

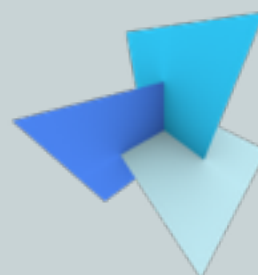
Simplification of digital terrain models using feature-based three-dimensional methods

Hugo Ledoux, Ravi Peters and Jantien Stoter

4th user committee meeting

2016-01-19

Zwolle



3D geoinformation
3dgeoinfo.bk.tudelft.nl

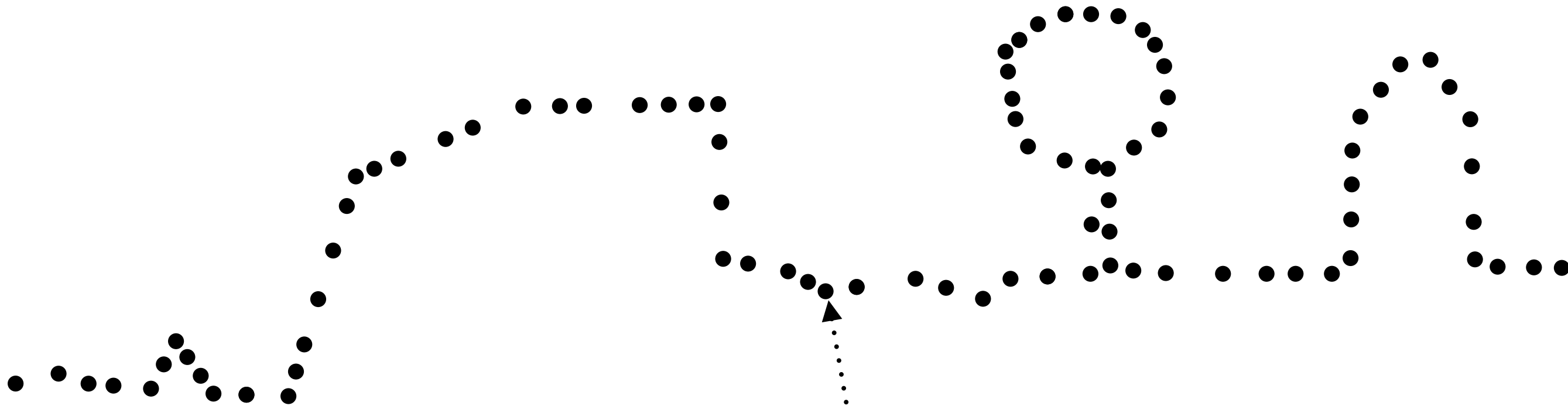
 **TU Delft** Delft University of Technology

What was the project about again?

