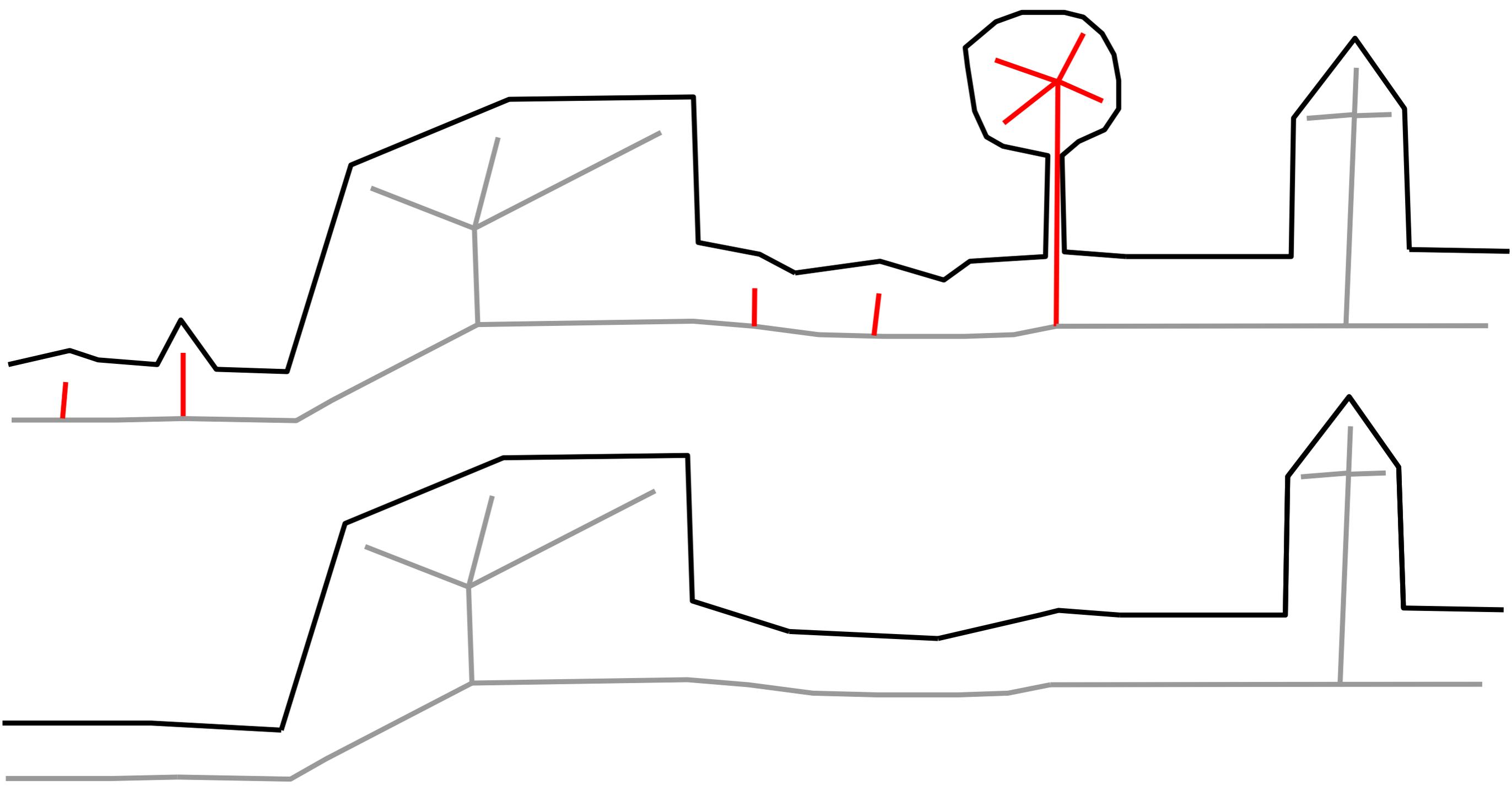
house



dike

tree

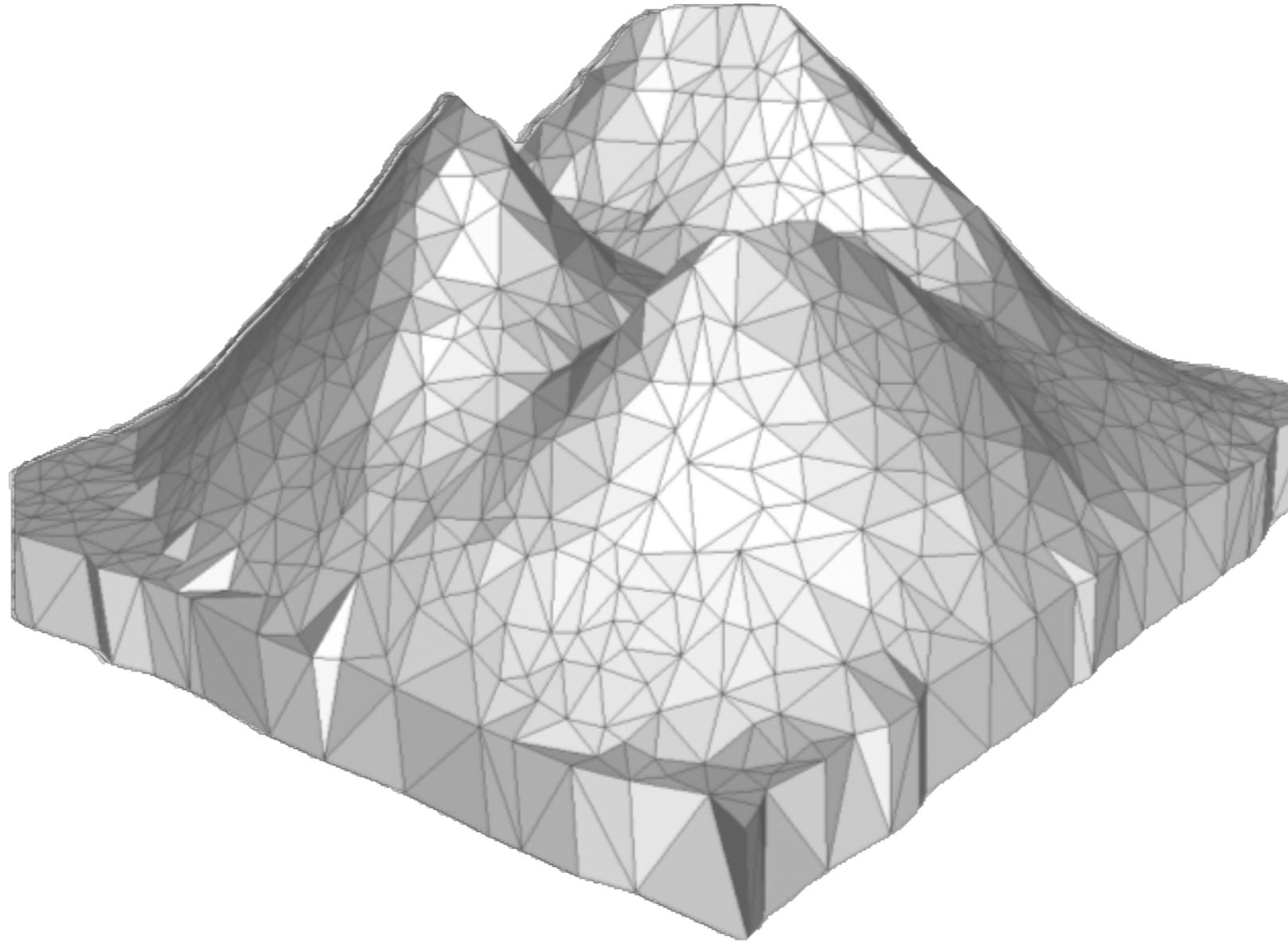
house



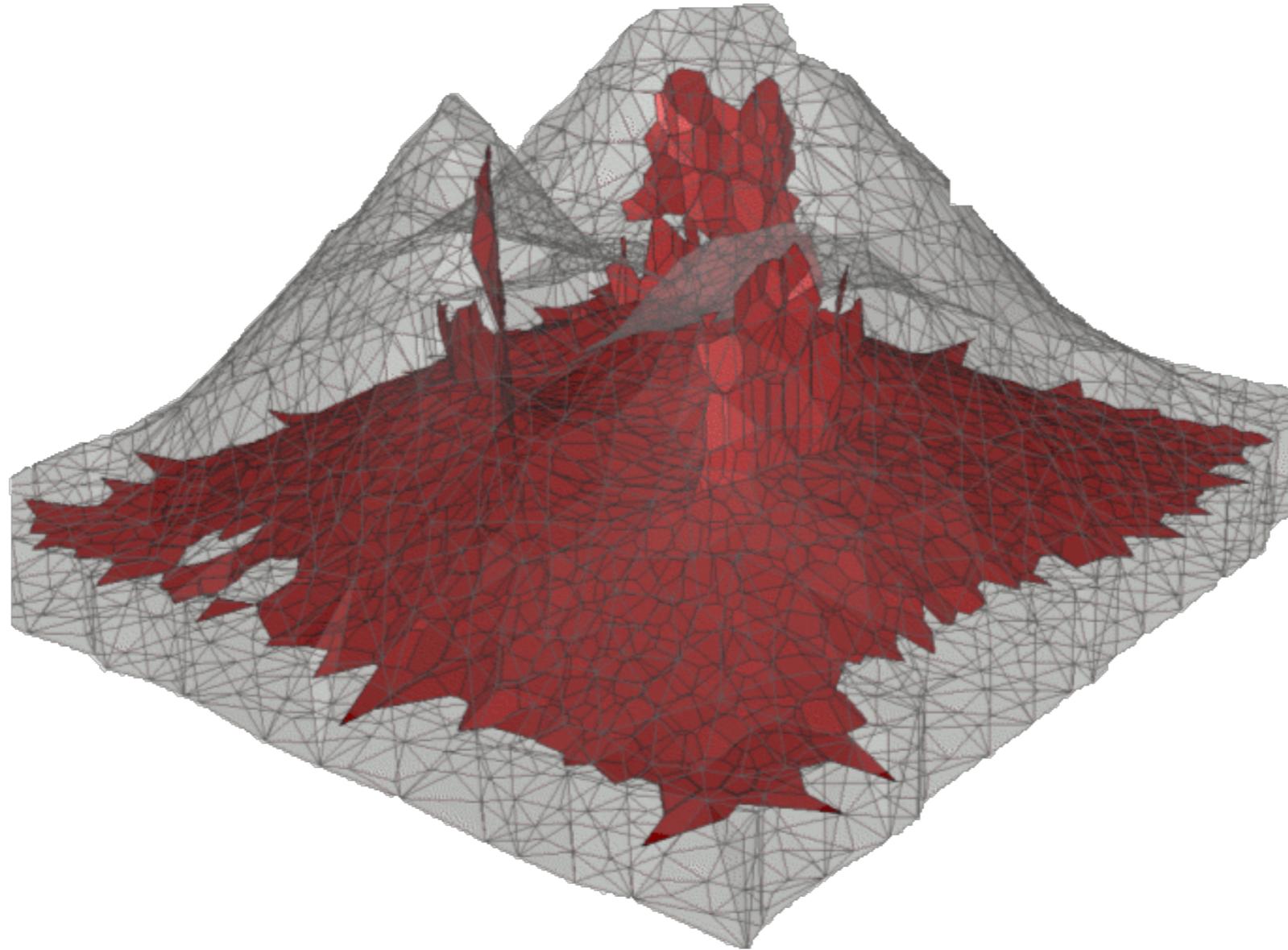
Medial axis transform (MAT) = skeleton



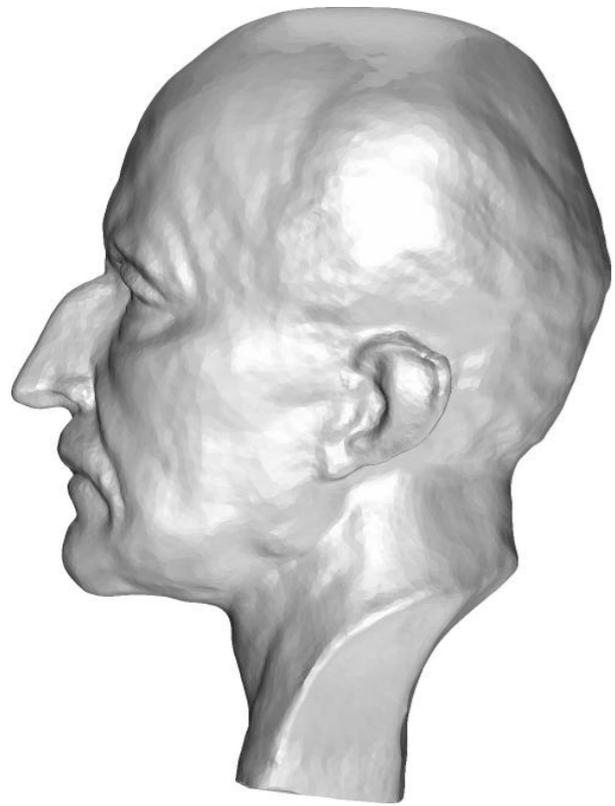
Medial axis transform (MAT) = skeleton



Medial axis transform (MAT) = skeleton



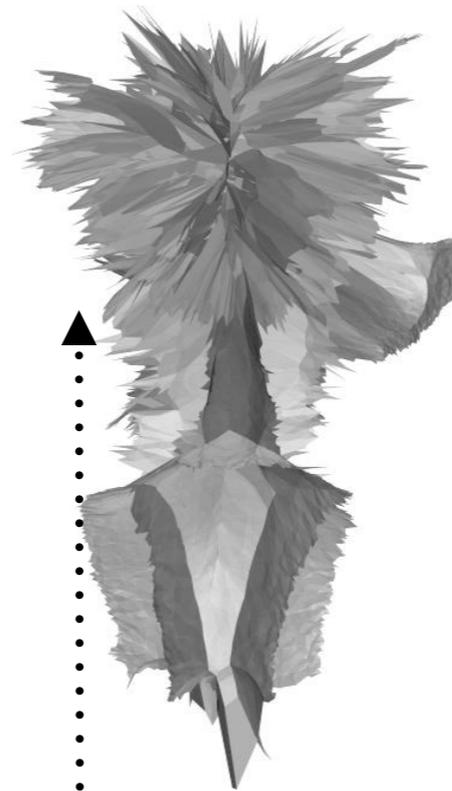
Tam & Heidrich (2003)



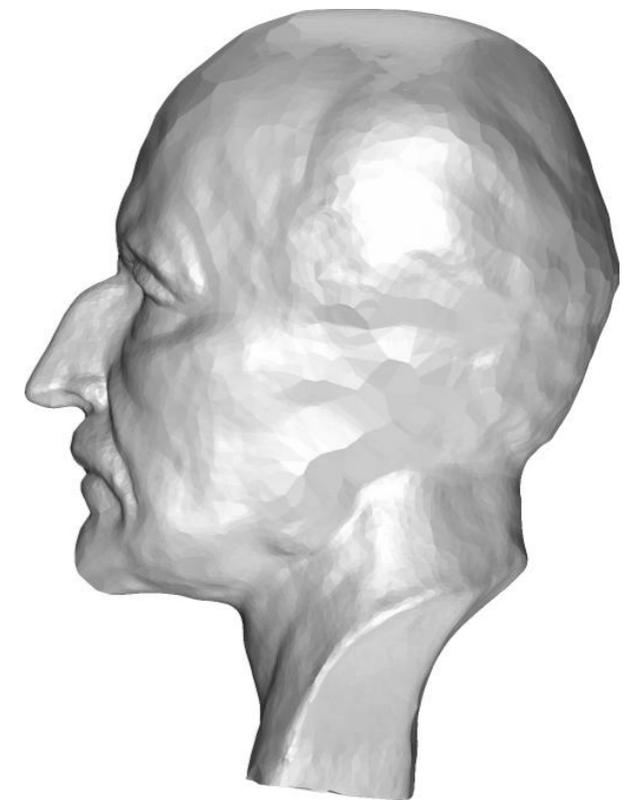
input



MAT



**ear
removed
from MAT**



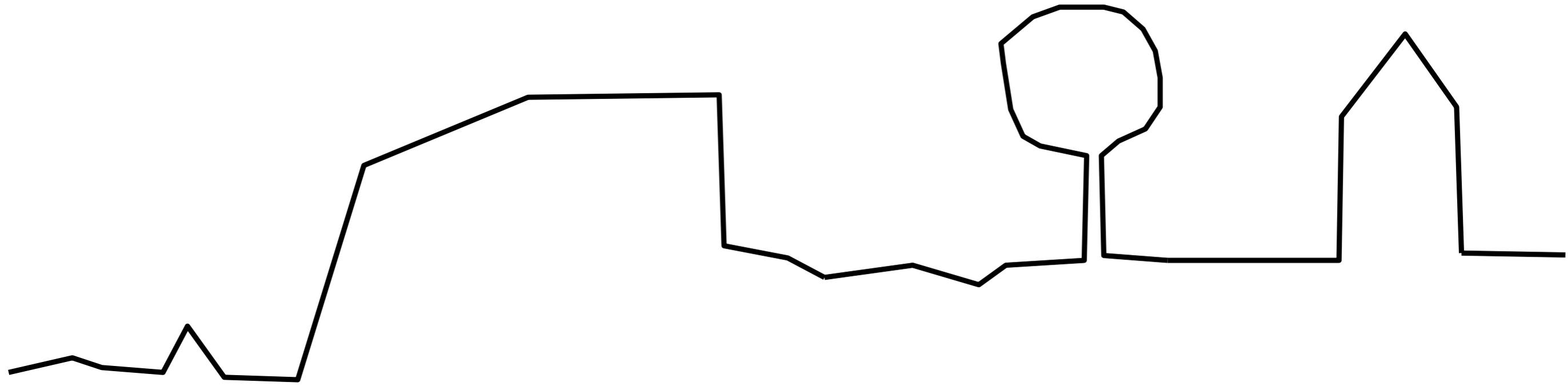
results

New & “improved”: no more surface, just the points

dike

tree

house

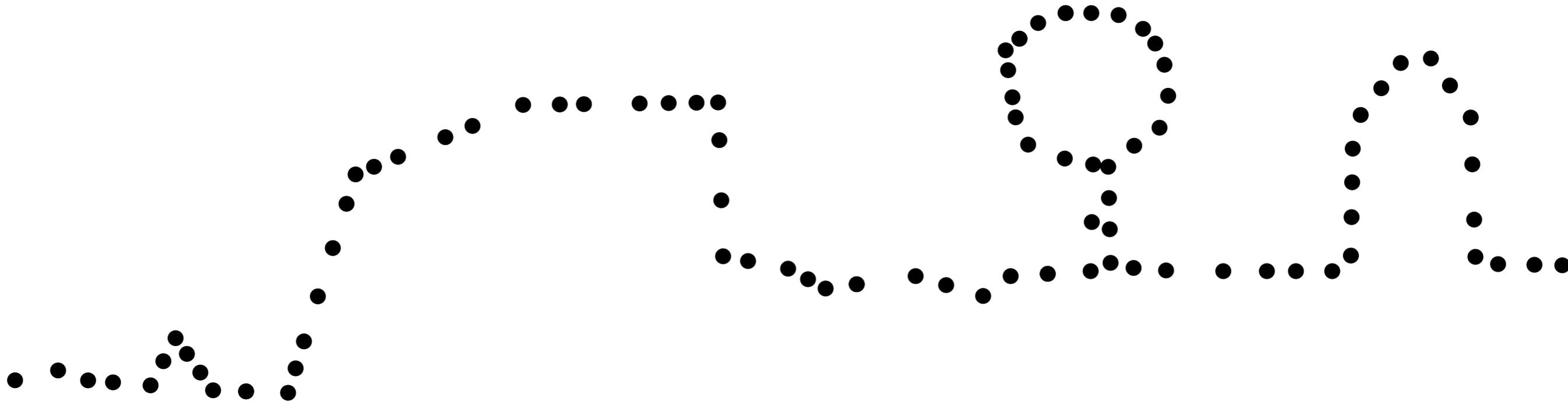


New & “improved”: no more surface, just the points

dike

tree

house

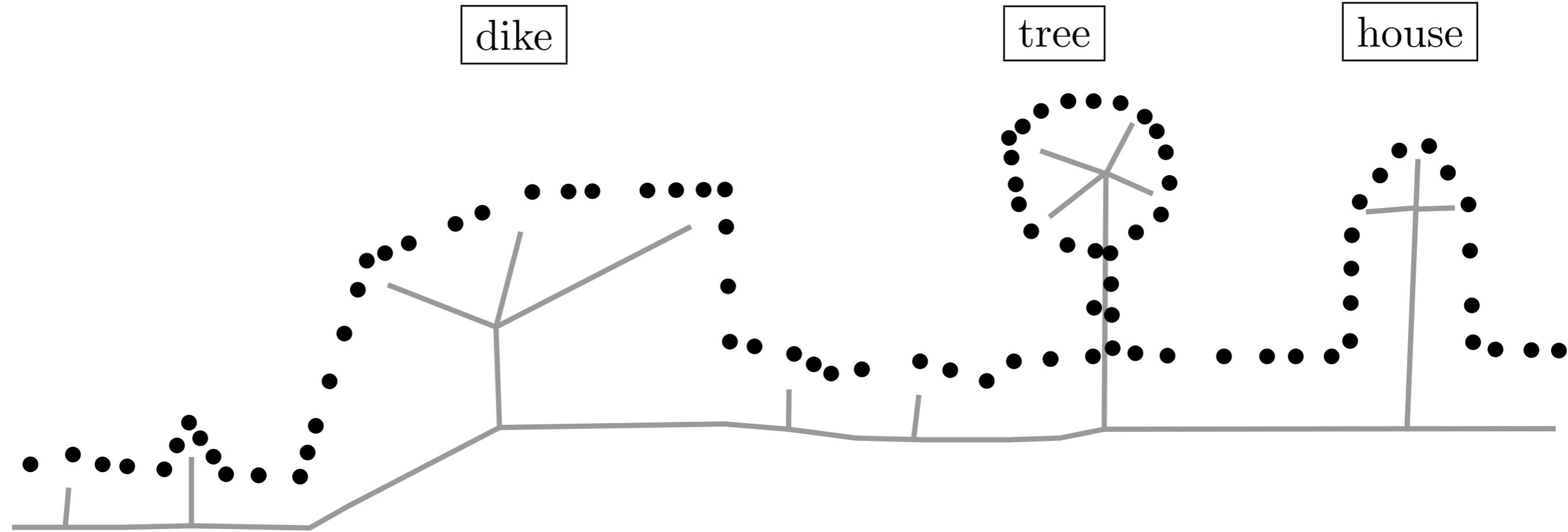


New & "improved": no more surface, just the points

dike

tree

house



Main results:

1. project page: <http://3dsm.bk.tudelft.nl>
2. alternative platform to download AHN2
3. diff presentations/workshops/conferences
4. prototype implementations → Ravi's pres
5. journal paper submitted: "Simplification of aerial LiDAR point clouds based on the local feature size"

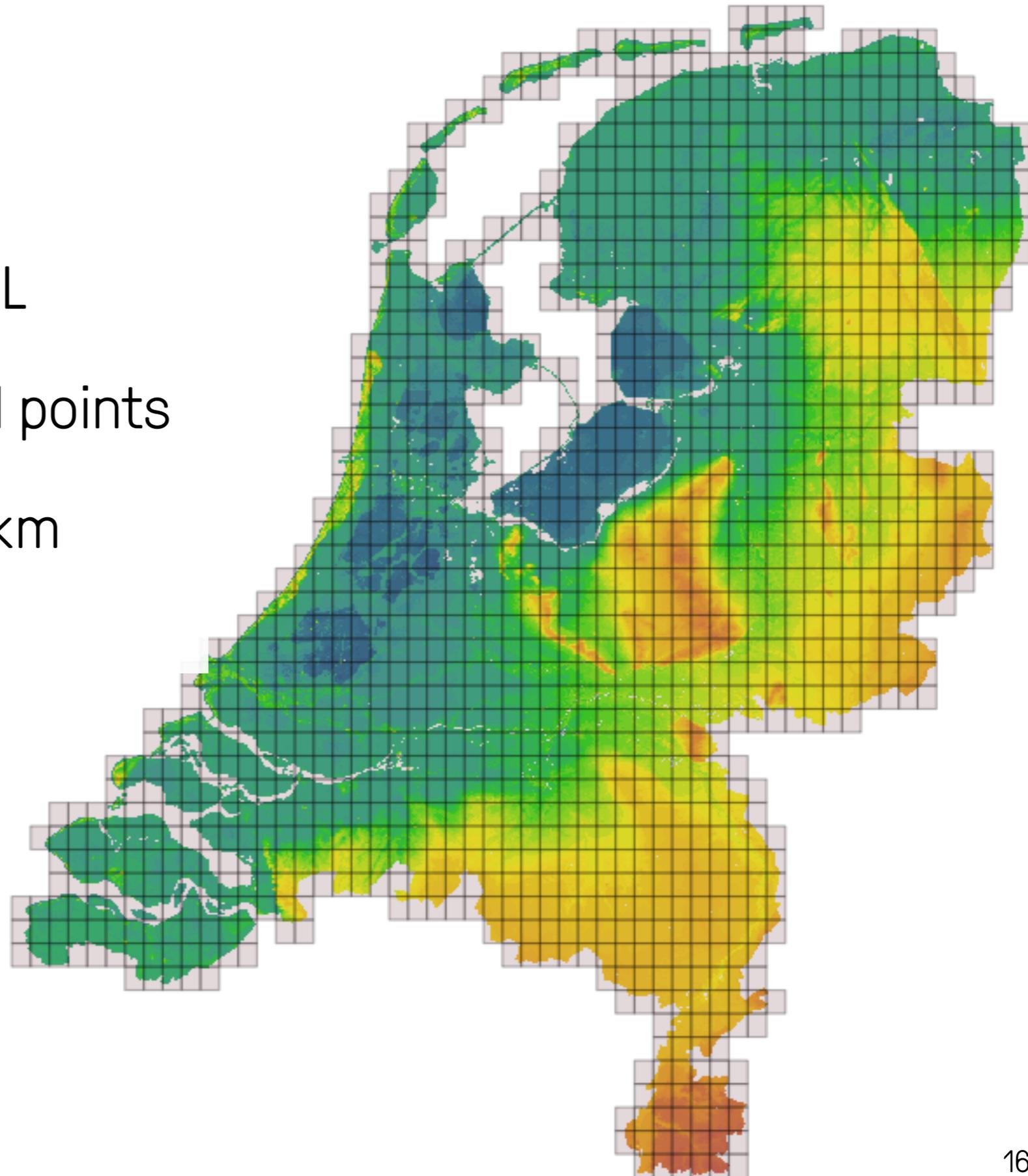
Activities coming year:

1. Continue prototype for real-cases
2. attempt to scale to massive datasets
3. starting work on the identification of features in point clouds
4. Ravi will make a research visit in February 2015 to Dr Michela Spagnuolo in Genova, Italy
5. write and publish one conference paper (based on use-cases), and write another journal paper (in collaboration with Michela Spagnuolo)

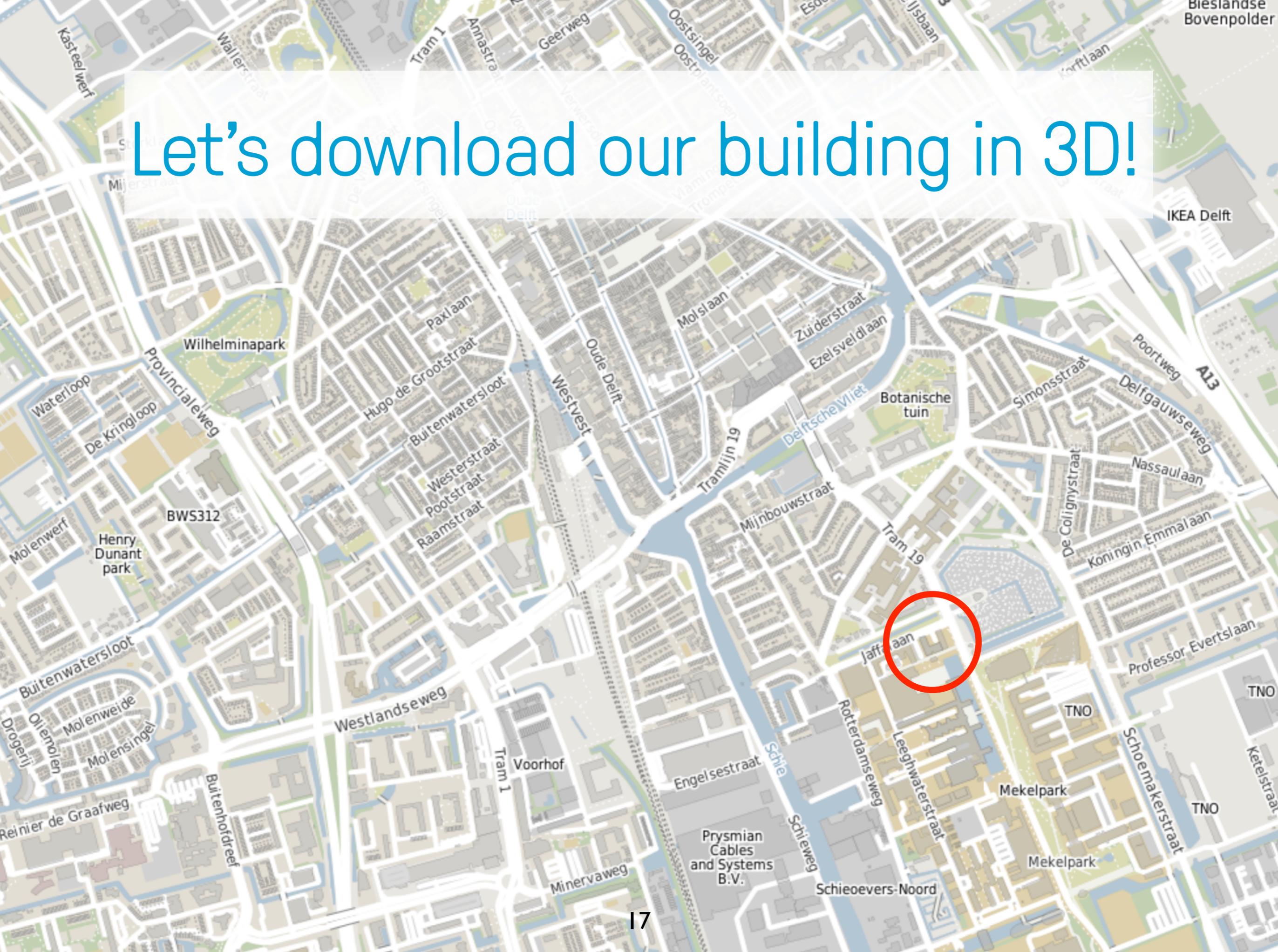
MATAHN

A seamless AHN2 download service

- elevation model whole NL
- it's big: 639,477,709,621 points
- 1372 tiles of 5km × 6.25km



Let's download our building in 3D!



Official AHN2 download workflow

1. get WMS to get tile name
2. get WMS of base map to locate our building
3. find download links in the Atom feed of PDOK
4. download the two files (gefiltered and uitgefiltered)
5. combine them to view the building and its surrounding

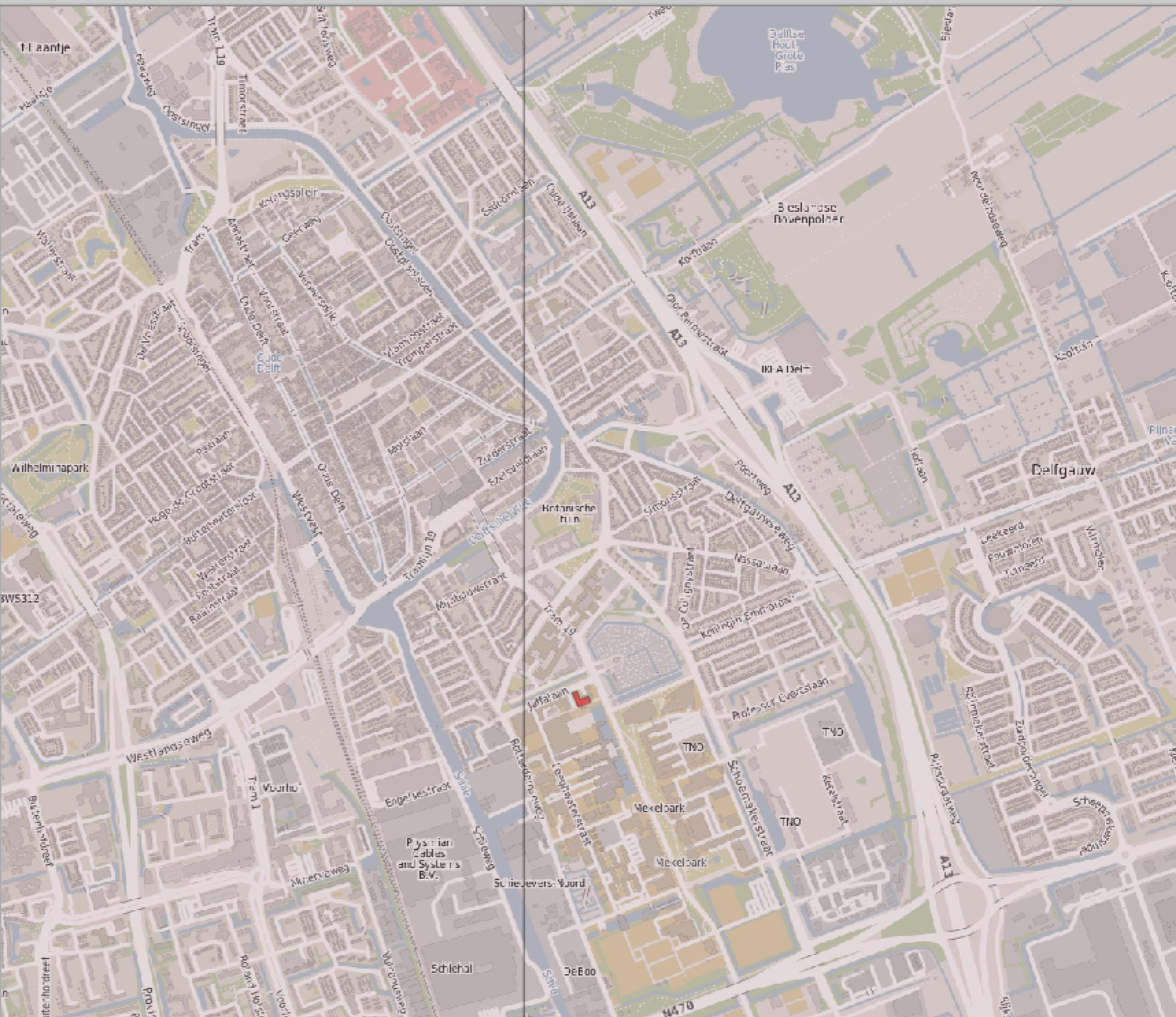


PDOK Geocoder zoek

Layers

- our building
- ahn2_bladindex
- ahn2_5m [ahn2_5m_detail]
- osm

Layers Browser



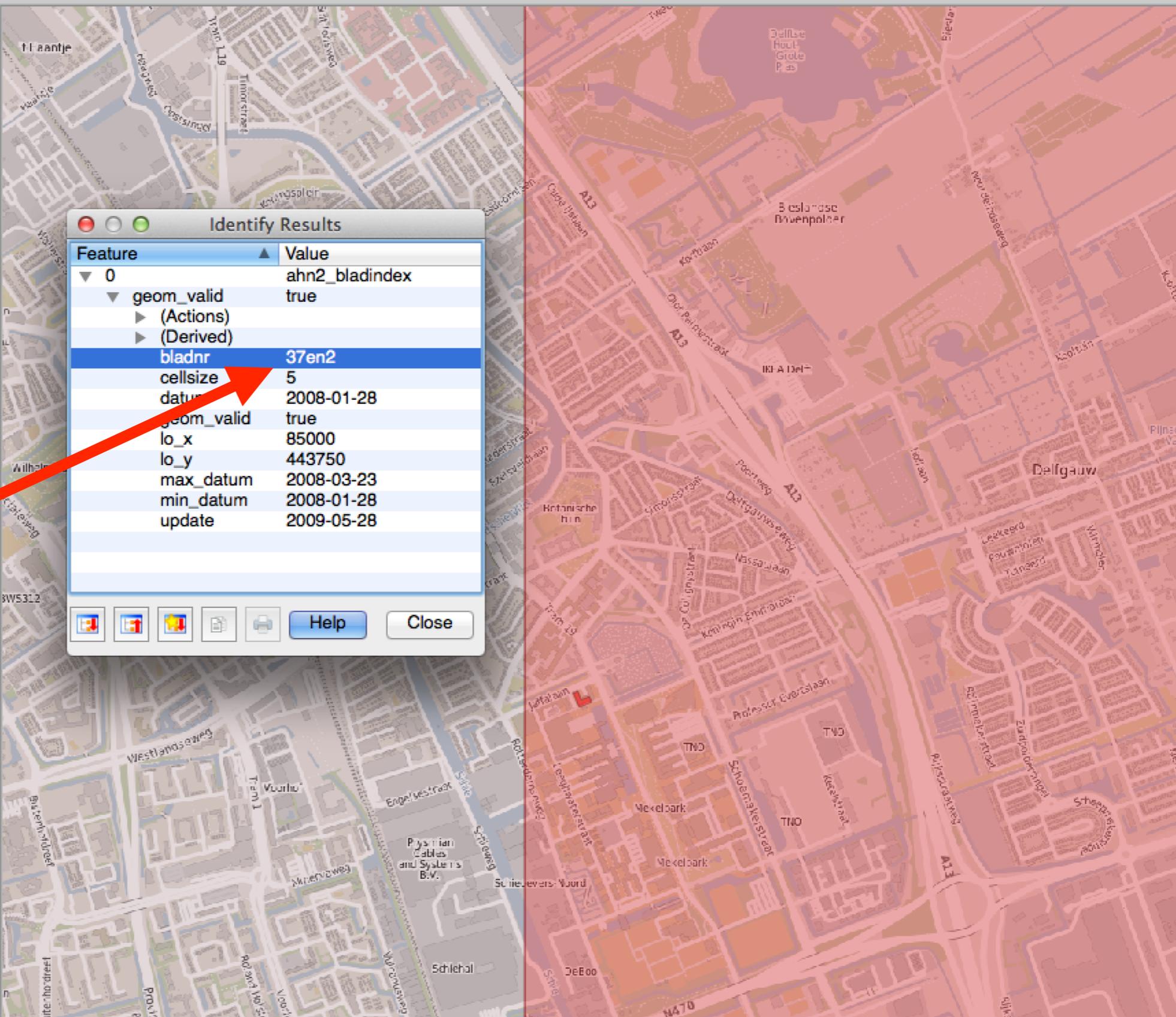
Getting tiles.



Layers

- our building
- ahn2_bladindex**
- ahn2_5m [ahn2_5m_detail]
- osm

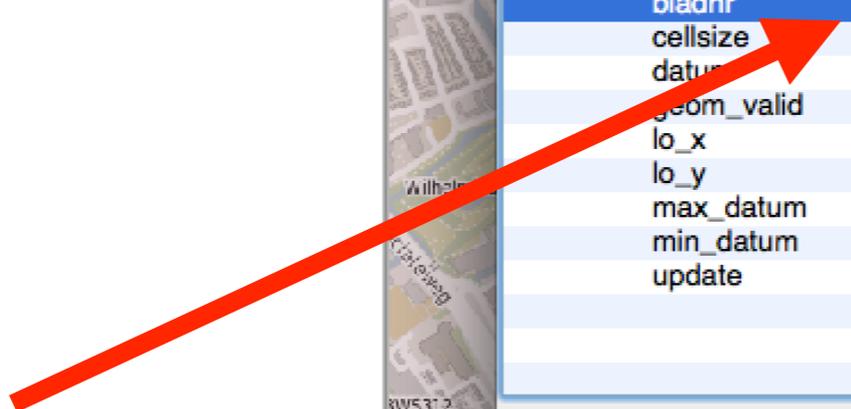
Layers Browser



Identify Results

Feature	Value
0	ahn2_bladindex
geom_valid	true
(Actions)	
(Derived)	
bladnr	37en2
cellsize	5
datum	2008-01-28
geom_valid	true
lo_x	85000
lo_y	443750
max_datum	2008-03-23
min_datum	2008-01-28
update	2009-05-28