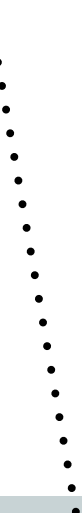
dike

tree

house



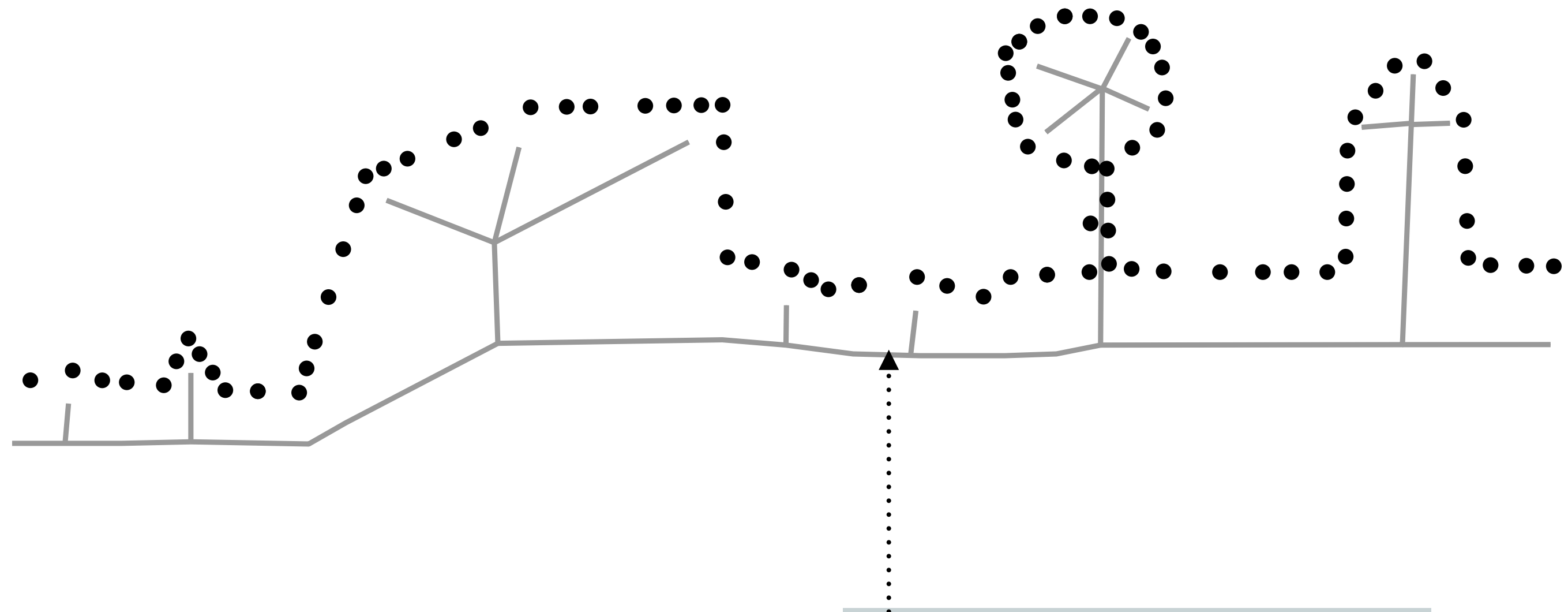
AHN3
points



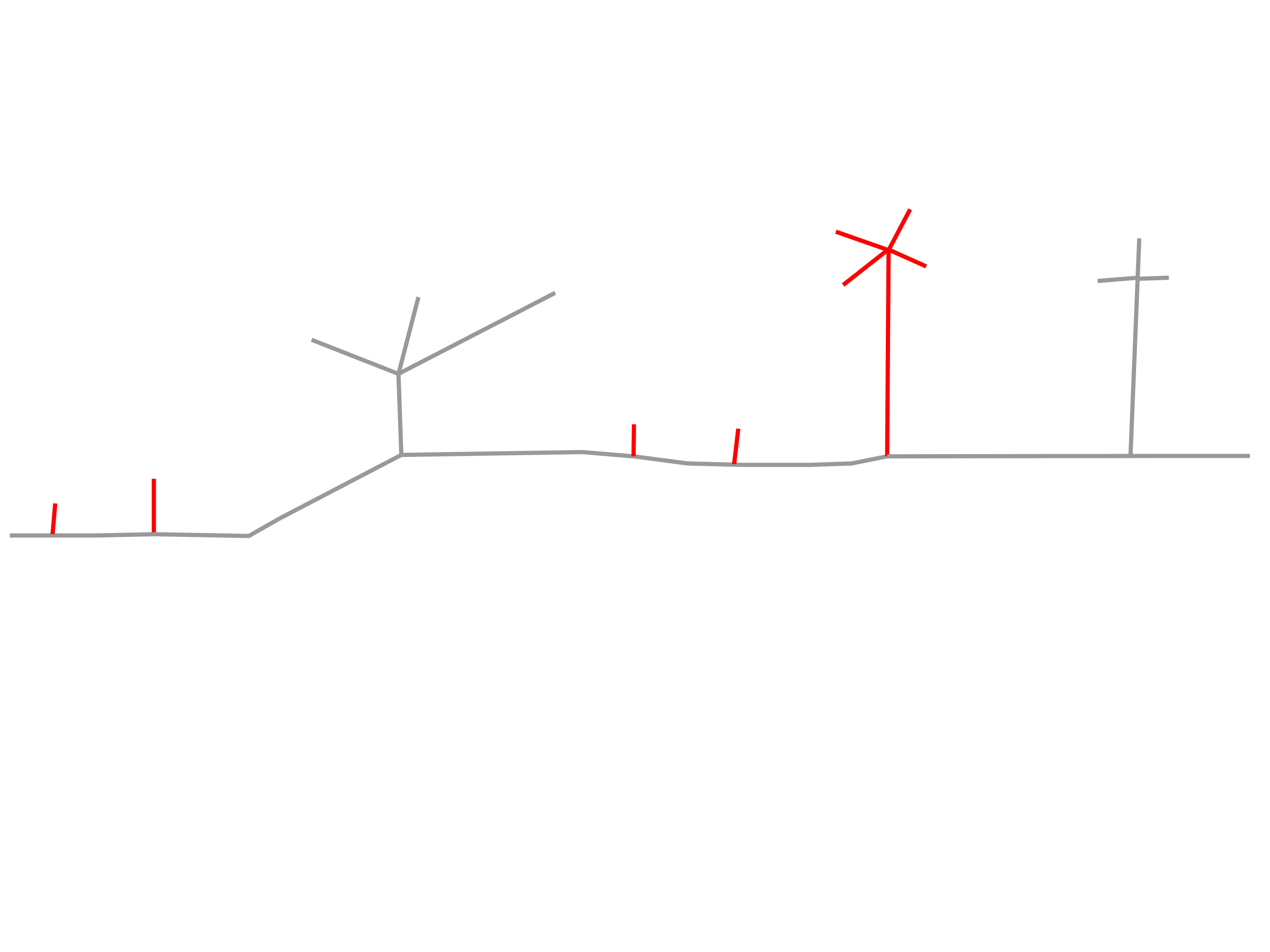
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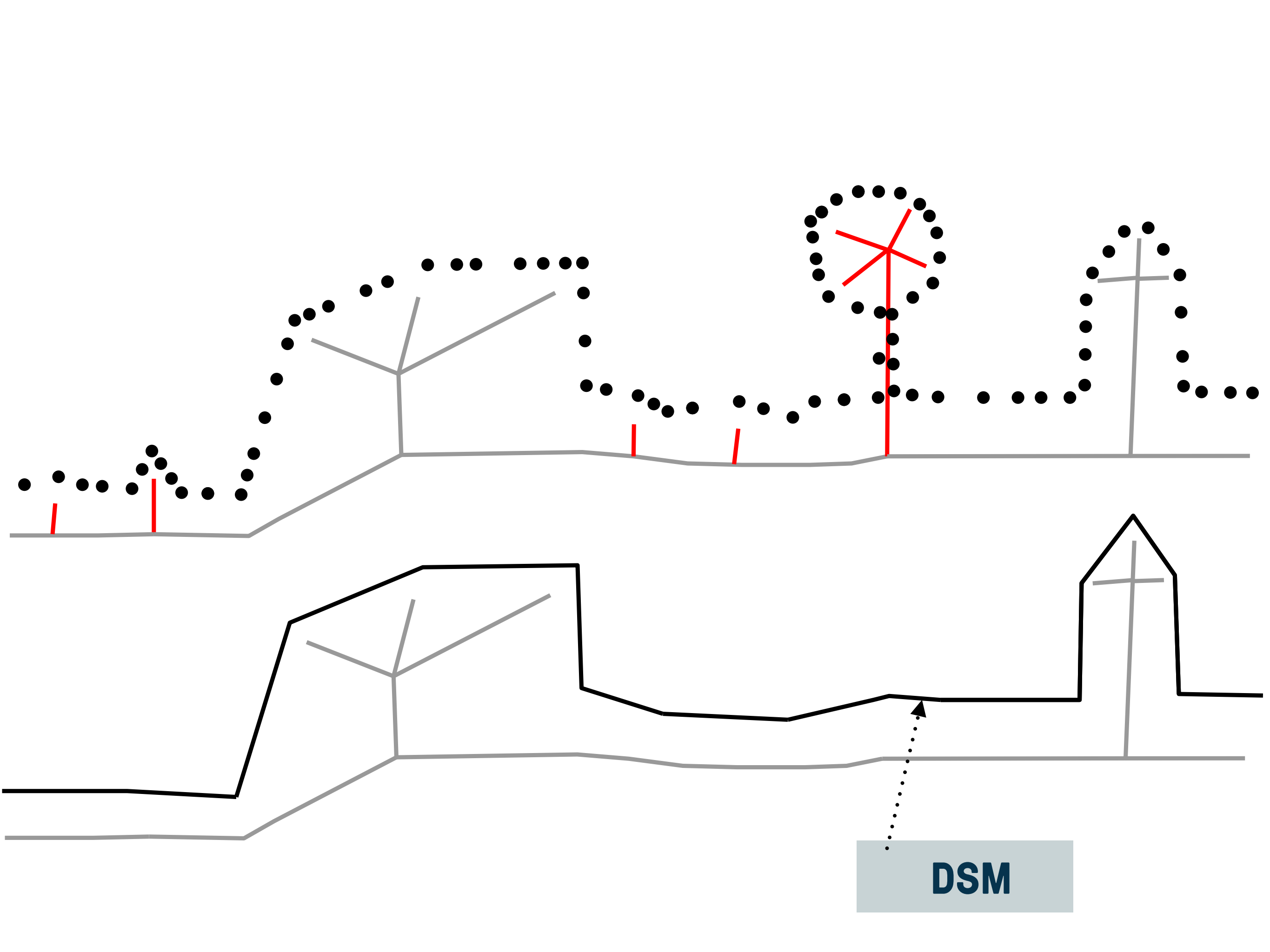
tree