Help Close



g37en2 1 of 4

```
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g37en2.laz.zip

367,517,644 points

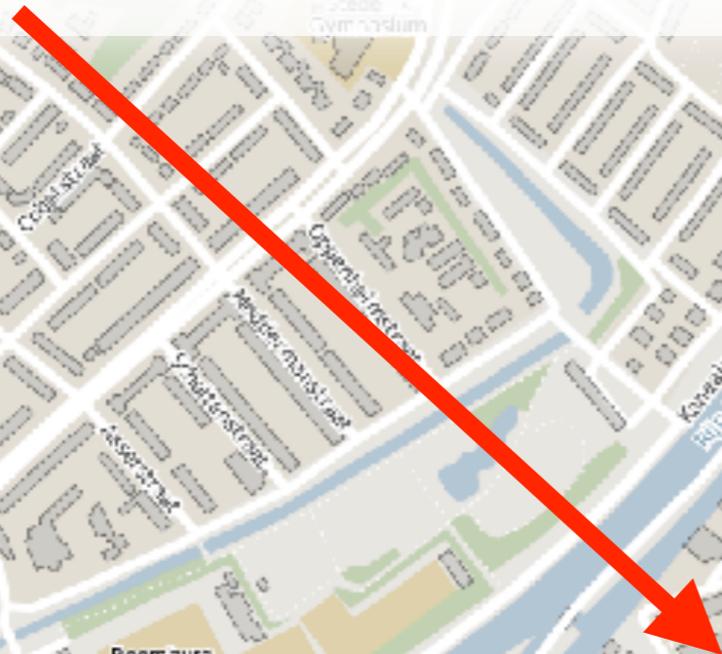
431MB

u37en2.laz.zip

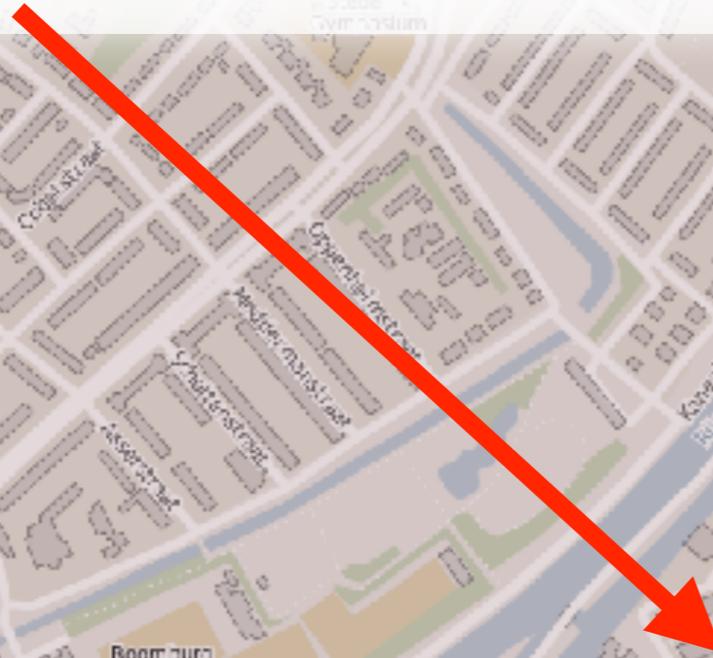
157,259,896 points

440MB

Happy not to work there



Happy not to work there



AHN2 - Overzicht download links

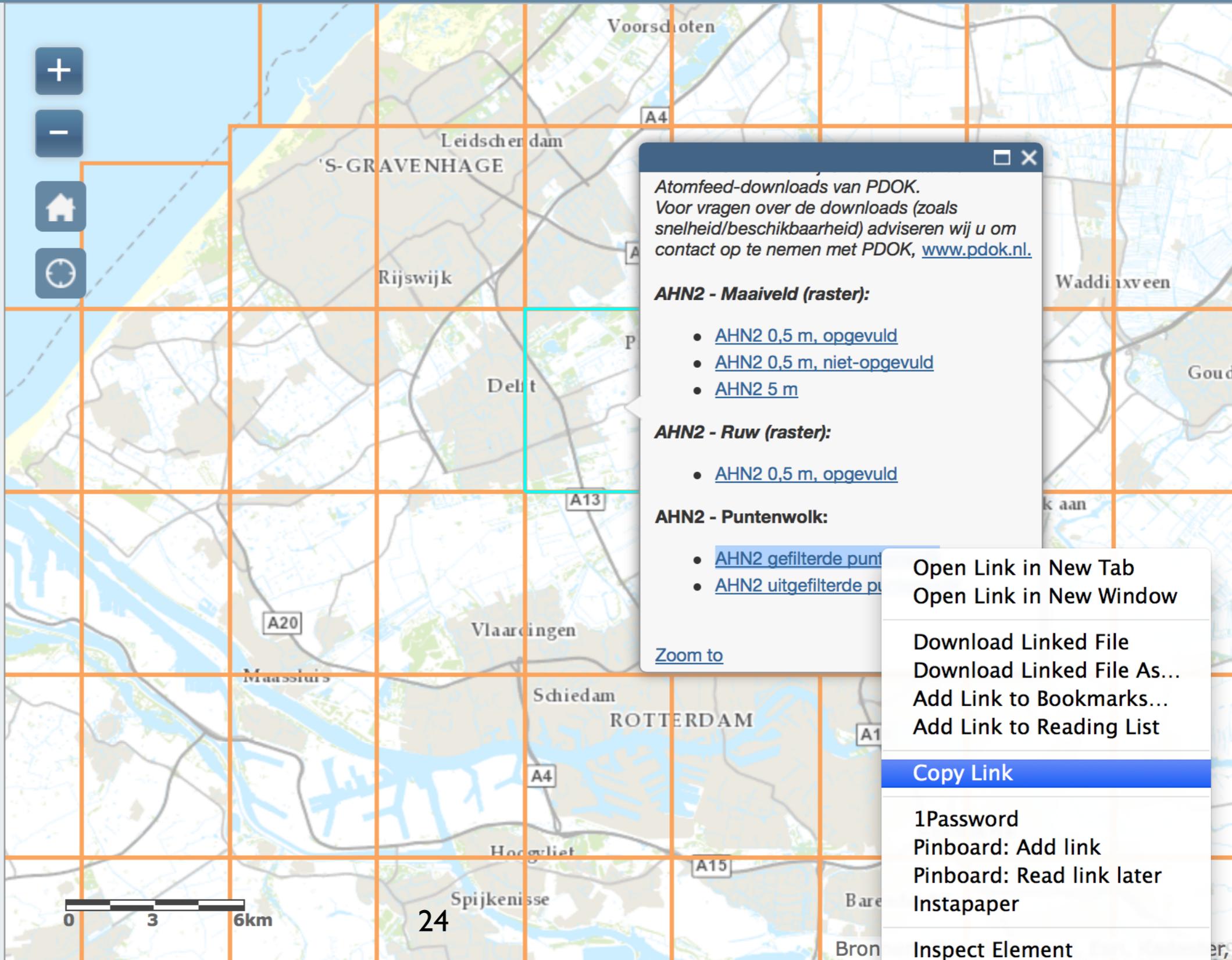
Details

Deze kaart geeft een overzicht van alle beschikbare kaartbladen van het Actueel Hoogtebestand Nederland (AHN2). Het is mogelijk om door middel van een pop-up informatie over het desbetreffende kaartblad te krijgen. Via de pop-up kunt u ook gemakkelijk de verschillende AHN2-bestanden downloaden.

NB: Zodra u op een link klikt om het bestand te downloaden, dan doet u dit direct bij PDOK. De links verwijzen allemaal direct naar de juiste kaartbladen in de Atomfeed-downloads van PDOK. Voor vragen/opmerkingen over de downloads (zoals snelheid, beschikbaar) adviseren wij u om contact op te nemen met PDOK, www.pdok.nl.

PDOK maakt onderscheid in de volgende AHN2-datasets:

- Het **AHN2 0,5 meter maaiveldraaster, opgevuld** is bedoeld als maaiveldbestand, waarbij alle niet-maaiveld objecten (bomen, gebouwen, bruggen en andere objecten) uit de puntenwolk zijn verwijderd. Incidentele No-Data cellen zijn opgevuld.
- Het **AHN2 0,5 meter maaiveldraaster, niet-**



How does that compare?

NSF OpenTopography Facility

OpenTopography
A Portal to High-Resolution Topography Data and Tools

[Login] myOpenTopo

Search

Home About **Data** Tools Education Community Support

LIDAR Point Cloud & Processing Raster Google Earth Files Metadata Contribute myOpenTopo

Find LiDAR Topography Data

Instructions:

Google

List all datasets | Search by local

SYSTEM STATUS

Miljøministeriet
Geodatastyrelsen

KORTFORSYNINGEN

DOWNLOAD

Geodataprodukter > Vilkår og betingelser > Hjælp > Om Kortforsyningen/Download

DHM/Punktsky

1. Udtræksmetode 2. Format og koordinatsystem 3. Vælg område på kort

Tilbage Læg i kurv

Udtræksmetode : Færdigt udtræk - 10 km blokke
Format : LAS
Koordinatsystem : UTM32-ETRS89

Valgte område

NLS
NATIONAL LAND SURVEY OF FINLAND

File service of open data

Select product

point

Laser scanning data (1)

point cloud

taustakartta

GeoVisor v.5.0

www.iderioja.larioja.org/geovisor/index_fs.php?lang=es&zoom=4&lat=4658463.49197&lon=...

GeoVisor IDErioja

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
520-4666	522-4666	524-4666	526-4666	528-4666	530-4666																									

Capas - 4666

- La Rioja - Cartografía tematica [IDerioja]
- La Rioja - Cartografía tematica [IDerioja]
- SIGPAC Web Map Service
- Cartografía raster (IGN)
- Mapa Topográfico 50k - IGN

Imprimir (PDF)

Medición

Búsqueda catastral

Compartir

Avisos

Datos asociados en la fecha actual

Coordenada ETRS89 UTM30:

525468.70,4659398.37

Datos asociados: La Rioja - Cartografía tematica [IDerioja]

Capas/ Lidar

Lidar

Id: 1259516

Nombre: Vuelo LIDAR PNOA reclasificado Bloque 524-4660

Proyecto: Reclasificación datos LIDAR vuelo PNOA 2010

Promotor: Trabajo de reclasificación realizado por el Gobierno de La Rioja

Fecha: 03/08/10

Bloque: 524-4660

Densidad: ,5