house



skeleton
(Medial Axis Transform)

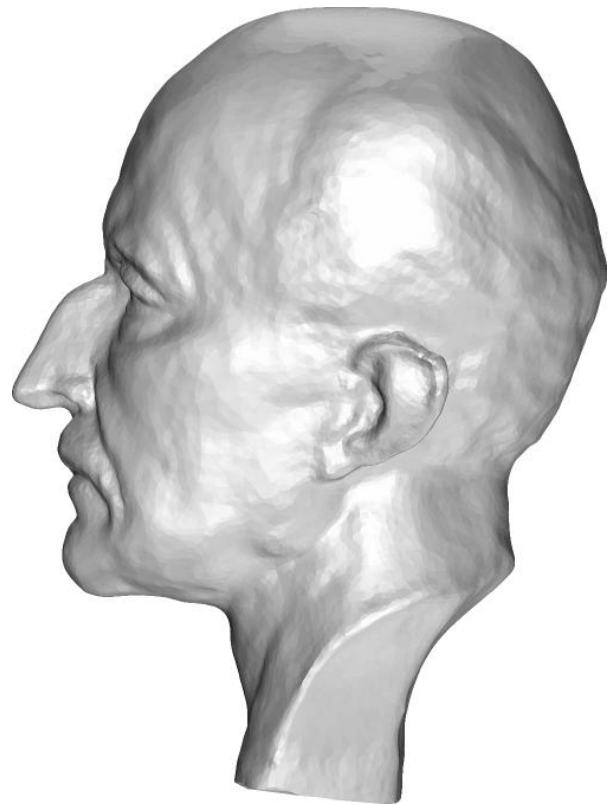




Medial axis transform (MAT) = skeleton



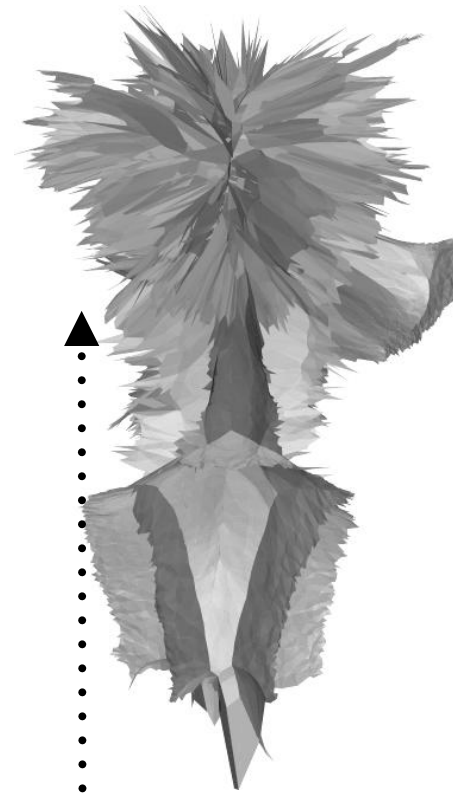
Inspiration: Tam & Heidrich (2003)