Observaciones: Fichero LAS reclasificado en 04/2014. Altura Ortométrica. Sistema Geográfico de Referencia: U

ETRS89 Huso 30N (EPSG:25830)

URL: ftp://ftp.larioja.org/sig/tmt/t187/laz/laz_20100803_bloque_524_4660_eps25830.laz

0 Imágenes

1 Documento

Lidar

Id: 1257806

Nombre: Vuelo LIDAR Villoslada de Cameros Bloque 045

Proyecto: Vuelo LIDAR Villoslada de Cameros

Promotor: Gobierno de La Rioja

Fecha: 19/11/09

Bloque: 45

Densidad: 1,5

Observaciones: Fichero LAS no clasificado. Altura Elipsoidal. Sistema Geográfico de Referencia: UTM ETRS89

30N (EPSG:25830)

URL: ftp://ftp.larioja.org/sig/tmt/t187/laz/laz_20091119_bloque_0045_eps25830.laz

0 Imágenes

5 Documentos

Datos asociados: La Rioja - Cartografía tematica [IDerioja]

Selected products

Laser scanning data

point cloud (14/100)

- L4133D3
- L4133F1
- L4133F2
- L4133D4
- L4133D2
- L4133B4
- L4134C1
- L4134C4
- L4134C2

MATAHN: an unofficial alternative

- As simple as possible
- Download only what you need
- No tiles

The screenshot displays the MATAHN web interface, which is a seamless AHN2 download service. It is presented as a series of three overlapping browser windows, each showing a different stage of the user's request.

Window 1: Selection

- Draw selection** (blue button)
- Feedback: "You selected about 245 thousand points!"
- Classification**: dropdown menu set to "ground (gefilterd)"
- Thinning (coming soon)**: dropdown menu set to "nth point"
- Email**: input field with "Your Email" placeholder
- Submit** (grey button)

Window 2: Processing

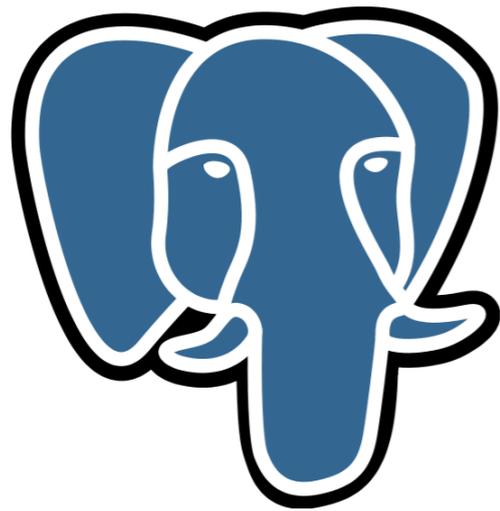
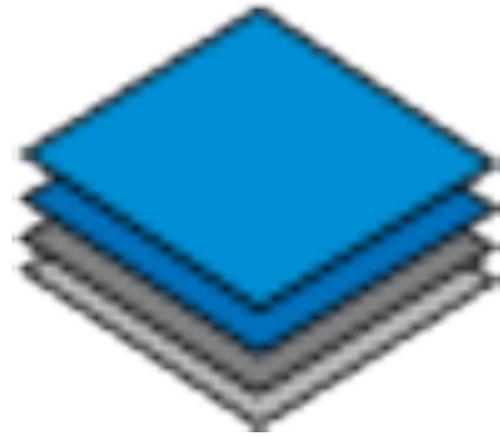
- Processing...** (gear icon)
- Message: "We successfully received your request and it is being processed now. You'll receive an email when your file is ready."
- Message: "You can safely leave this window, maybe to make a [new request](#)."
- Task summary** (info icon)
- Geometry (EWKT)**: SRID=28992;POLYGON((851
- AHN2 class**: g

Window 3: Ready to download

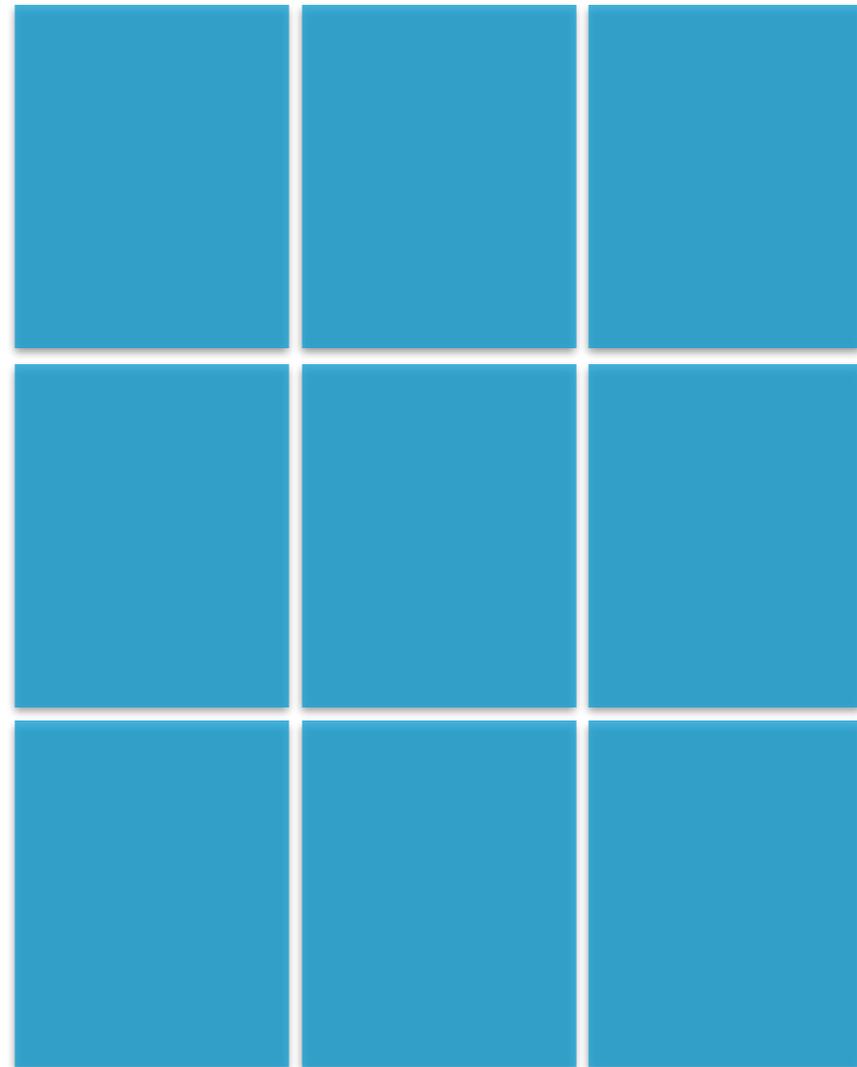
- Ready to download** (checkmark icon)
- Message: "Please note that your file will be deleted after 24 hours. But, you can always make a [new request](#)."
- Download** (green button)
- Task summary** (info icon)
- Geometry (EWKT)**: SRID=28992;POLYGON((851
- AHN2 class**: g
- Execution time (s)**: 0.446162939072
- Actual point count**: 166894

The background of the interface is a map showing a street grid. A blue rectangle highlights a specific area on the map, which corresponds to the selected points. Labels on the map include "Faculty of Architecture", "Colignystraat", "Aldergondes", "Chiel de Ruyterweg", "Prins Bernhardlaan", "Jaffalaan", "Mekelweg", "Landbergstraat", "Tram 19", and "OTB-Research Institute".

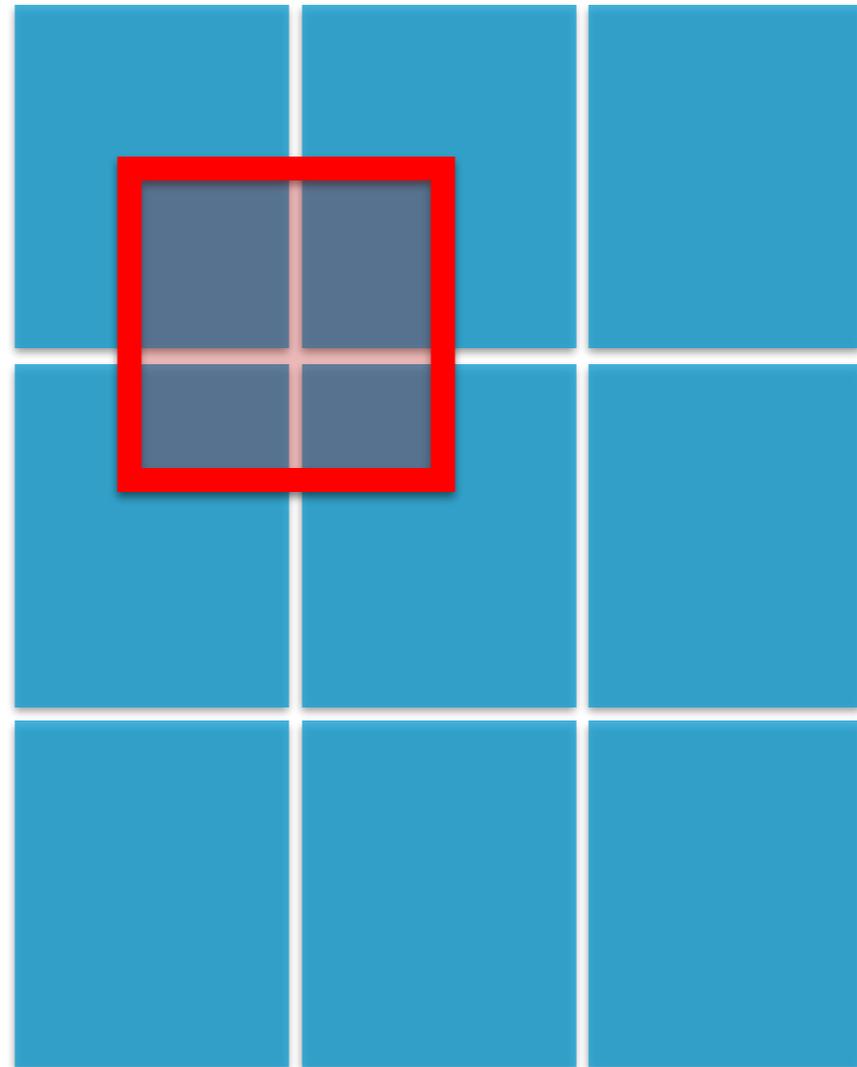
MATAHN: only open-source software



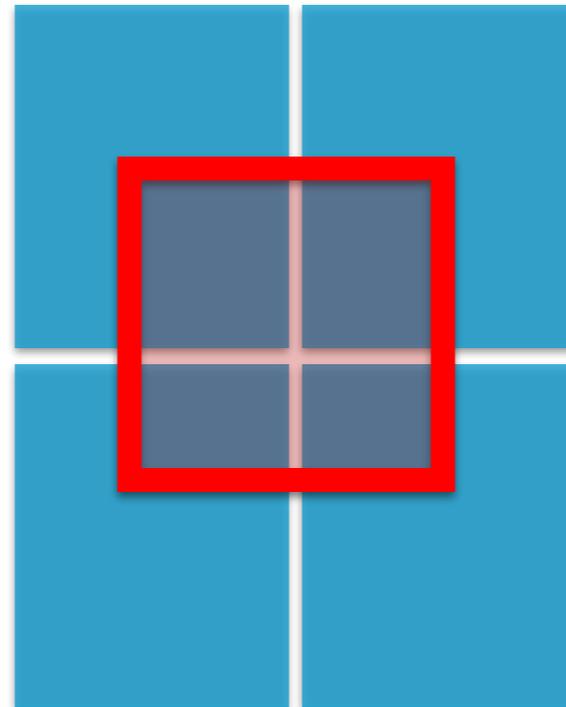
- AHN2 tiles

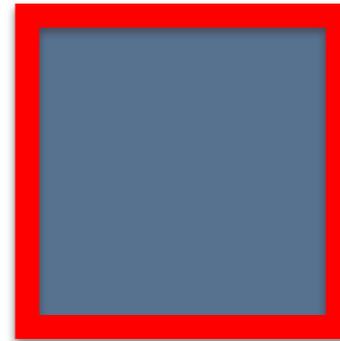


- User request



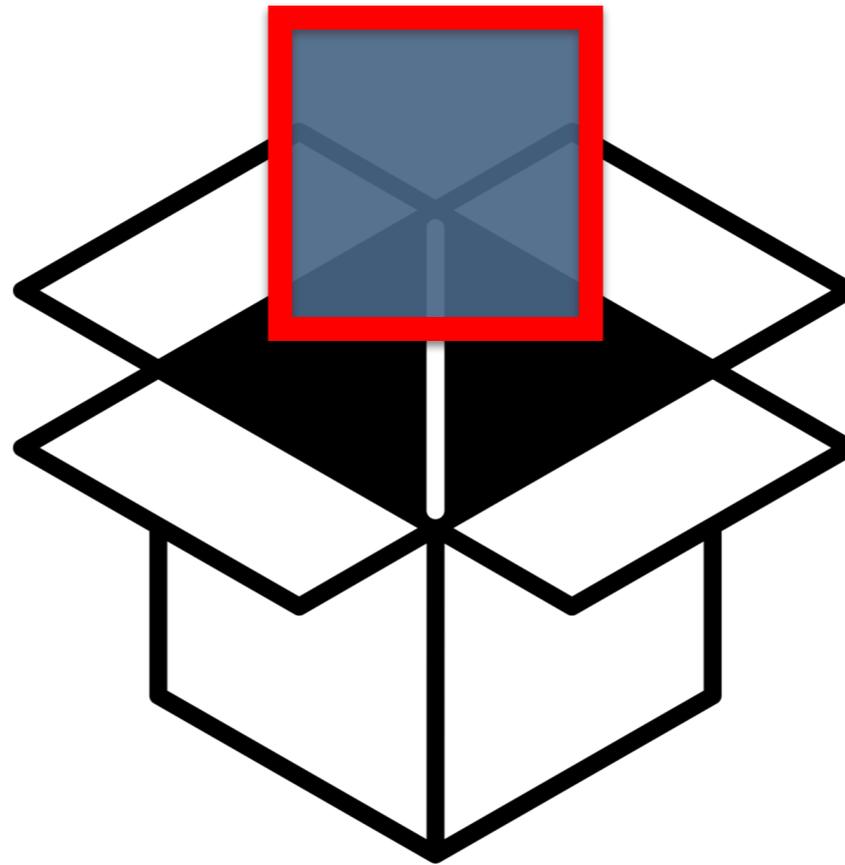
- Intersect tiles





- Merge and clip

- Send to user



3DSM

Progress

2nd User Committee meeting

Rotterdam, 11 September 2014

Ravi Peters





Introduction

Hypotheses