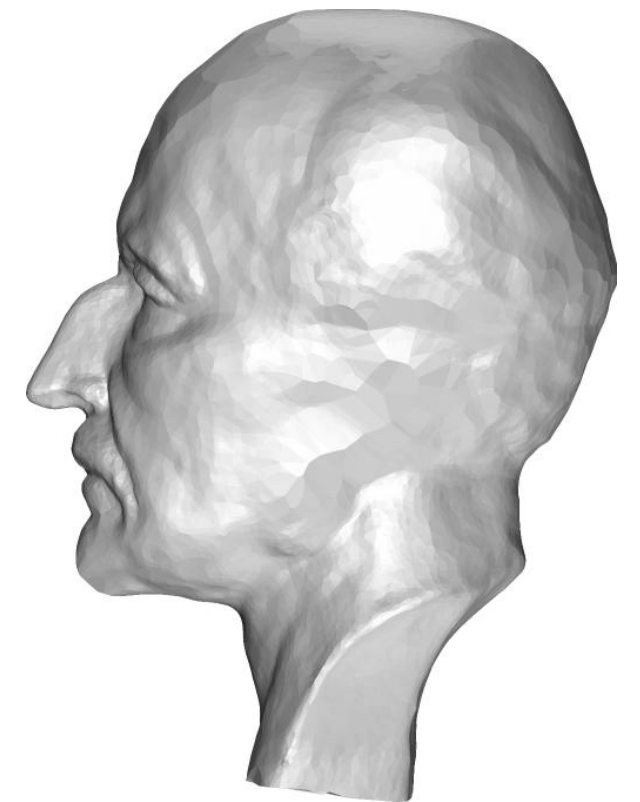
input



MAT



**ear
removed
from MAT**



results

Main results last 7 months

Milestones

- Software to construct 3D MAT scaled to massive datasets (several billions) and released as open-source software (in C++)
- First journal paper written + submitted (currently under review)
- One use-case implemented: the visibility analysis in 3D GIS
- Procedure to generate synthetic PC developed

Code released open-source

The screenshot shows a GitHub repository page for 'tudelft3d / masbcpp'. The repository is a C++ implementation of the Medial Axis Shrinking Ball algorithm. It has 62 commits, 1 branch, 0 releases, and 1 contributor. The latest commit is by Yianni, made 6 days ago. The repository includes a 'src' directory, a 'thirdparty' directory, and files like 'CMakeLists.txt', 'COPYING', and 'README.md'. The README.md file is currently selected and shows the title 'masbcpp' and a brief description: 'masbcpp is a C++ implementation of the shrinking ball algorithm to approximate the Medial Axis Transform (MAT) of an oriented point cloud. It is being developed in support of the 3DSM project that'. On the right side, there are navigation options for Code, Issues (3), Pull requests (0), Wiki, Pulse, Graphs, and Settings. At the bottom right, there are options to clone the repository using SSH, HTTPS, or Subversion, and buttons for 'Clone In Desktop' and 'Download ZIP'.

GitHub, Inc. github.com/tudelft3d/masbcpp

This repository Search Explore Gist Blog Help hugoledoux

tudelft3d / masbcpp Watch 0 Star 0 Fork 0

C++ implementation of the Medial Axis Shrinking Ball algorithm — Edit

62 commits 1 branch 0 releases 1 contributor

branch: master masbcpp / +

Update README.md

Yianni authored 6 days ago latest commit 577c74463f

src	add cmdline argument for disabling kdtree-reordering	7 days ago
thirdparty	update readme, forgot to uncomment part of cnpv	7 days ago
CMakeLists.txt	better openmp detection	7 days ago
COPYING	add licensing information	10 days ago
README.md	Update README.md	6 days ago

README.md

masbcpp

masbcpp is a C++ implementation of the shrinking ball algorithm to approximate the Medial Axis Transform (MAT) of an oriented point cloud. It is being developed in support of the [3DSM project](#) that

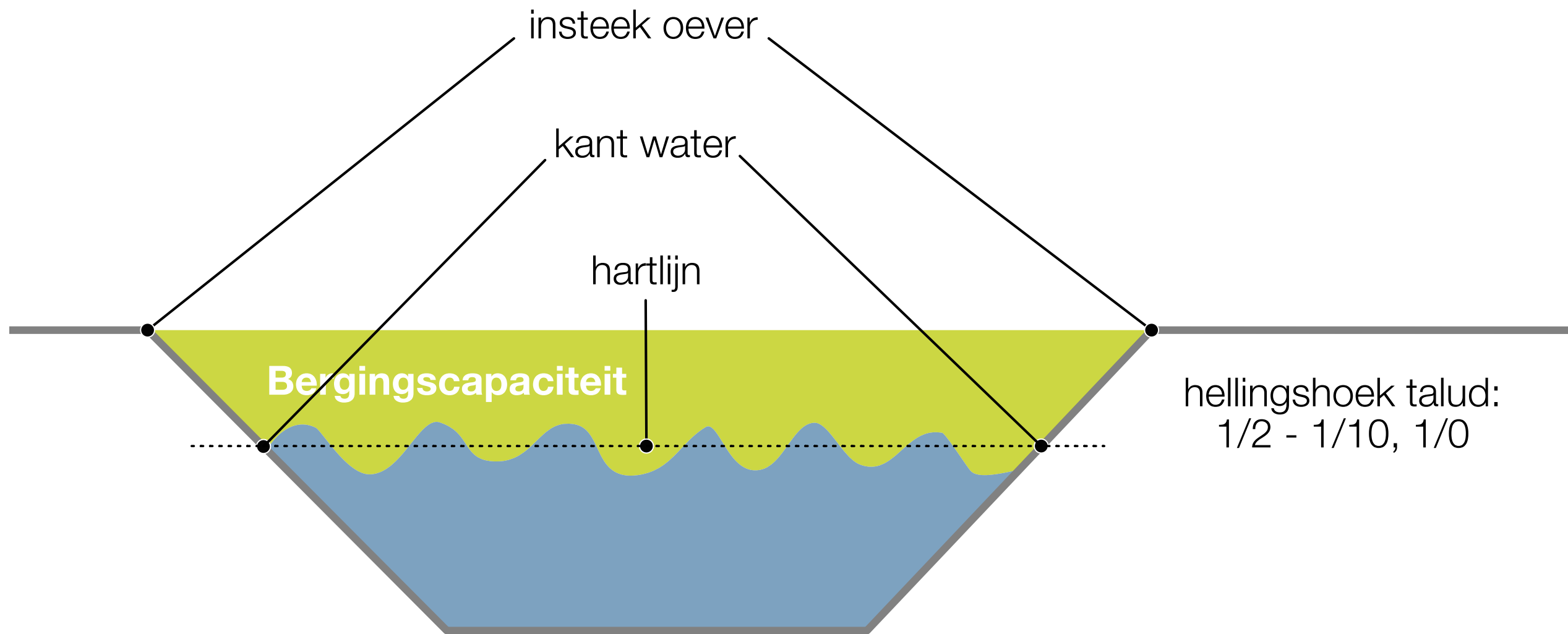
SSH clone URL
git@github.com:tude:

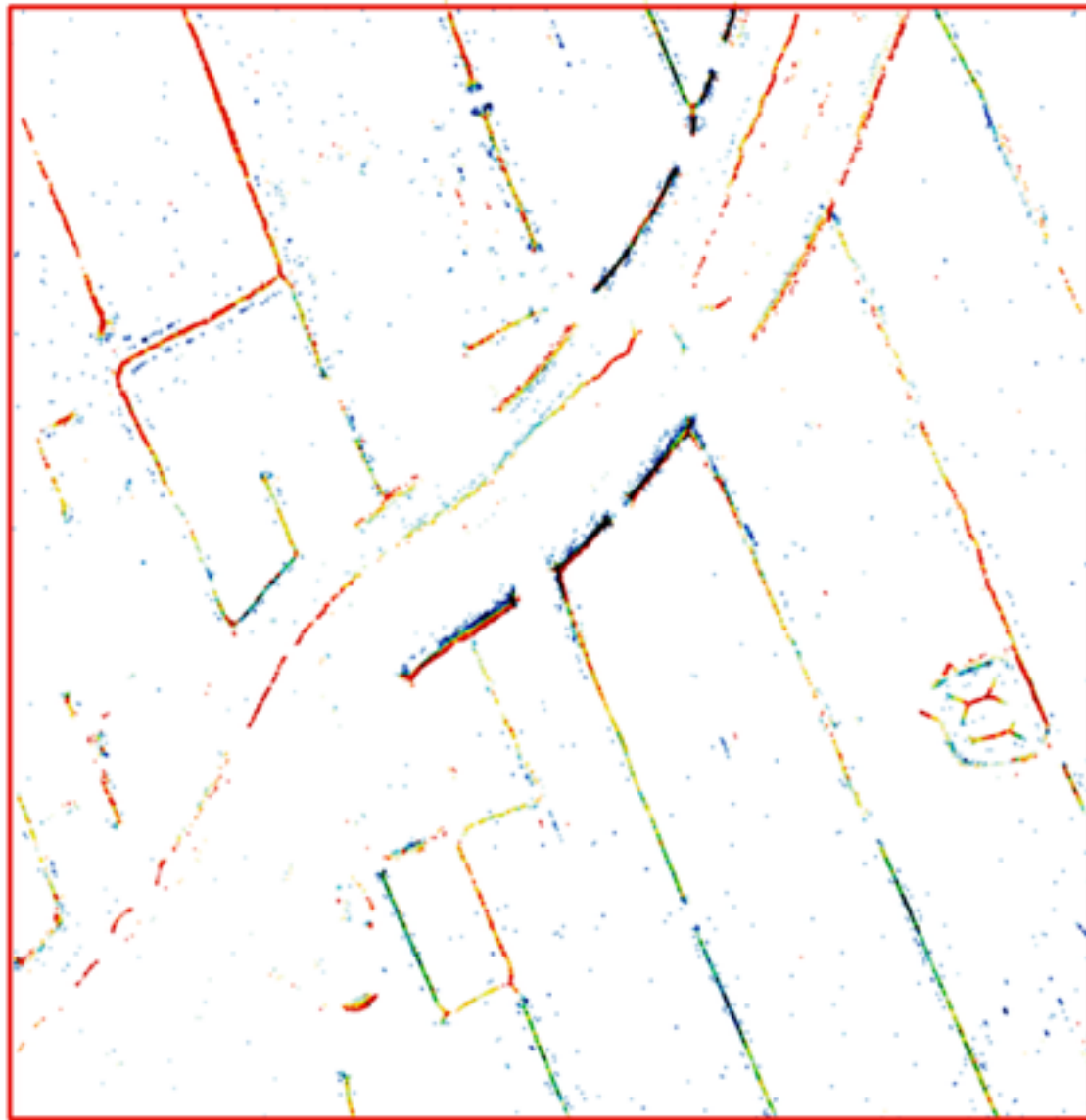
You can clone with [HTTPS](#), [SSH](#), or [Subversion](#).