Medial Axis Transform (MAT) of LiDAR point cloud:

1. *enables truly **3D** analysis*
2. *can be used to effectively **define features** in DSM using MAT **geometry** and **topology***

Current goal

Simplification of LiDAR point clouds:

Reduce number of points while maintaining detail.

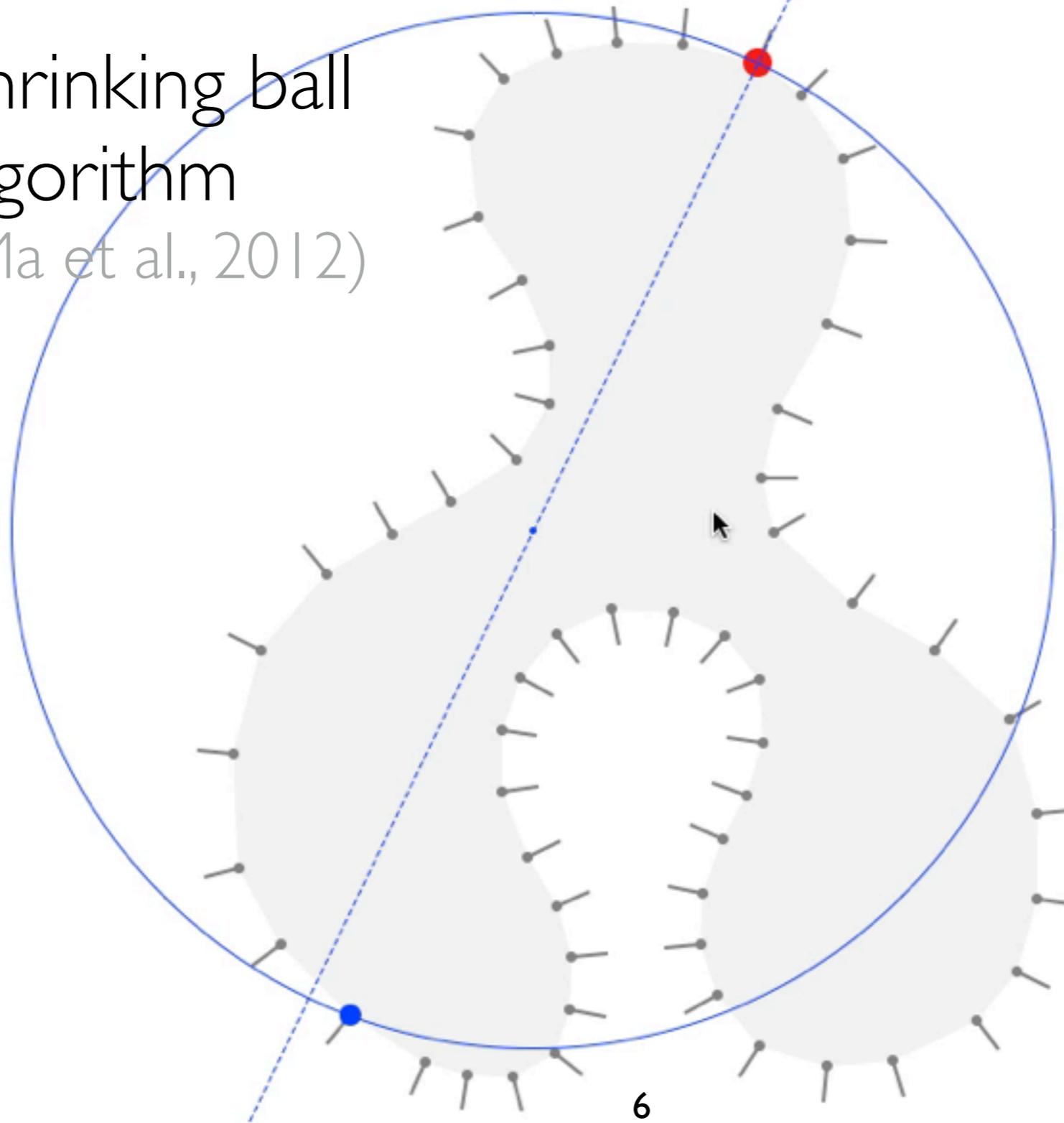
E.g. for creation 3DTOP10NL



Methods

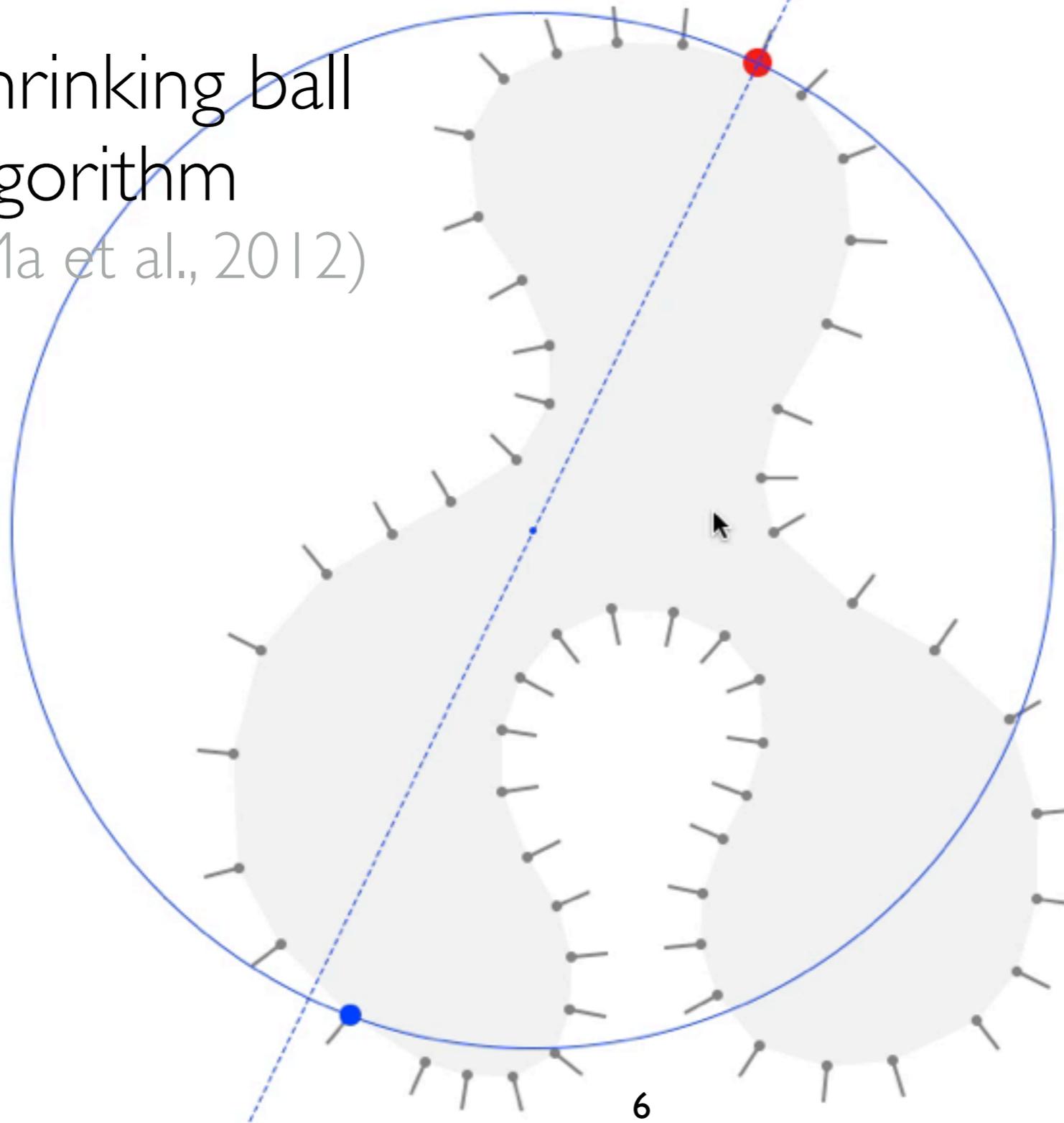
MAT approximation

Shrinking ball
algorithm
(Ma et al., 2012)



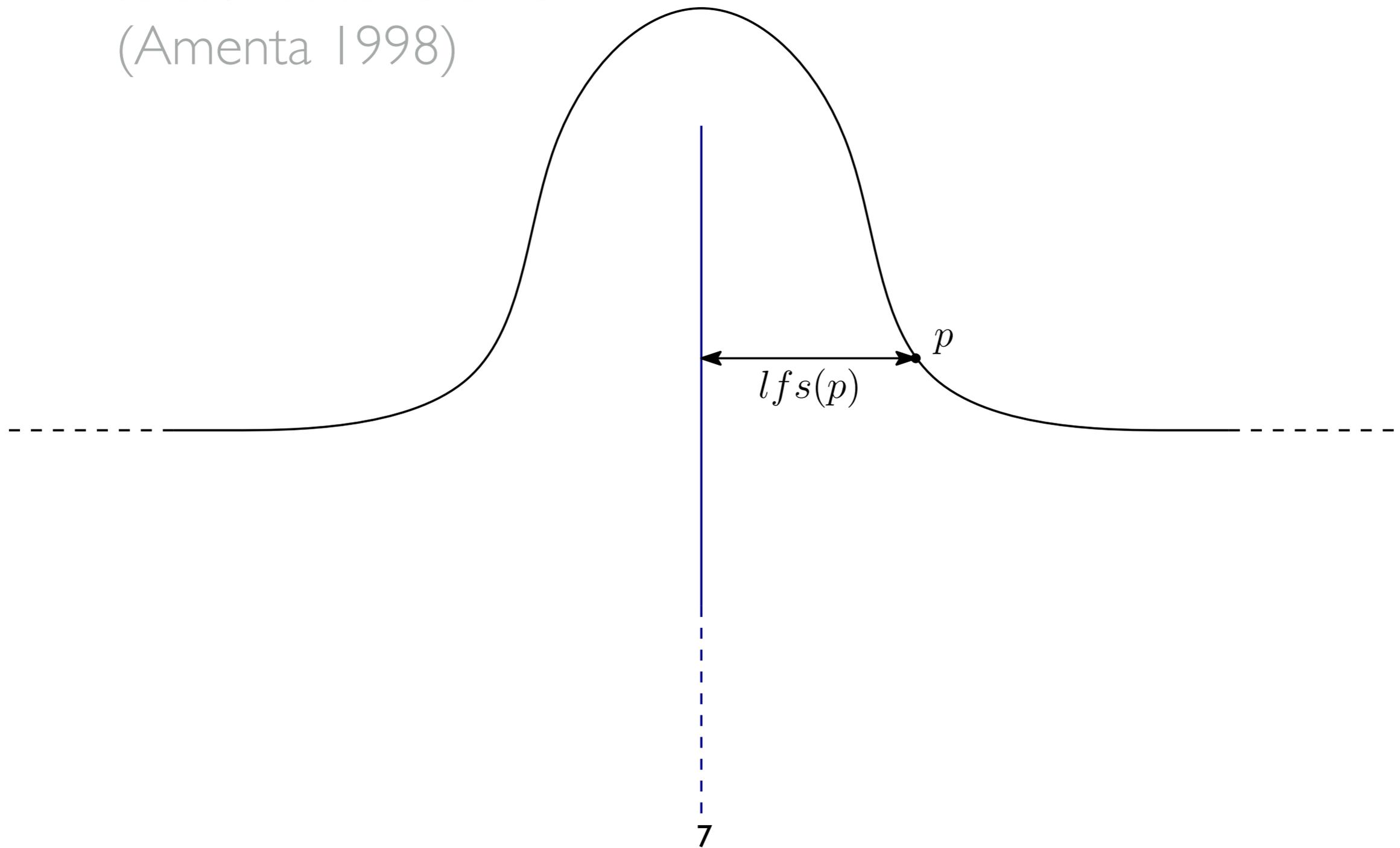
MAT approximation

Shrinking ball
algorithm
(Ma et al., 2012)

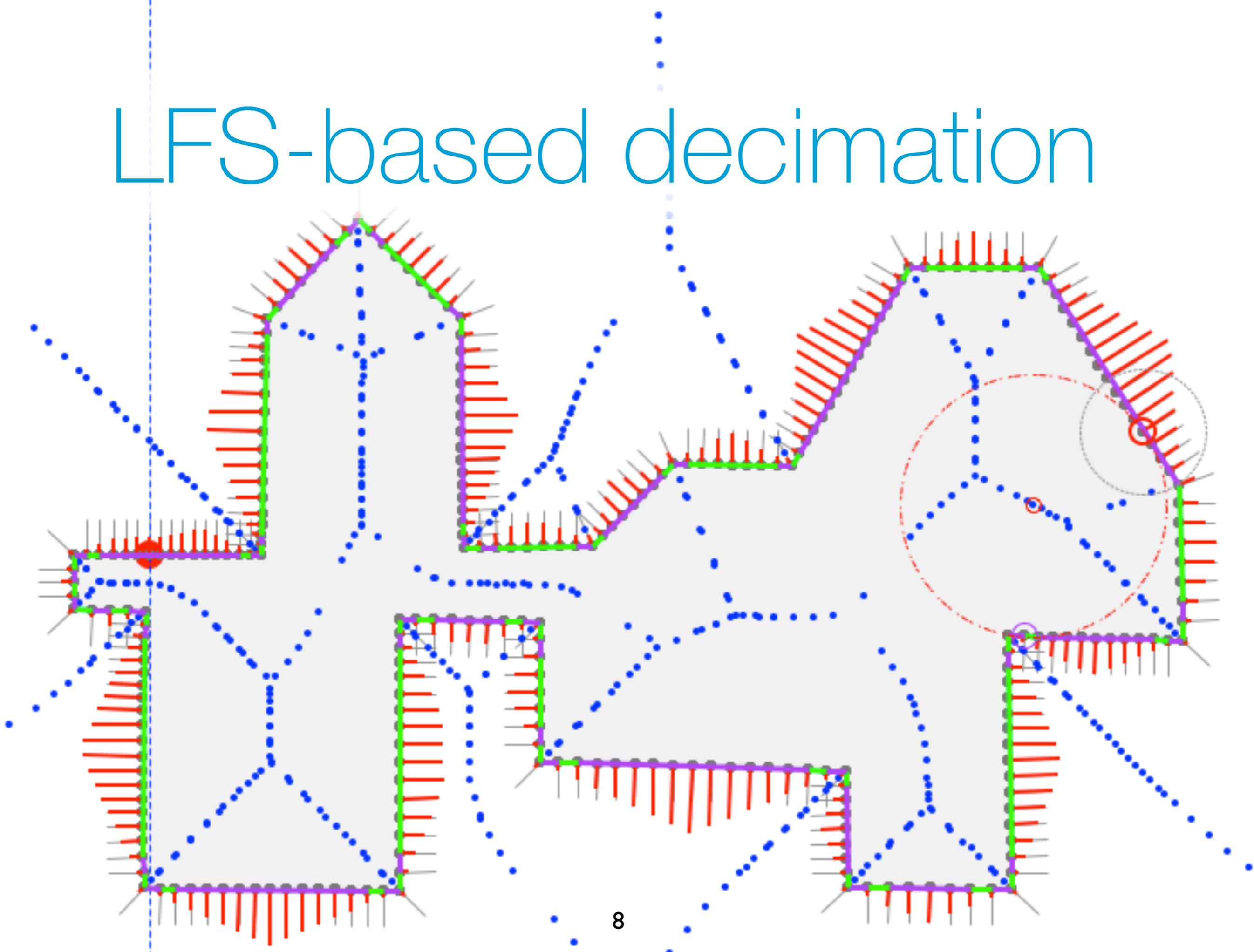


Metrics on the MAT

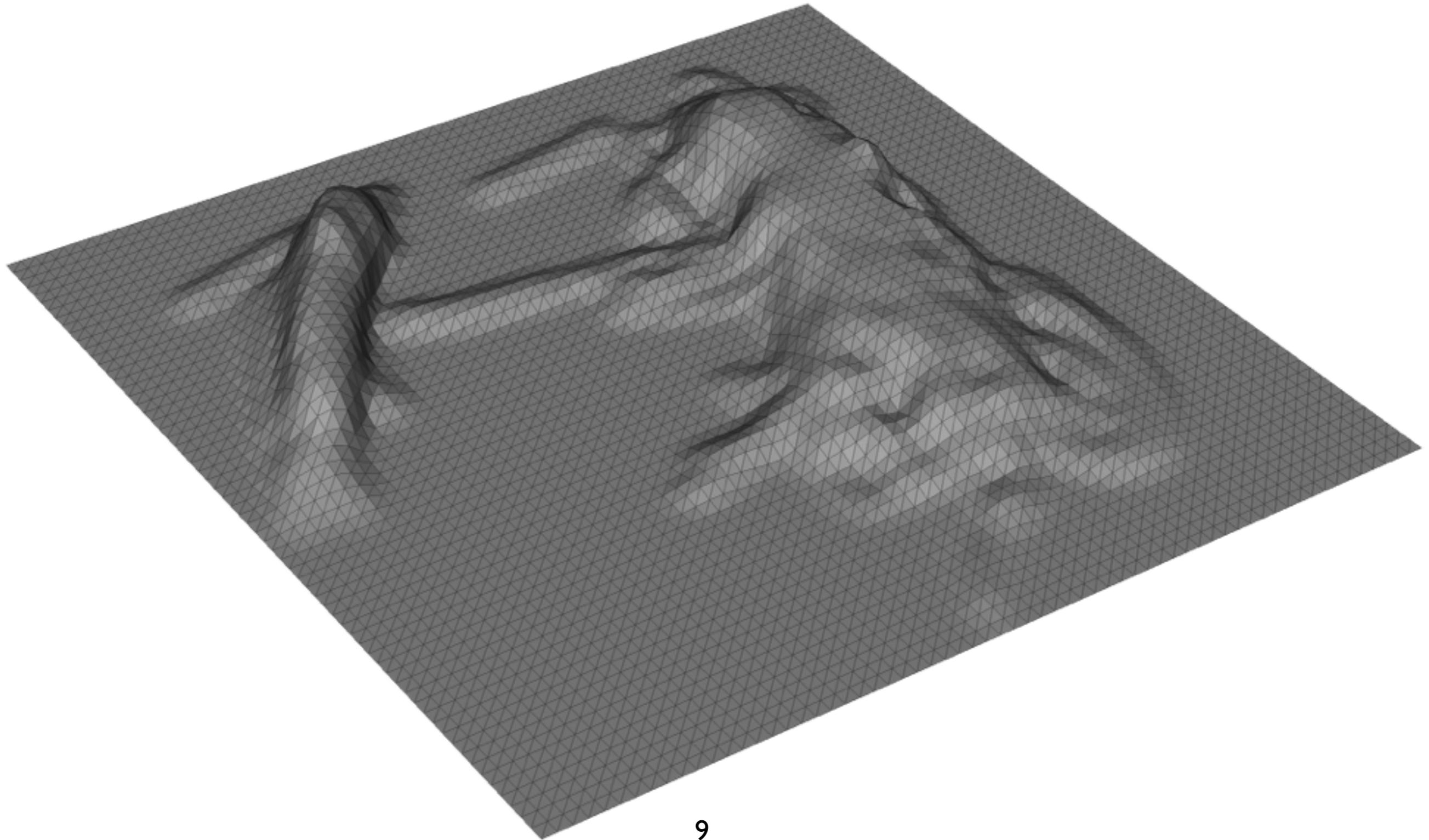
local feature size
(Amenta 1998)



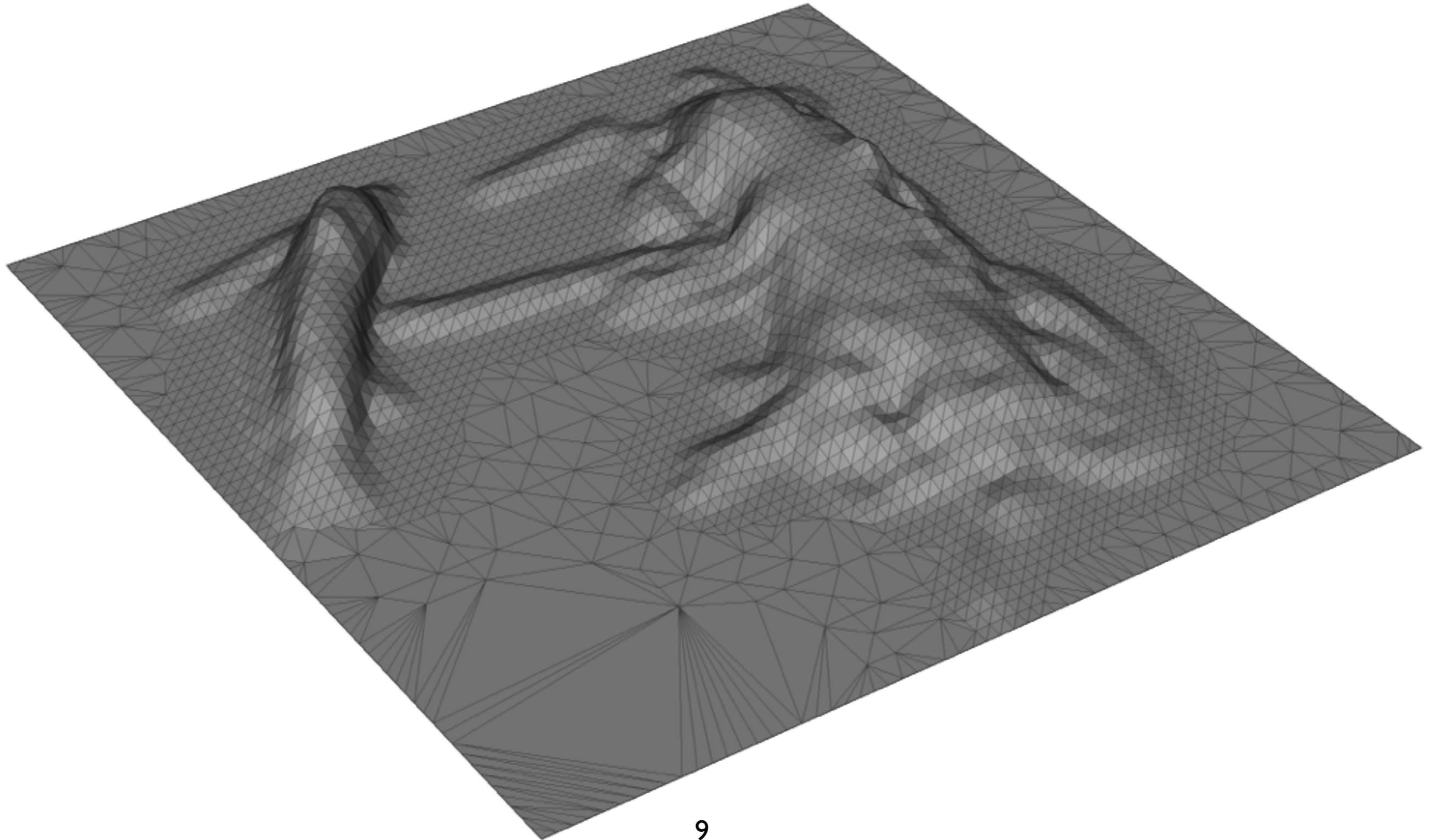
LFS-based decimation



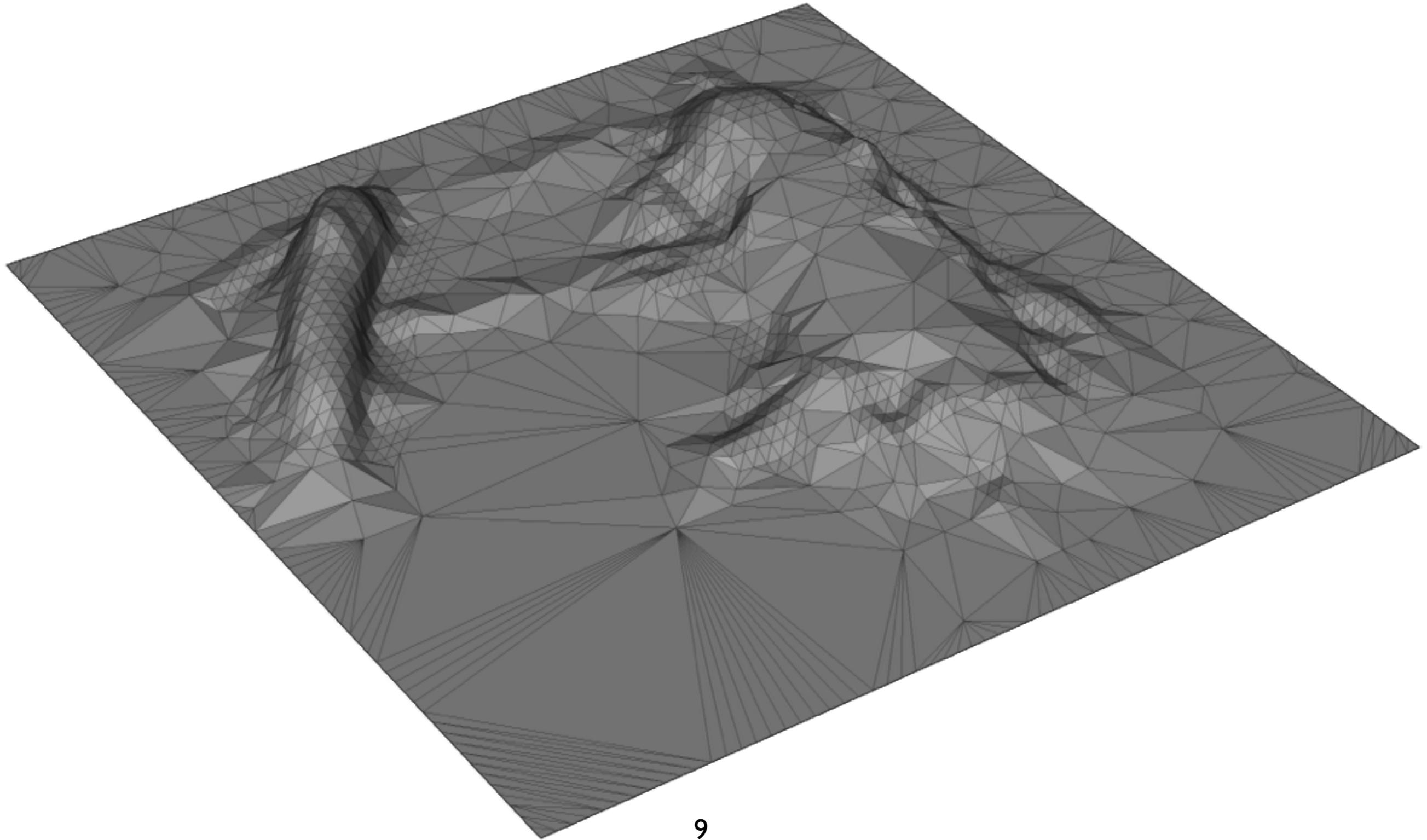
LFS-based decimation



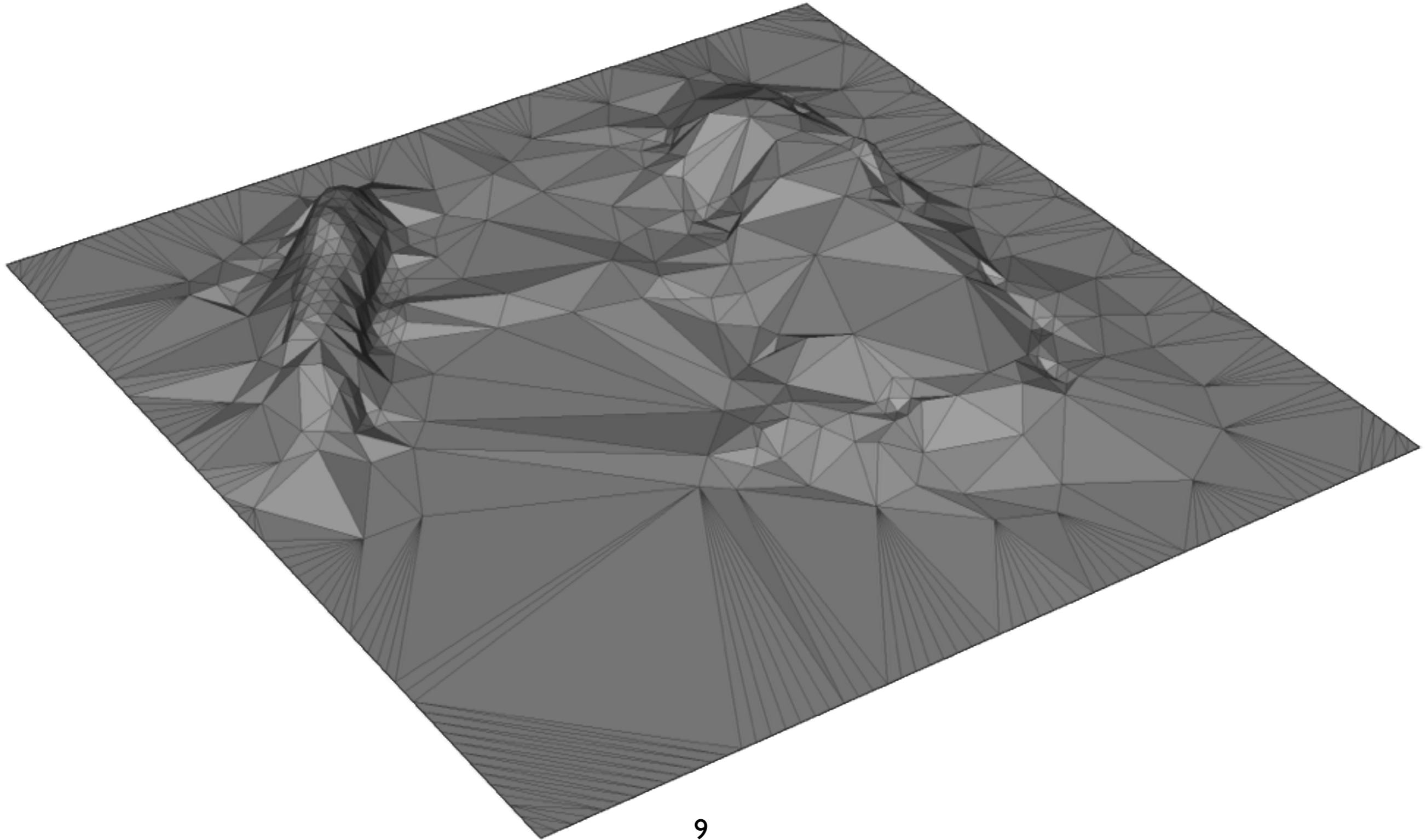
LFS-based decimation



LFS-based decimation



LFS-based decimation





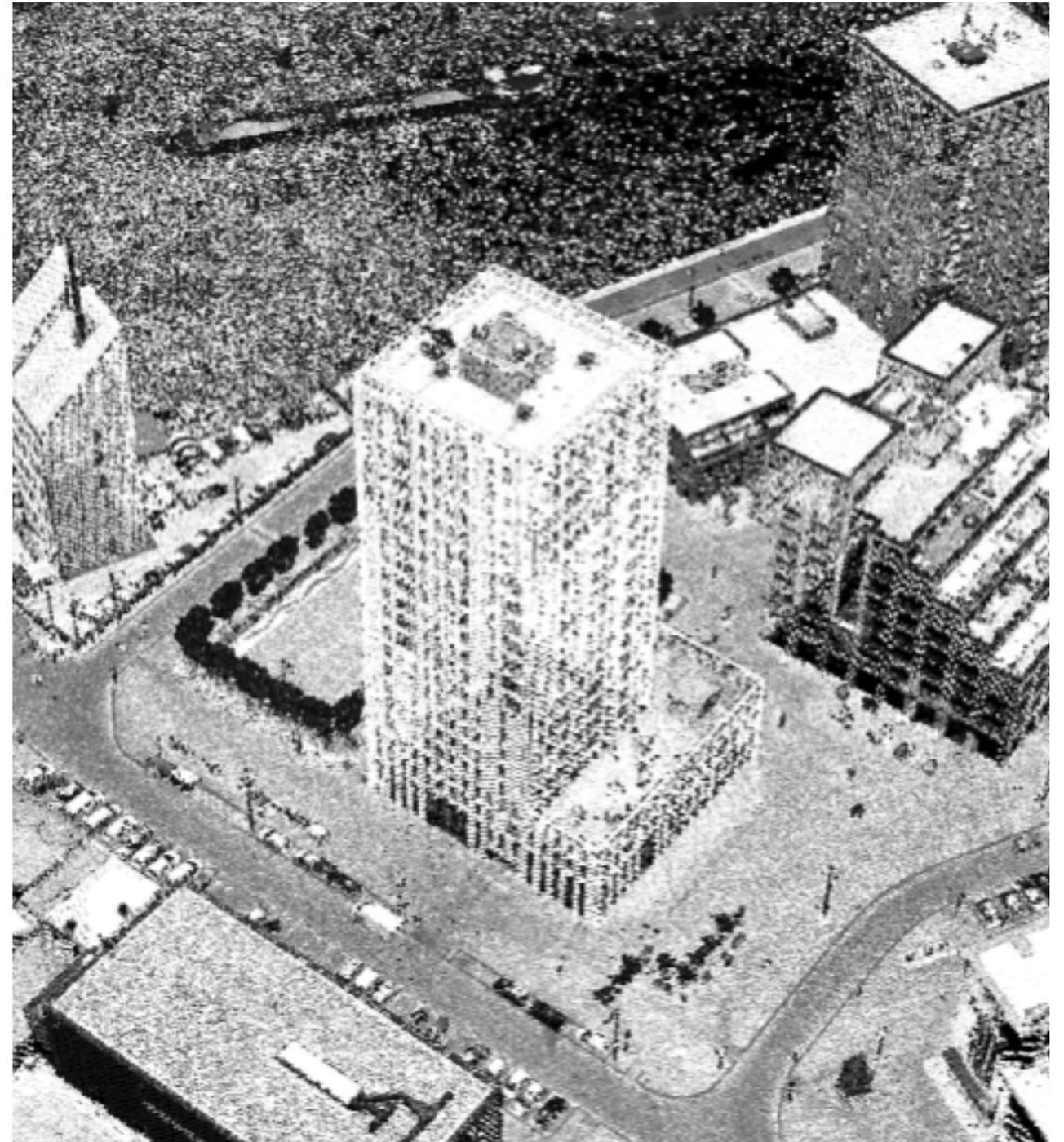
Noise

Noise

dataset:

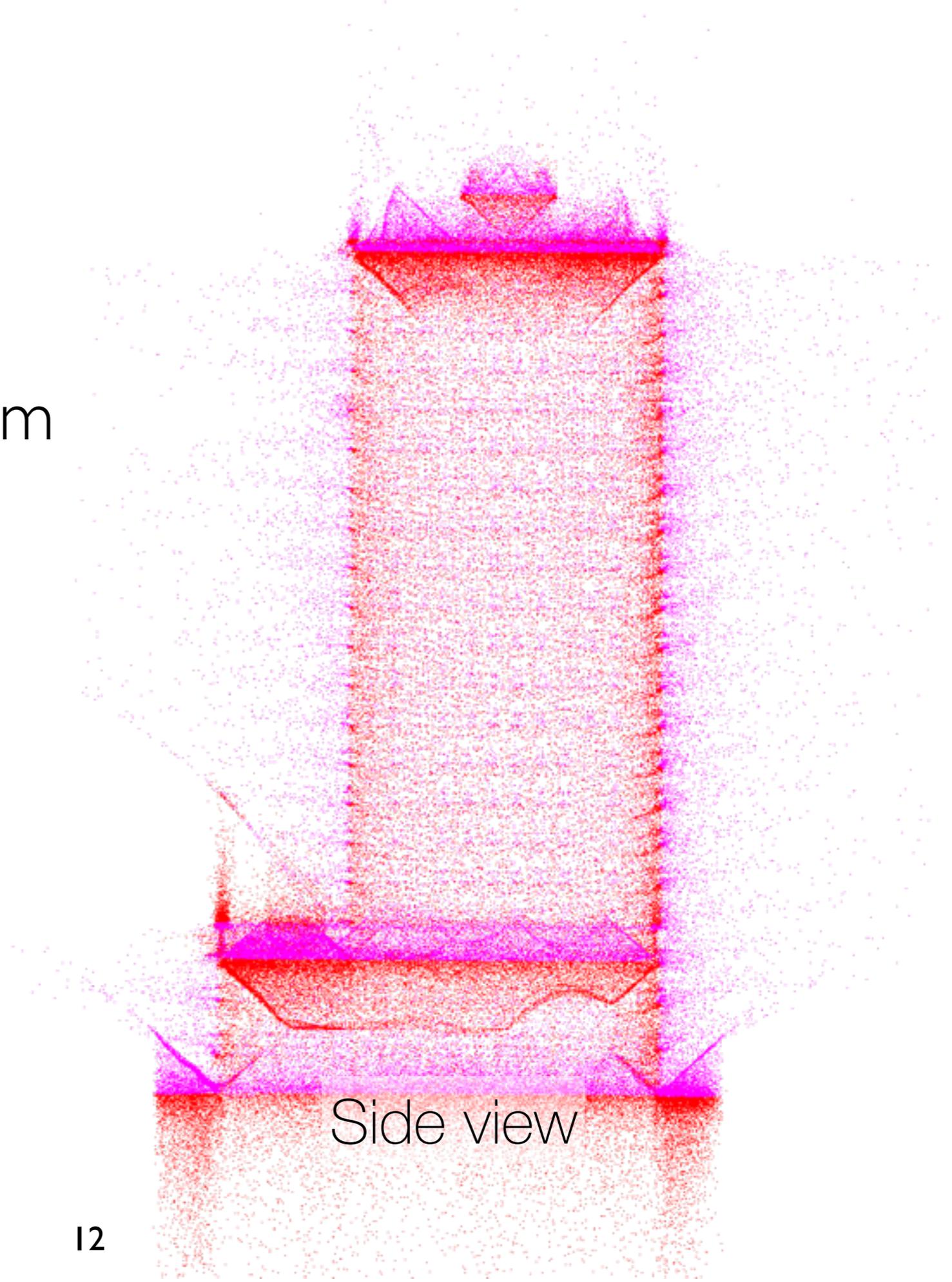
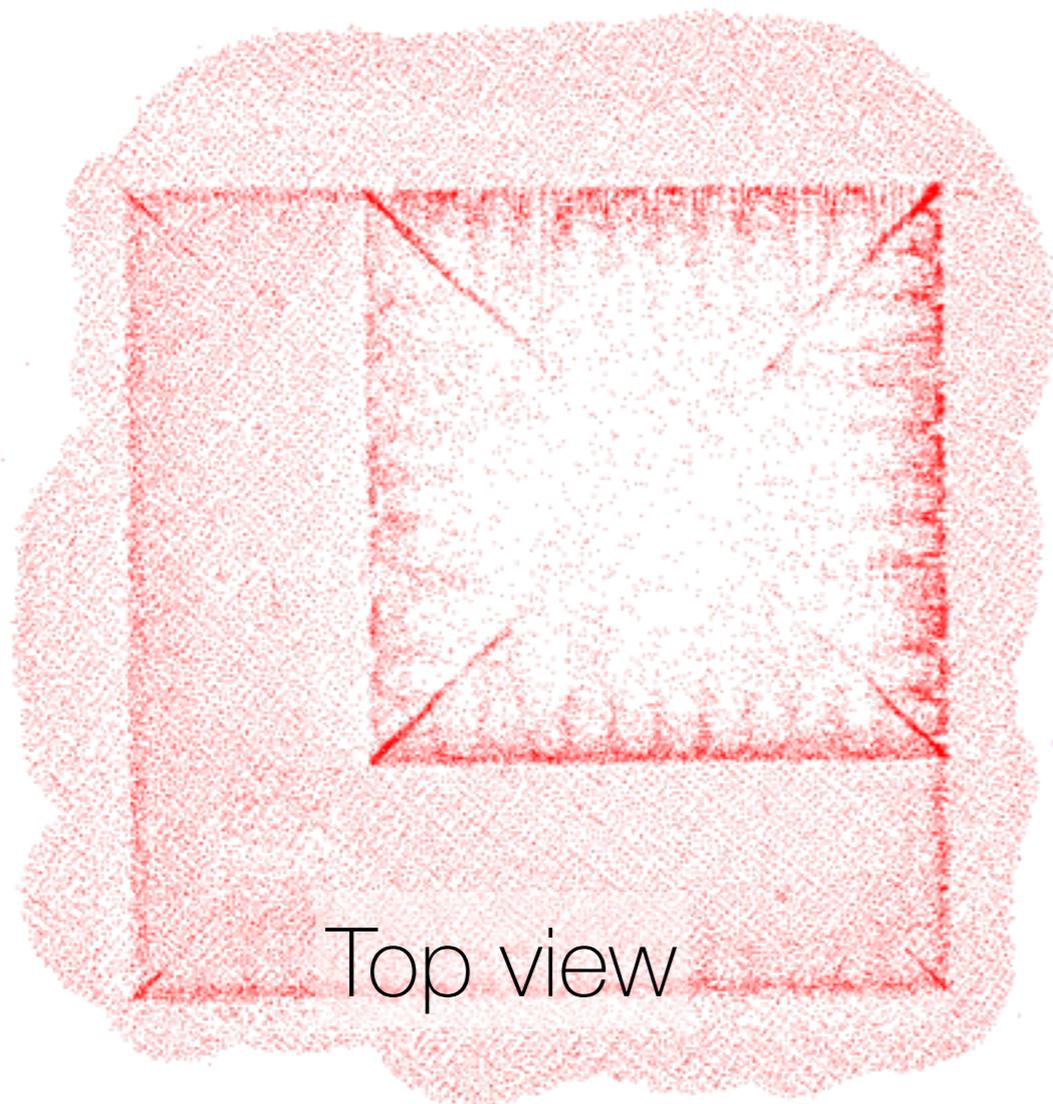
Rotterdam 2012

(50 pt/m²)

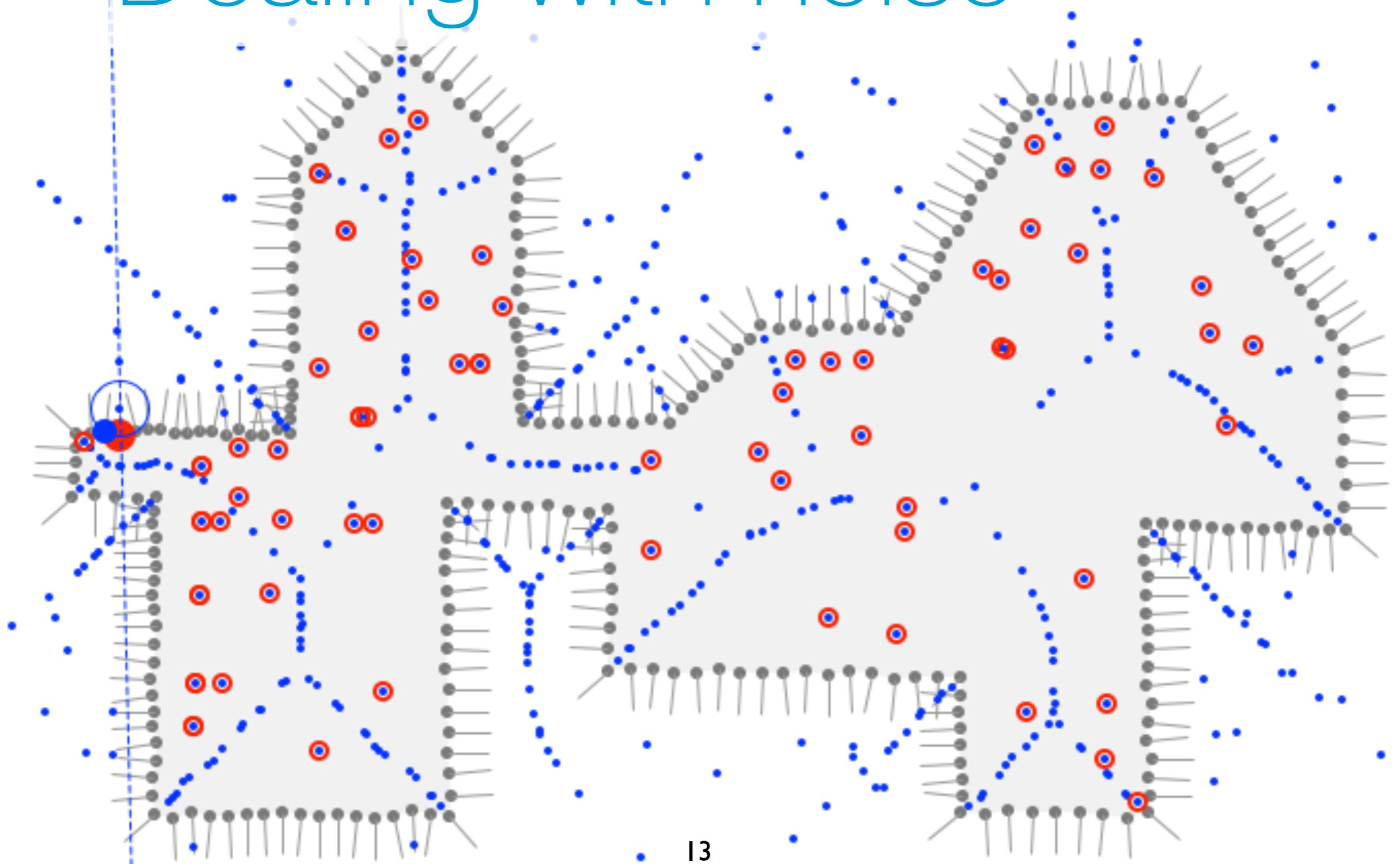


Noise

unmodified
shrinking ball algorithm

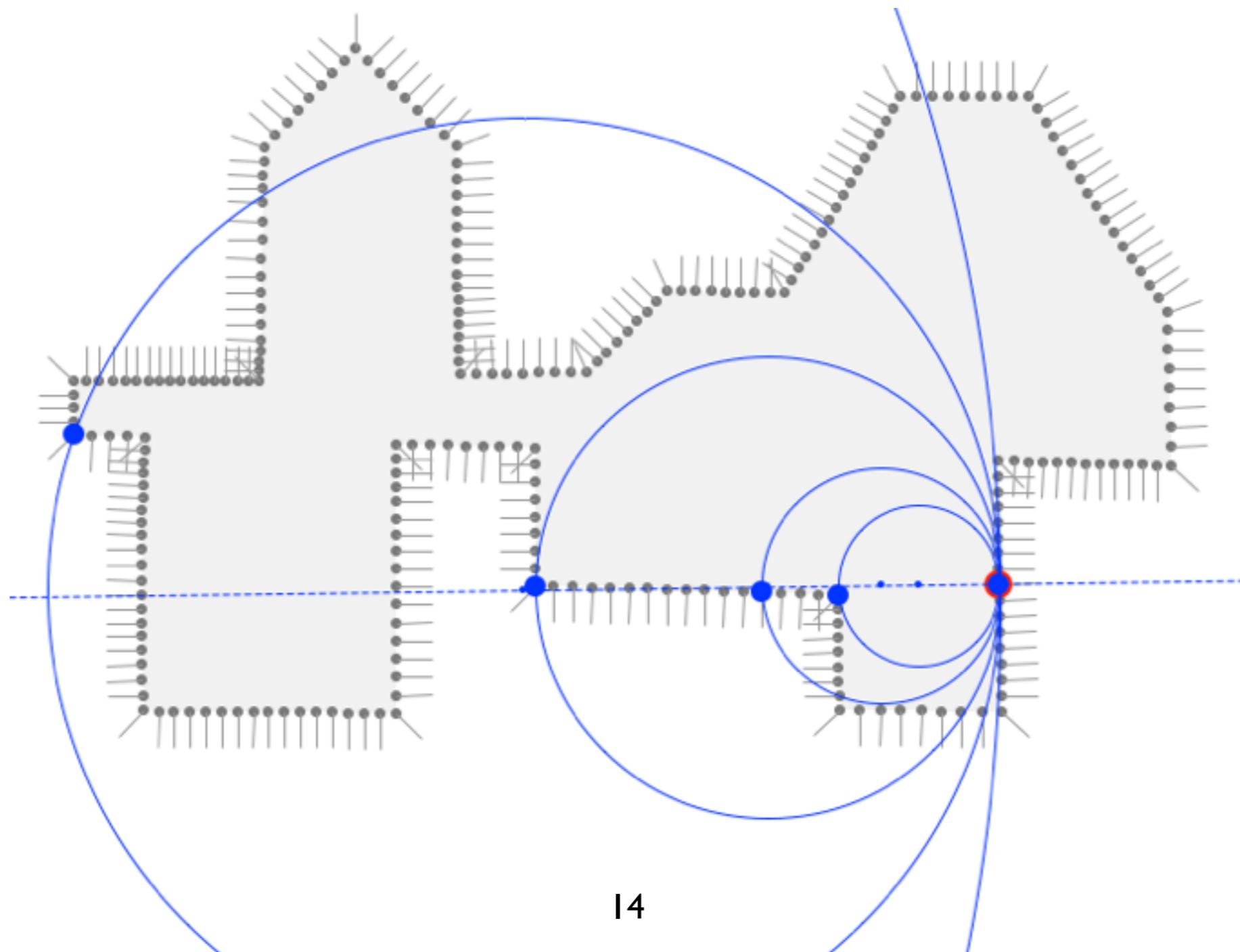


Dealing with noise



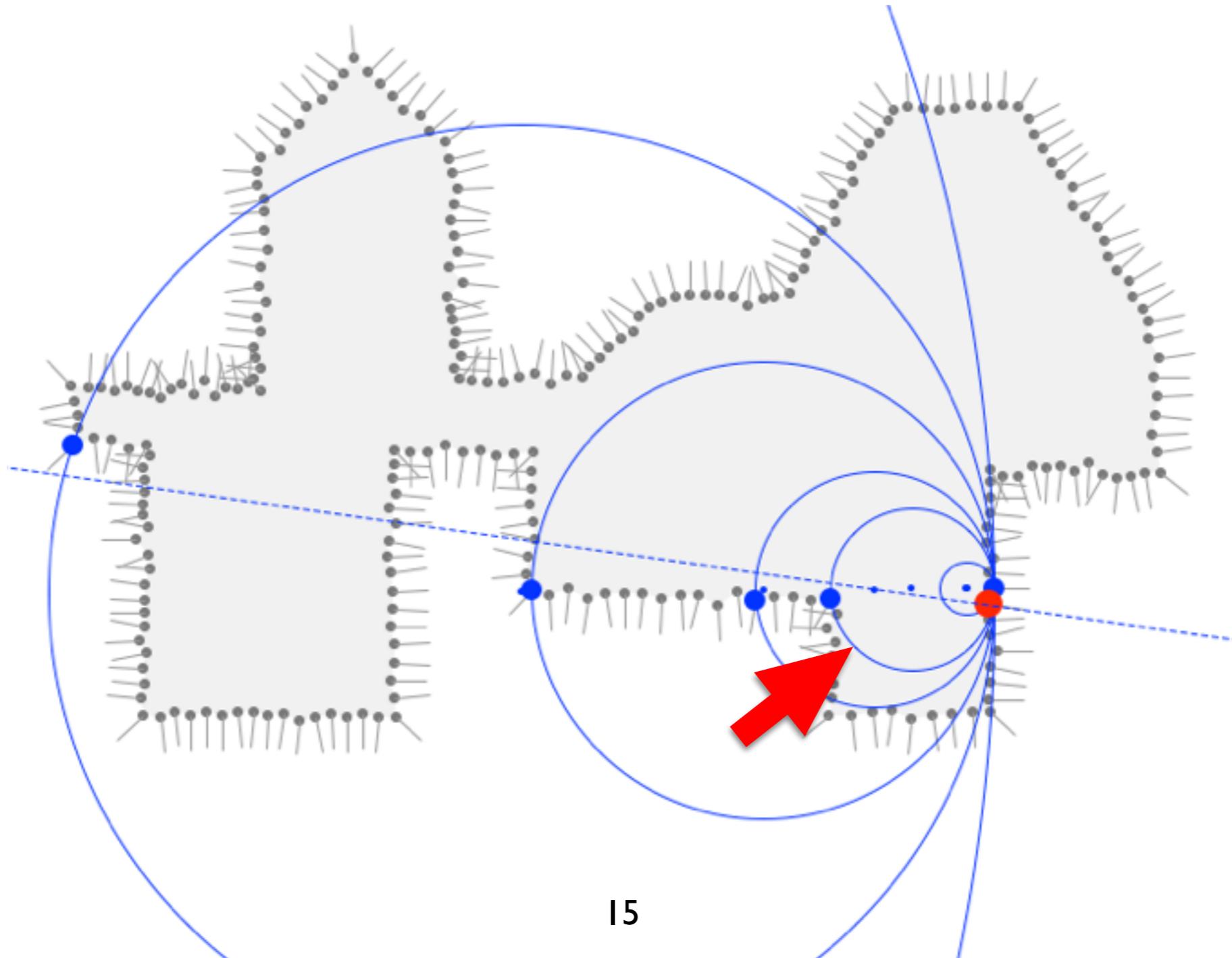
My proposal

Consider series of *shrinking balls* for every point



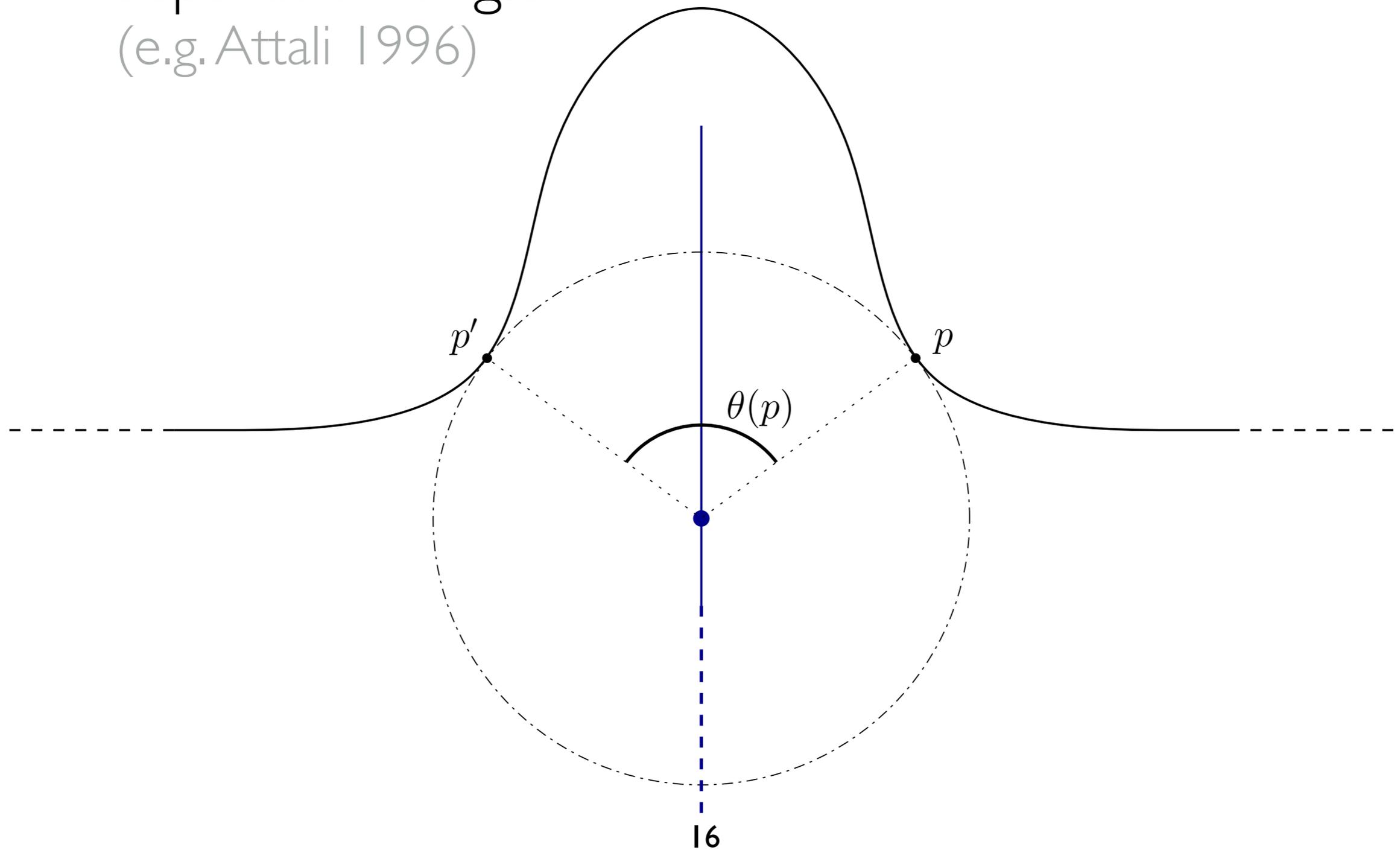
Observation

Even for noisy points, 'good' ball is computed



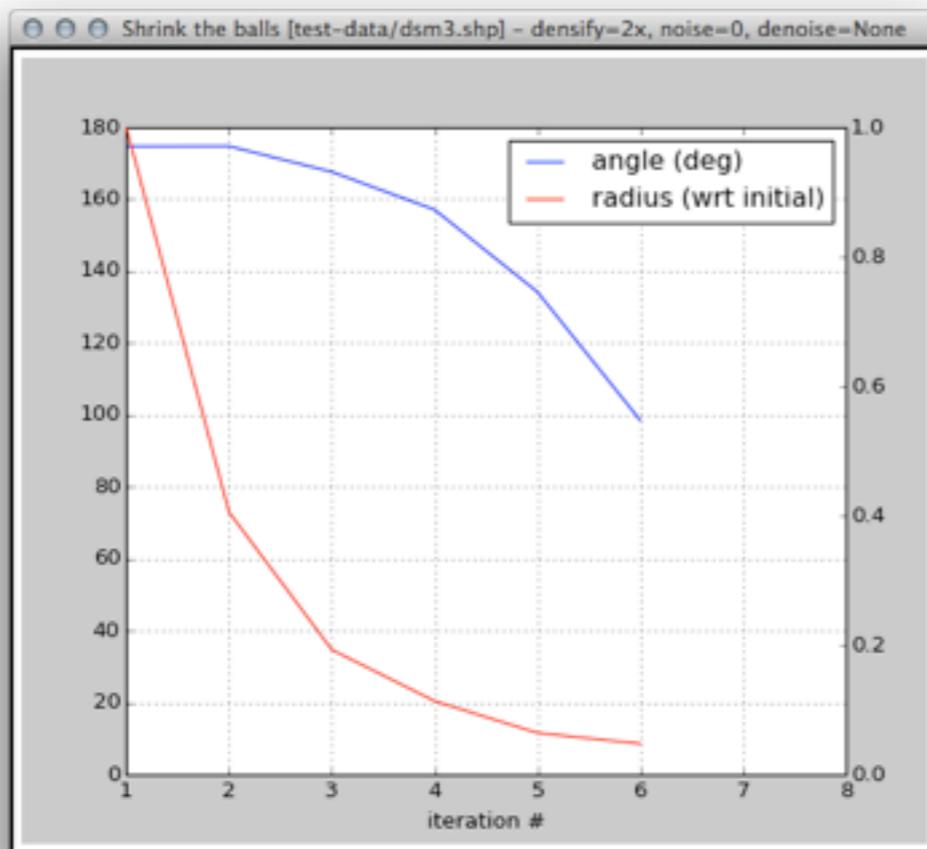
Metrics on the MAT

separation angle
(e.g. Attali 1996)