Clone In Desktop

Download ZIP

Identification of water courses





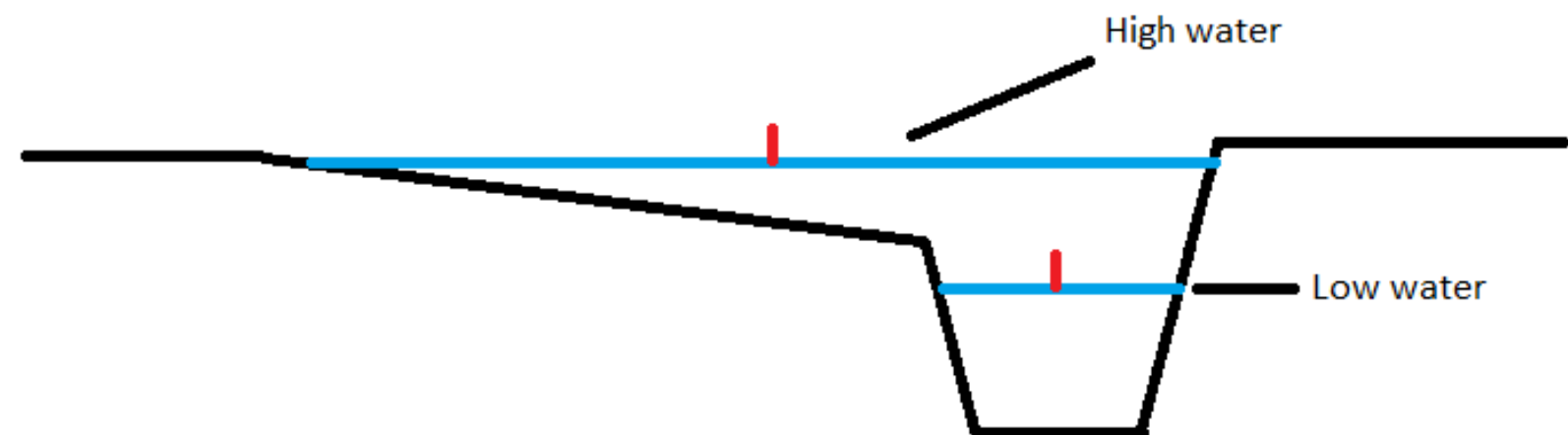
MAT points (AHN2)