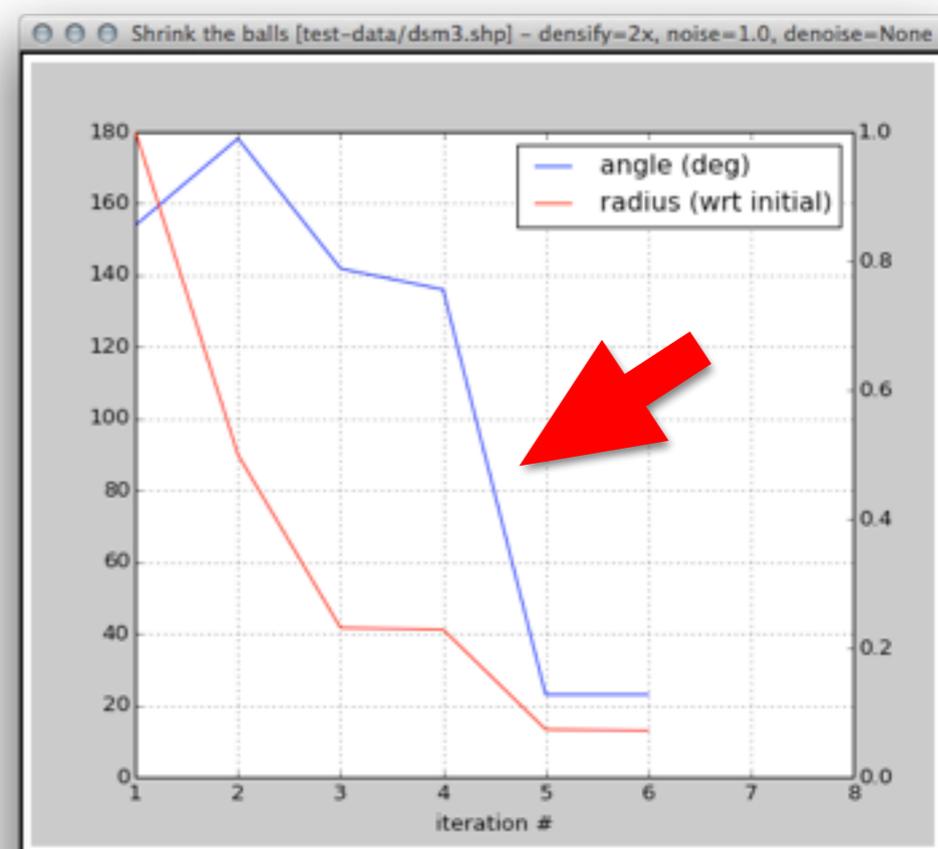


How to recognise 'good' ball?

Look at development of ball metrics



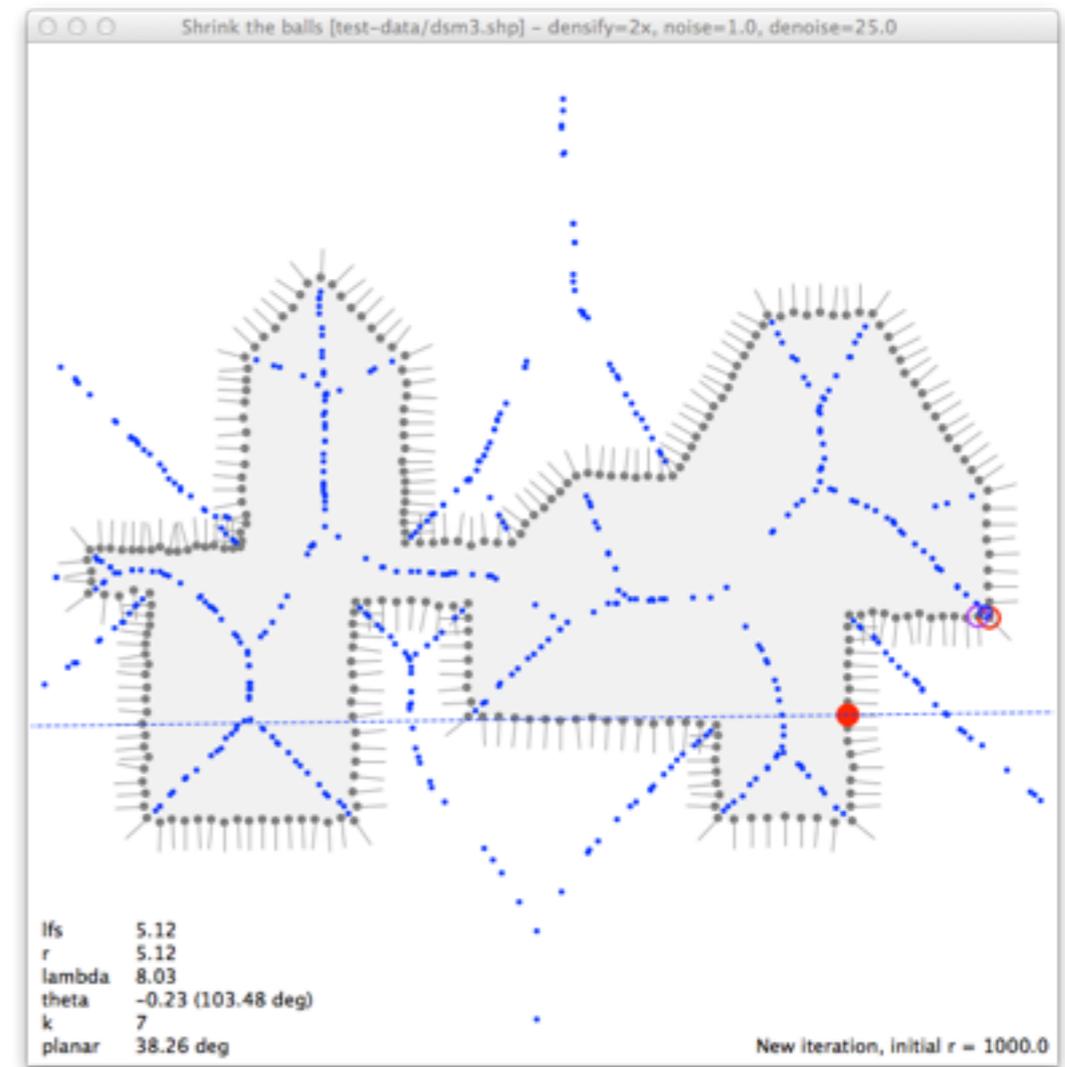
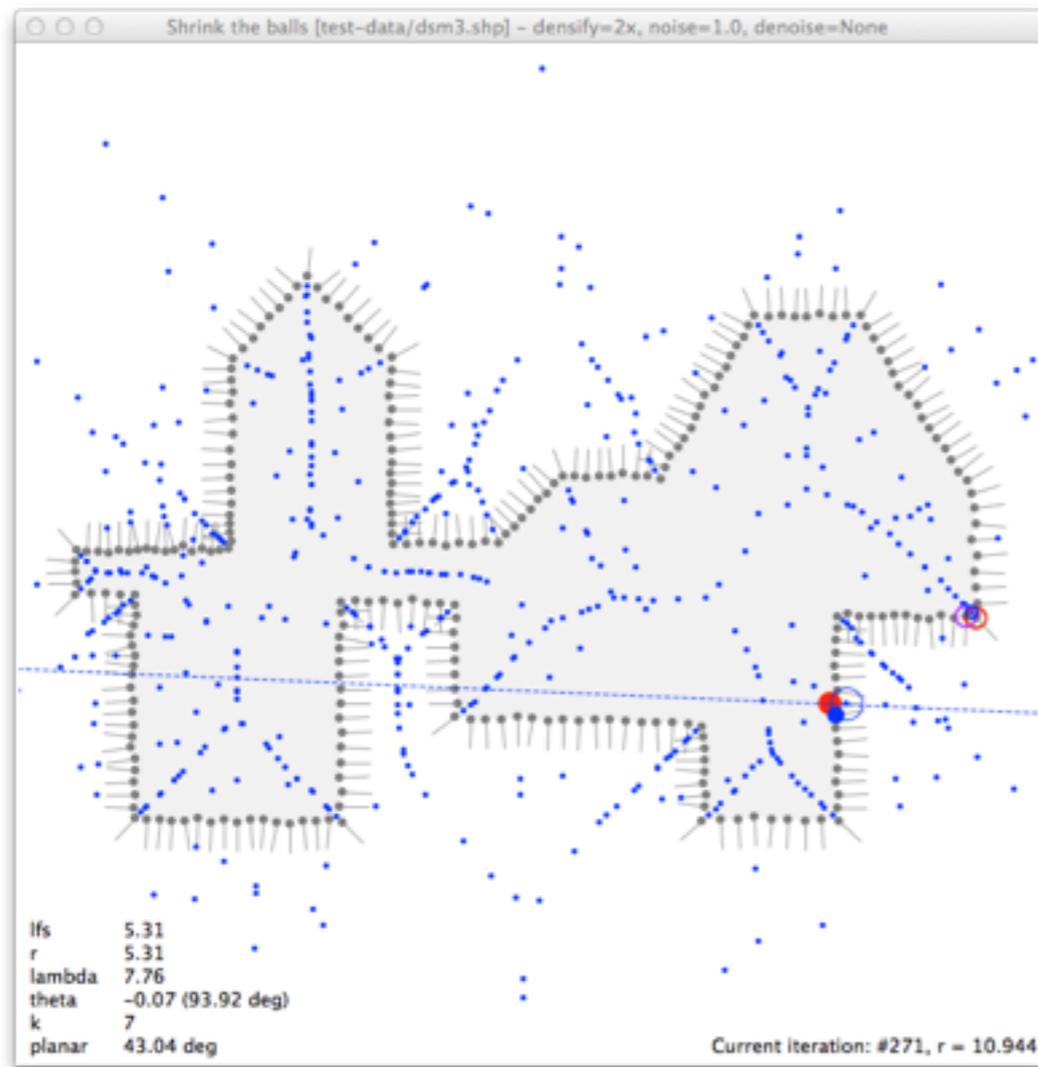
Good point



Noisy point

Getting a denser MAT

by keeping 'good' balls





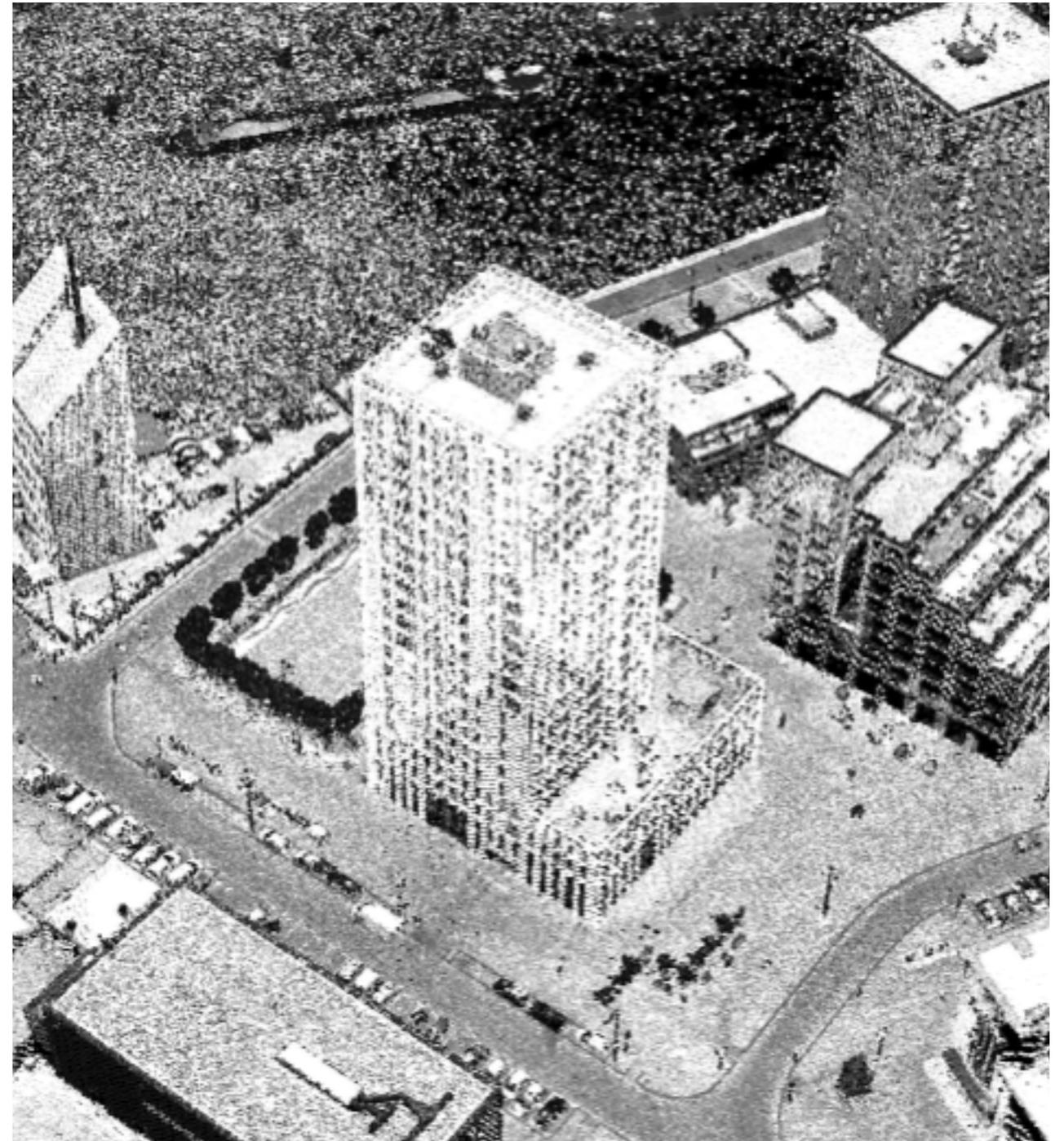
Results

Noise

dataset:

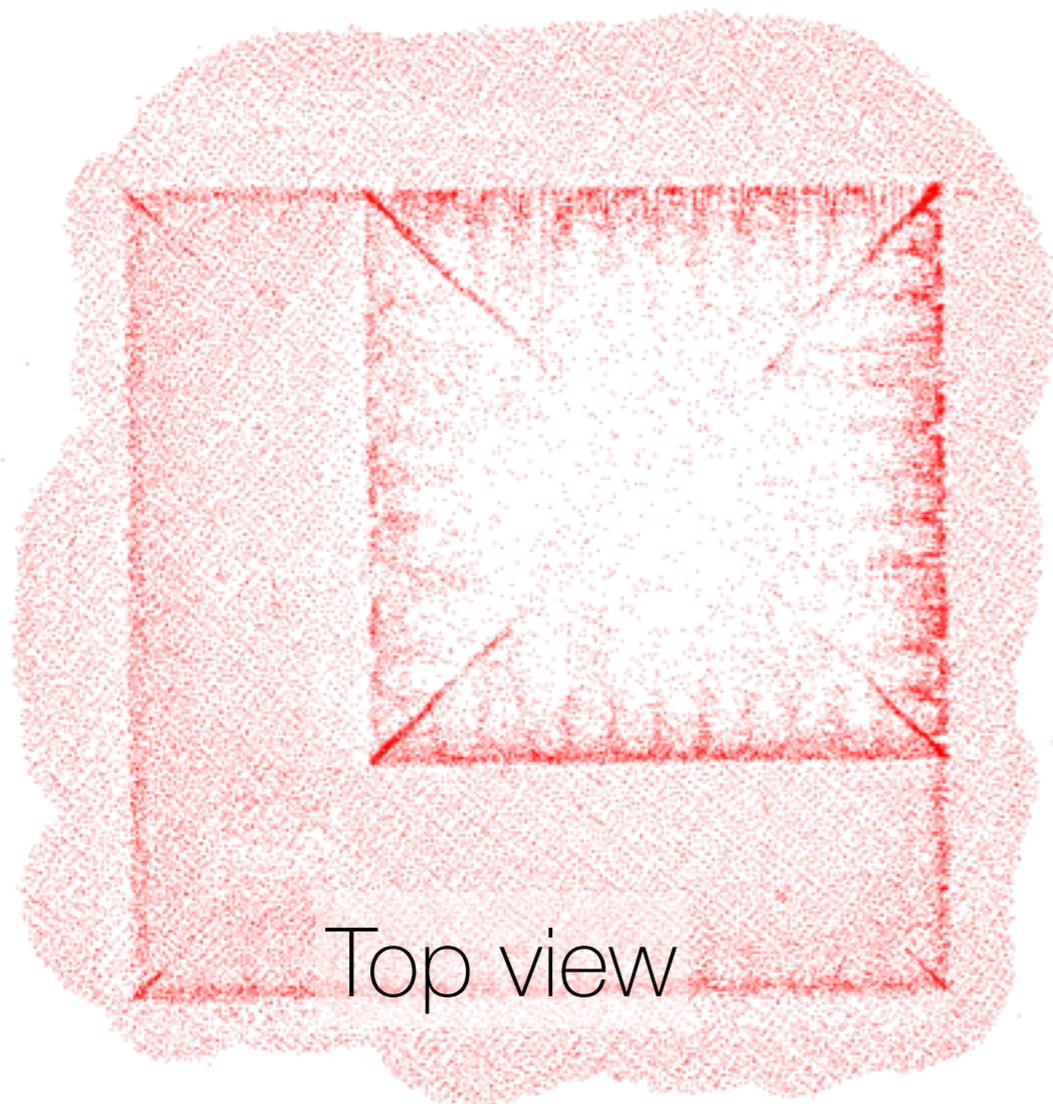
Rotterdam 2012

(50 pt/m²)

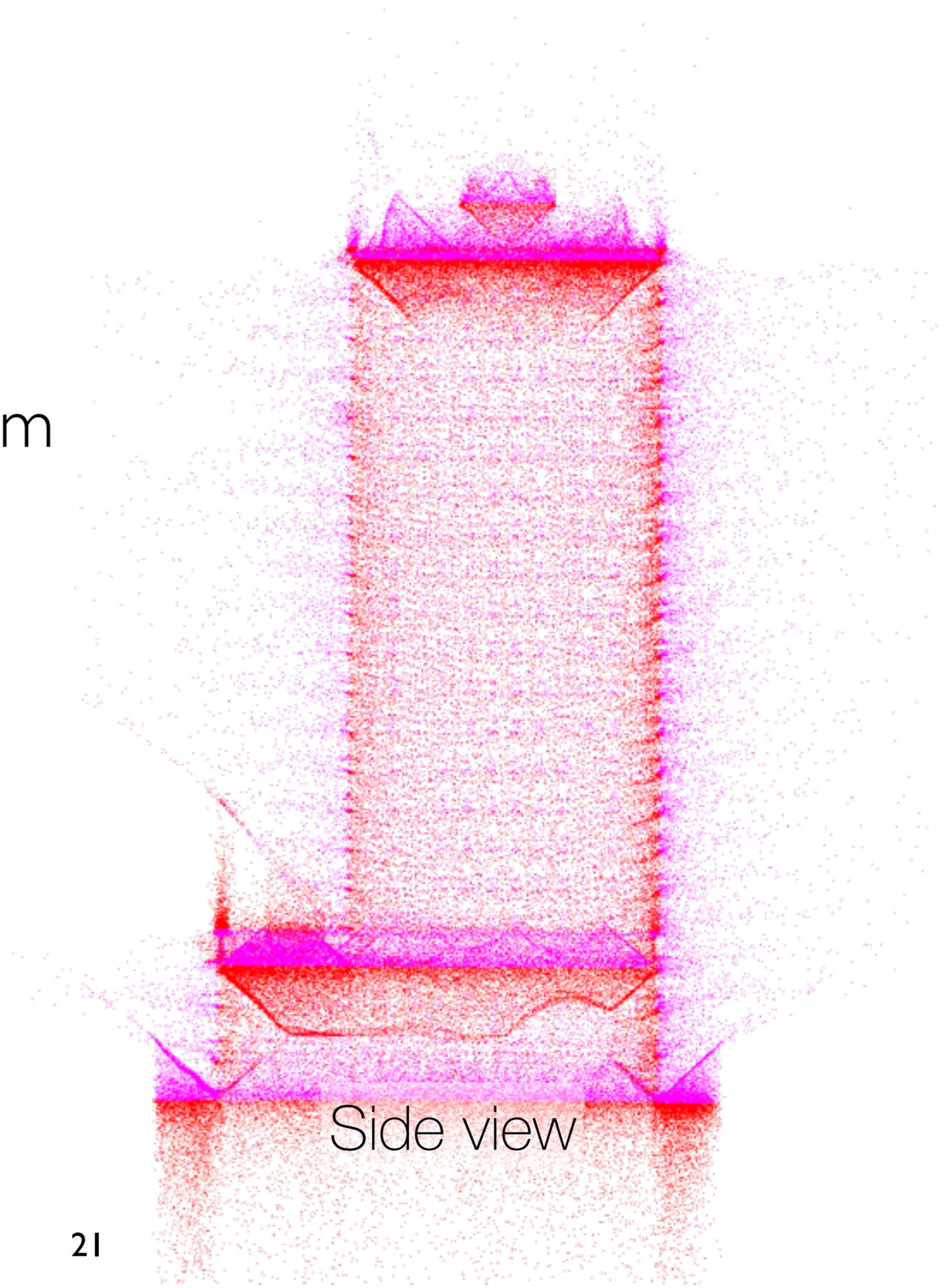


Noise

unmodified
shrinking ball algorithm



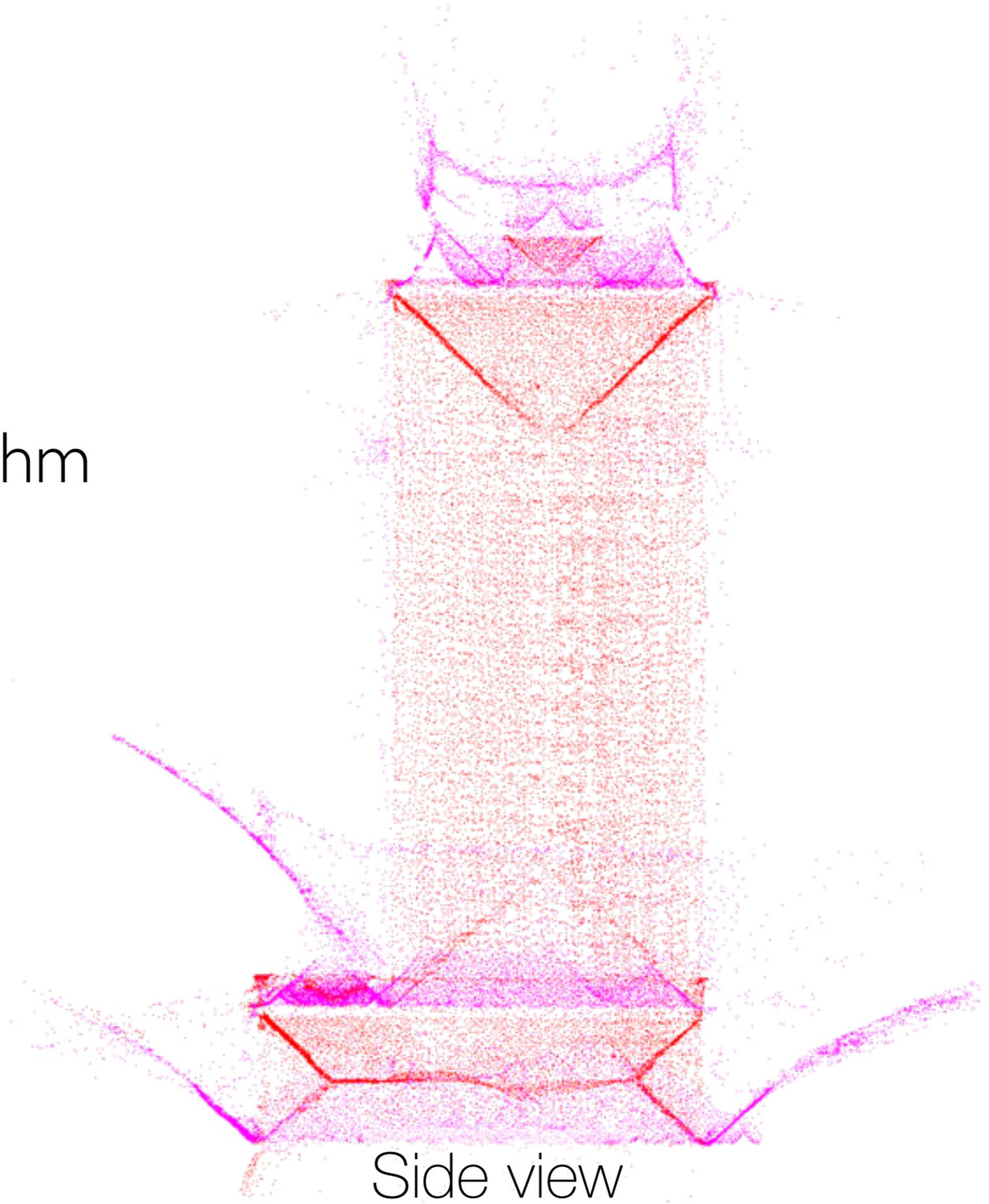
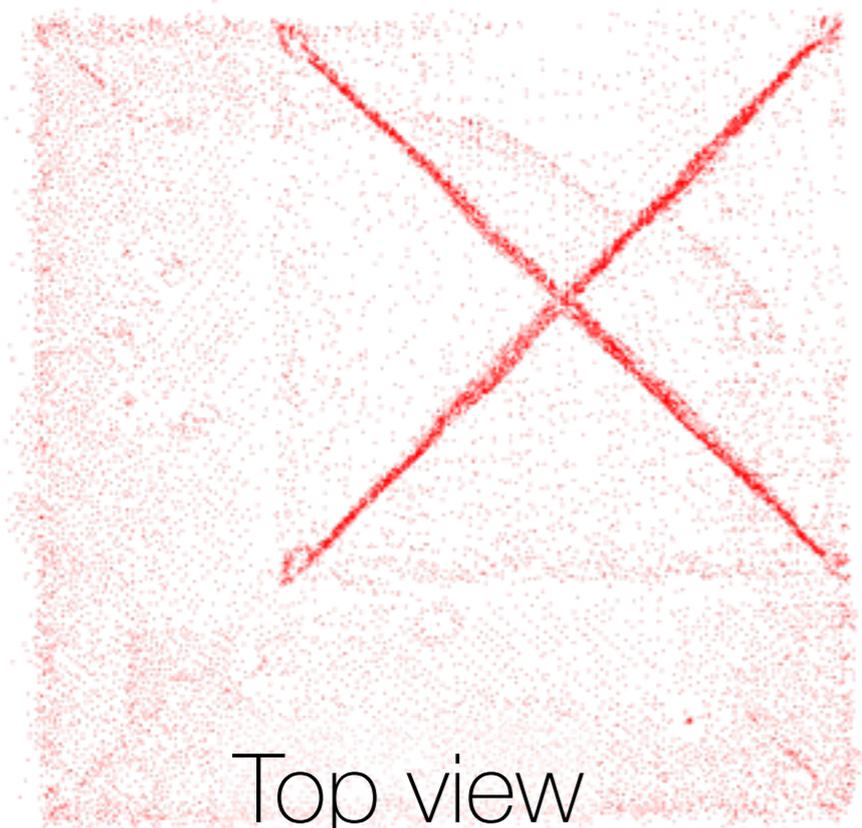
Top view



Side view

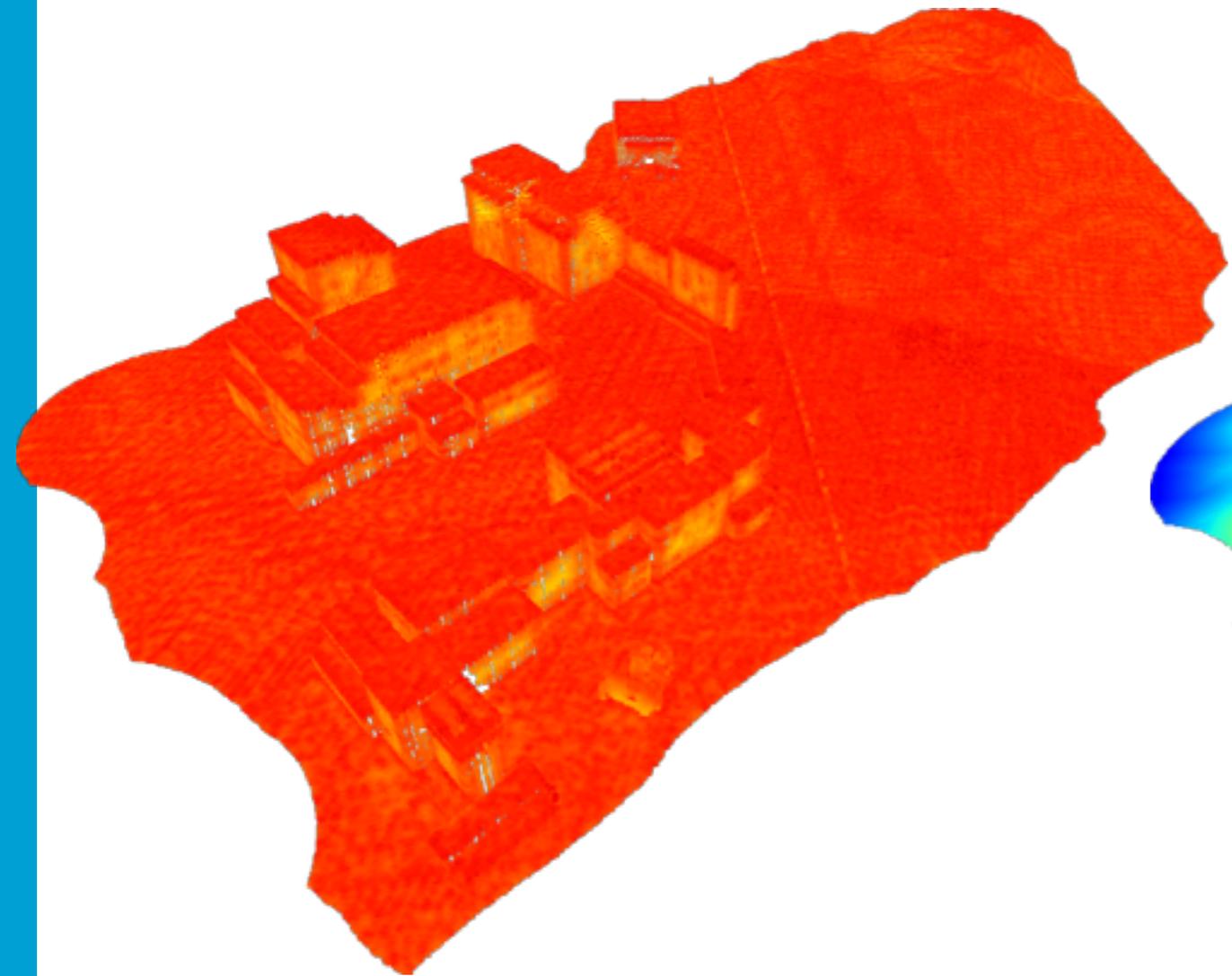
Noise

modified
shrinking ball algorithm

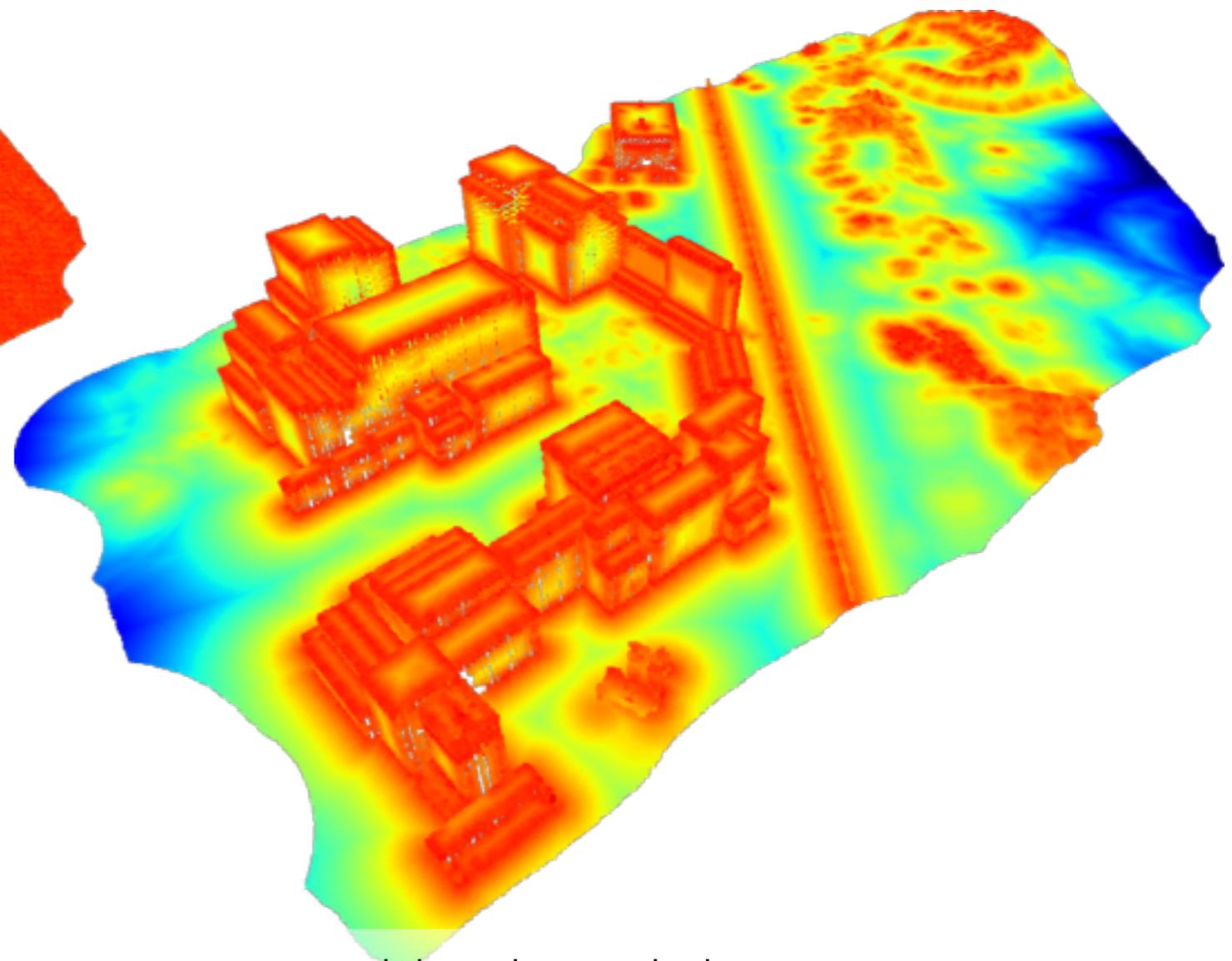


Demo

LFS estimations



without denoising



with denoising

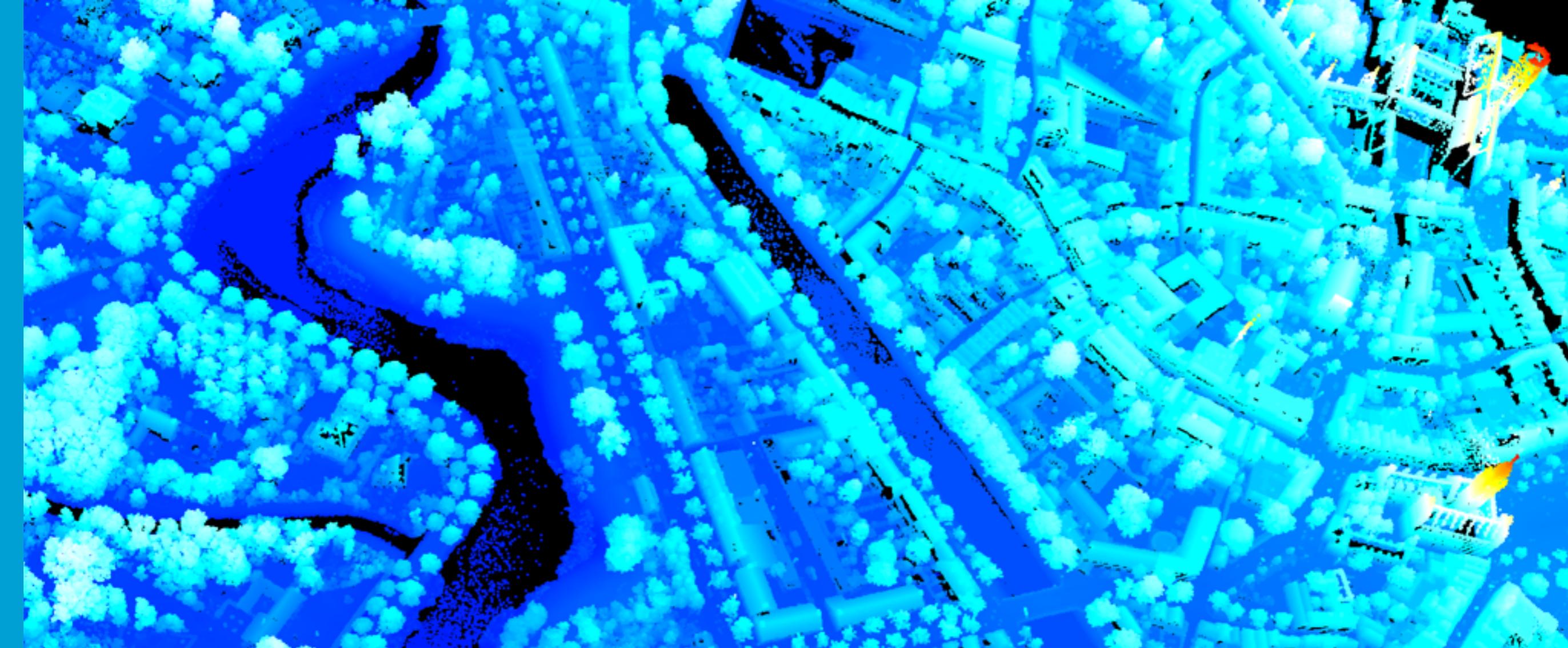
Demo



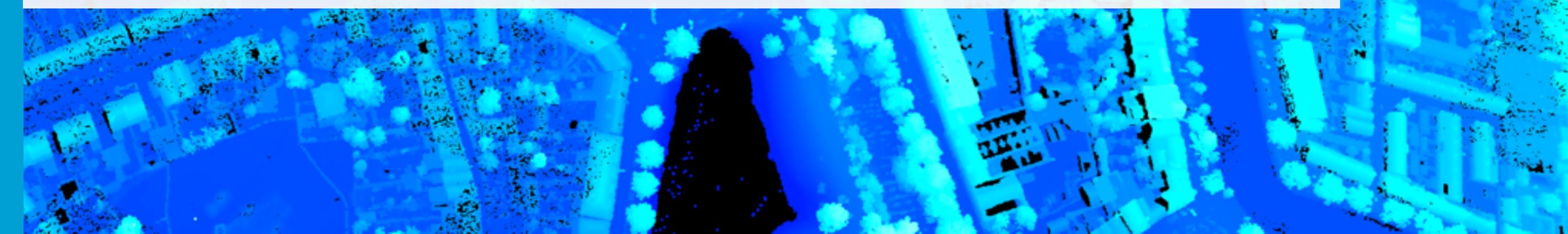
Conclusions & outlook

Conclusions

- Noise can be dealt with
- Assume point cloud with sufficient sampling
- LFS-simplification works for real datasets



Thank you

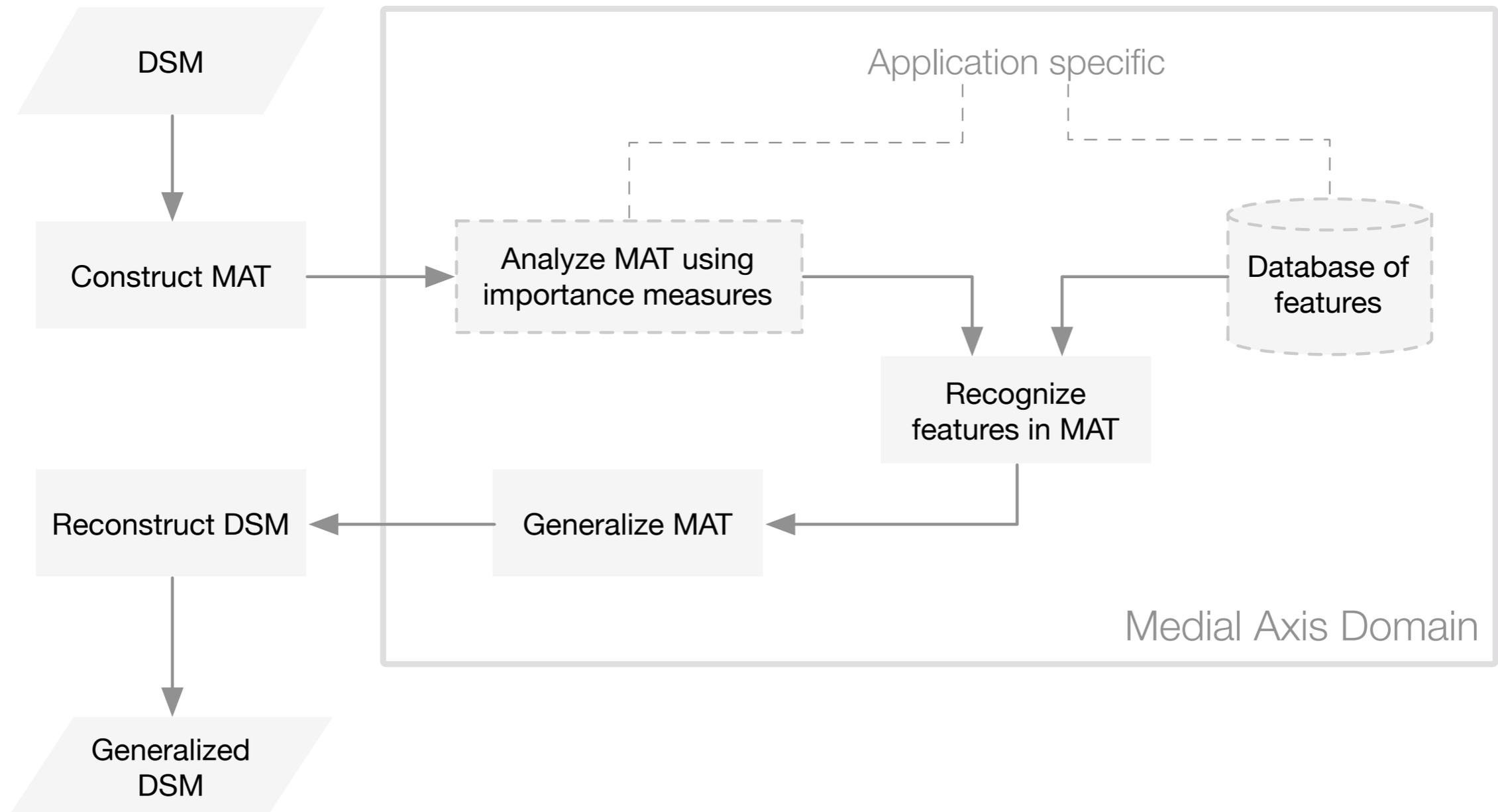


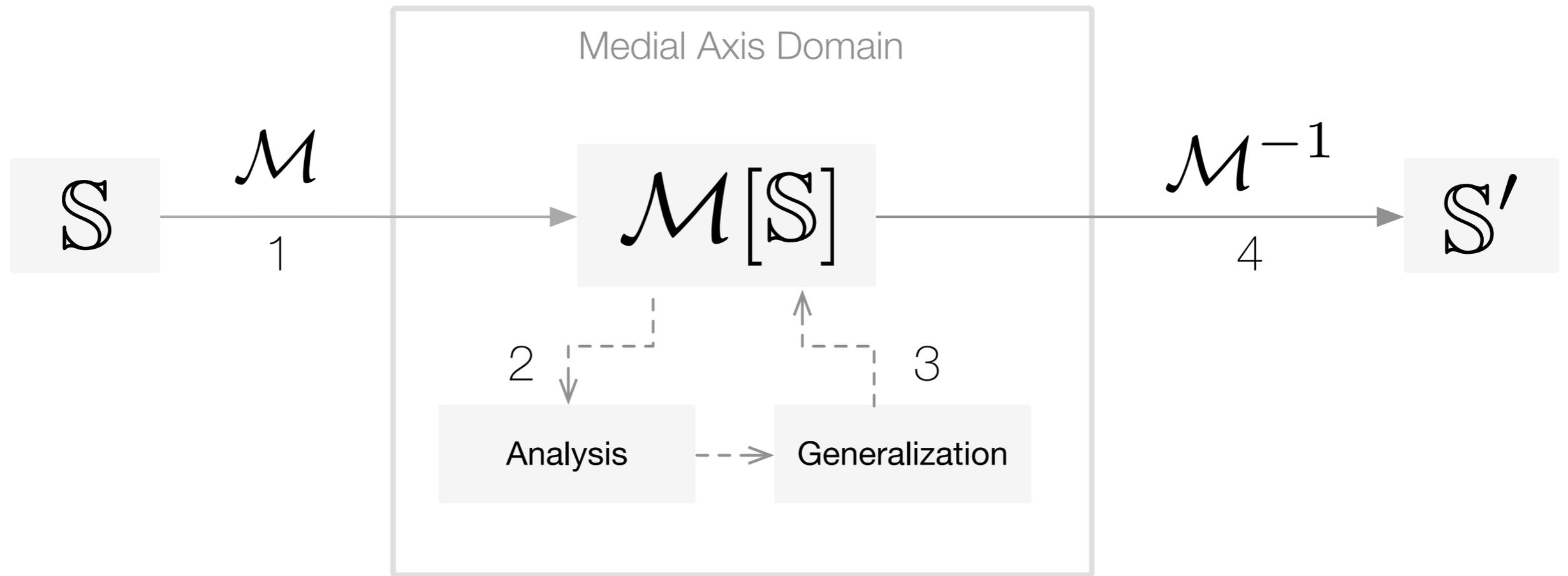
References

Dominique Attali and Annick Montanvert. Modeling noise for a better simplification of skeletons. In *Image Processing, 1996. Proceedings., International Conference on*, volume 3, pages 13–16. IEEE, 1996.

Jaehwan Ma, Sang Won Bae, and Sunghee Choi. 3D medial axis point approximation using nearest neighbors and the normal field. *The Visual Computer*, 28(1):7–19, 2012.

Workflow





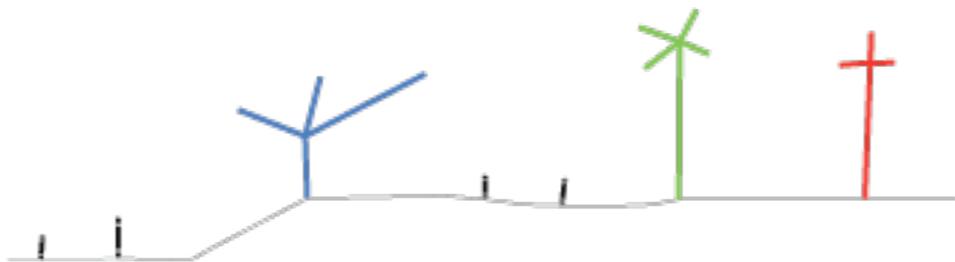
1



3



2



4