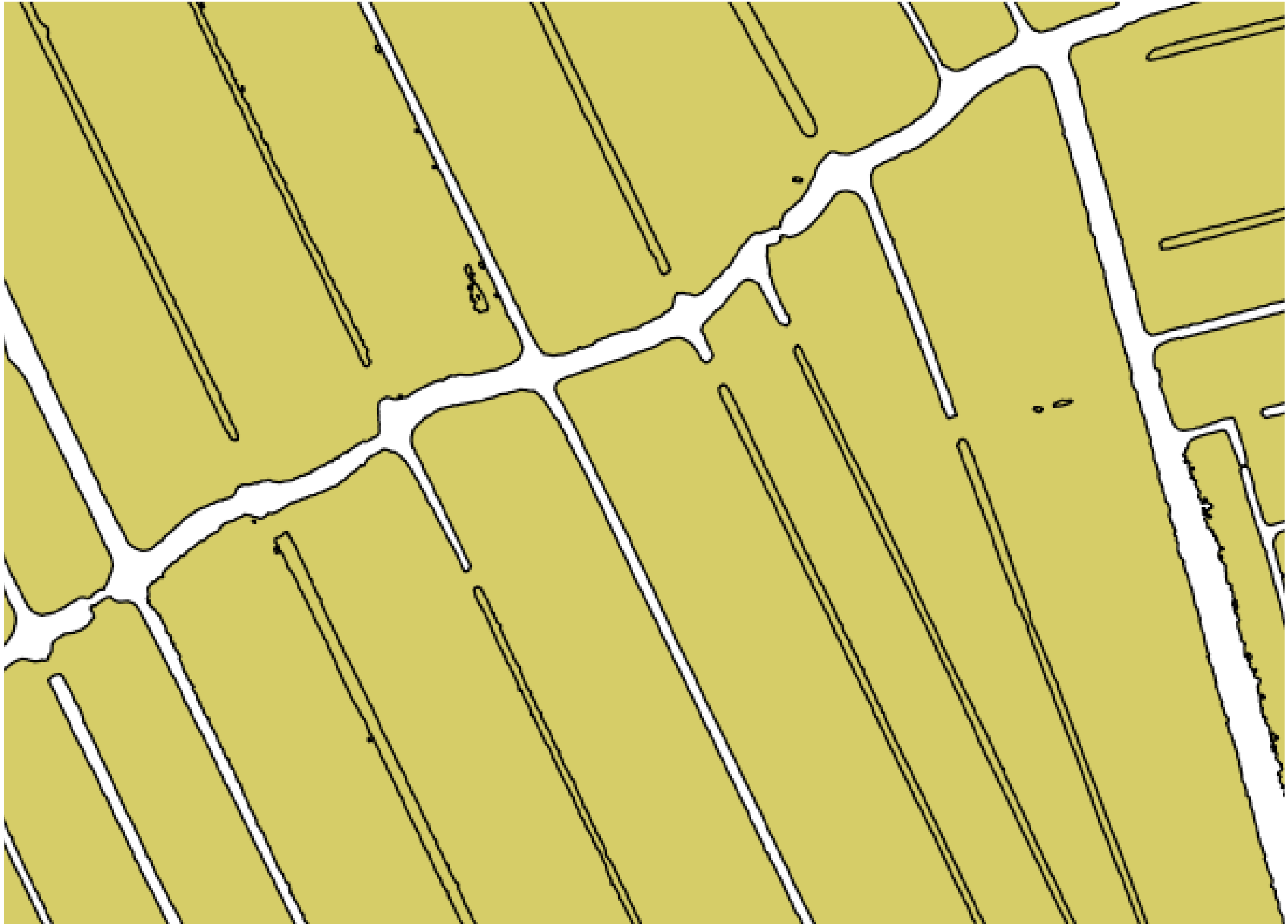
as registered by Waterschap

MSc graduation topic: Tom Broersen

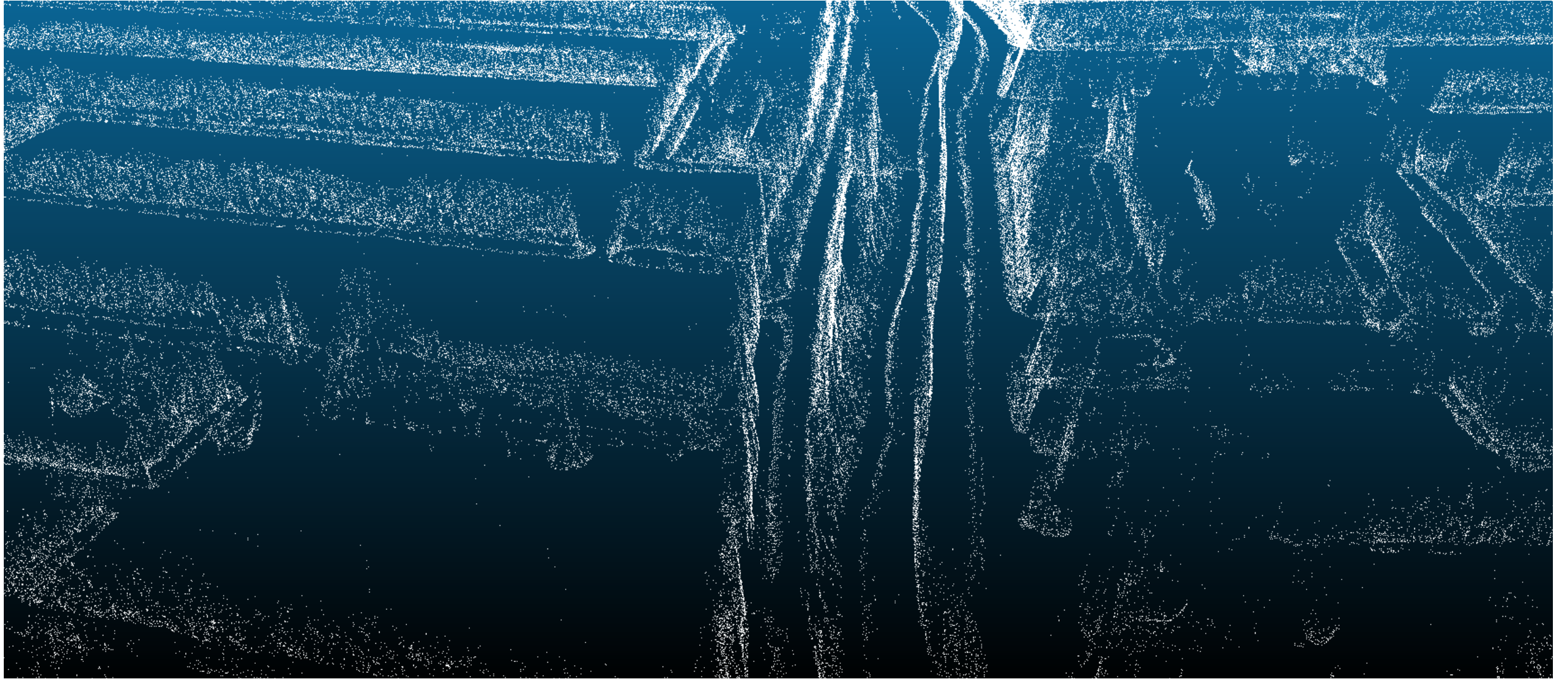
- already MSc in physical geography
- promising preliminary results
- comparison of diff methods (MAT, raster-based)
- objective: full “3D” geometry of the water courses



if water is visible: create polygons



if not \rightarrow use MAT



if not → use MAT



Figure 12: Dry channels identified by MAT (in red rectangles). Channels are fragmented.

Planning

	Year 1				Year 2				Year 3				Year 4				
	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51
Literature review	Green	Green	Green														Yellow
Development			Green	Green	Green	Green	Green	Green	Green	Green	Blue						Yellow
Prototype					Blue	Blue	Blue	Blue	Green	Green	Green	Orange					Yellow
Comparison							Blue	Blue	Blue	Blue	Blue		Orange	Orange			Yellow
Dissemination					Green	Green							Orange	Orange	Orange	Orange	Yellow

slide from May 2015

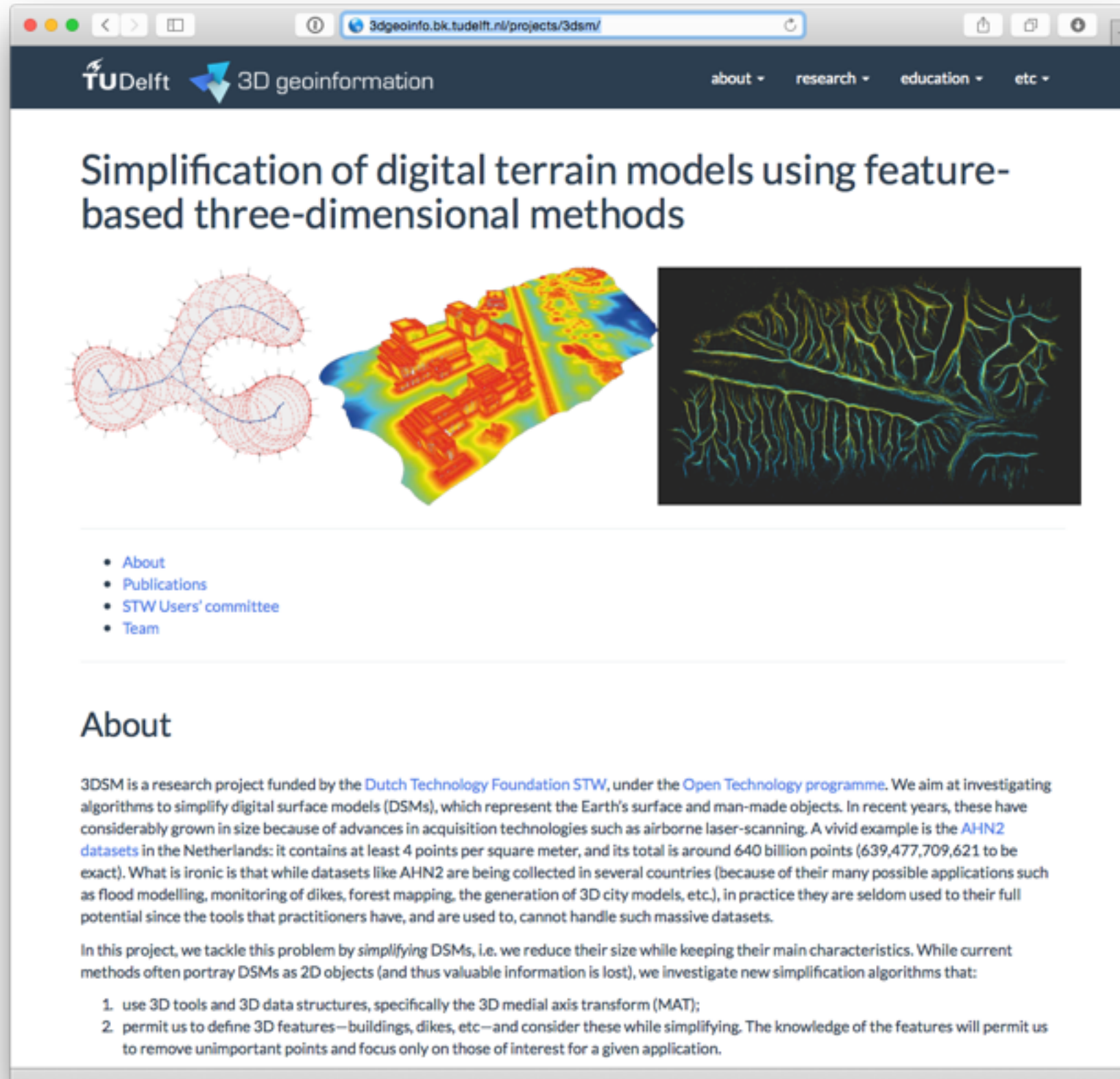
Activities coming year:

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 [less relevant: cancelled]
5. write and publish one conference paper (based on use-cases), and write another journal paper ✓ [partly]

Activities coming year:

1. Algorithm to construct the hierarchical topological structure. That will allow us to explore how can features be identified in a point cloud (with the help of the MAT obviously).
2. One journal article about this
3. For the visibility analysis, we plan to extend the work we presented at the workshop into a journal paper.
4. Use-case of automatic identification of water courses (MSc thesis)

3dsm.bk.tudelft.nl has all information



The screenshot shows a web browser window with the URL 3dgeoinfo.bk.tudelft.nl/projects/3dsm/. The page header includes the TU Delft logo and '3D geoinformation' with navigation links for 'about', 'research', 'education', and 'etc'. The main heading is 'Simplification of digital terrain models using feature-based three-dimensional methods'. Below the heading are three images: a red wireframe mesh of a terrain, a 3D city model with buildings, and a 3D visualization of a river network. A sidebar on the left contains a list of links: 'About', 'Publications', 'STW Users' committee', and 'Team'. The 'About' section contains text about the project's funding and goals, followed by a list of two key methods used in the research.

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

- [About](#)
- [Publications](#)
- [STW Users' committee](#)
- [Team](#)

About

3DSM is a research project funded by the [Dutch Technology Foundation STW](#), under the [Open Technology programme](#). We aim at investigating algorithms to simplify digital surface models (DSMs), which represent the Earth's surface and man-made objects. In recent years, these have considerably grown in size because of advances in acquisition technologies such as airborne laser-scanning. A vivid example is the [AHN2 datasets](#) in the Netherlands: it contains at least 4 points per square meter, and its total is around 640 billion points (639,477,709,621 to be exact). What is ironic is that while datasets like AHN2 are being collected in several countries (because of their many possible applications such as flood modelling, monitoring of dikes, forest mapping, the generation of 3D city models, etc.), in practice they are seldom used to their full potential since the tools that practitioners have, and are used to, cannot handle such massive datasets.

In this project, we tackle this problem by *simplifying* DSMs, i.e. we reduce their size while keeping their main characteristics. While current methods often portray DSMs as 2D objects (and thus valuable information is lost), we investigate new simplification algorithms that:

1. use 3D tools and 3D data structures, specifically the 3D medial axis transform (MAT);
2. permit us to define 3D features—buildings, dikes, etc.—and consider these while simplifying. The knowledge of the features will permit us to remove unimportant points and focus only on those of interest for a given application.