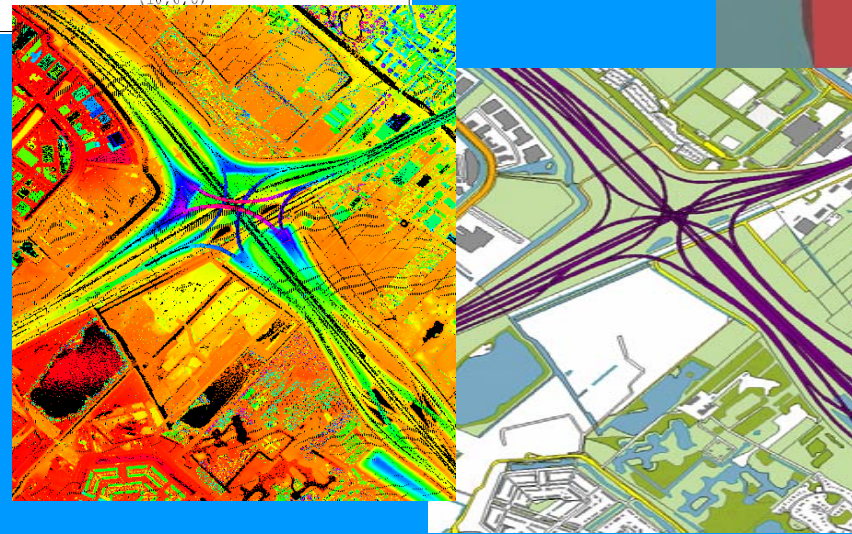
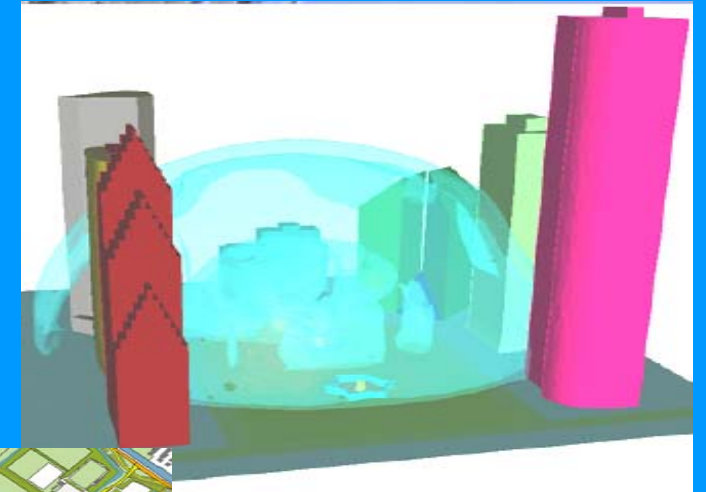
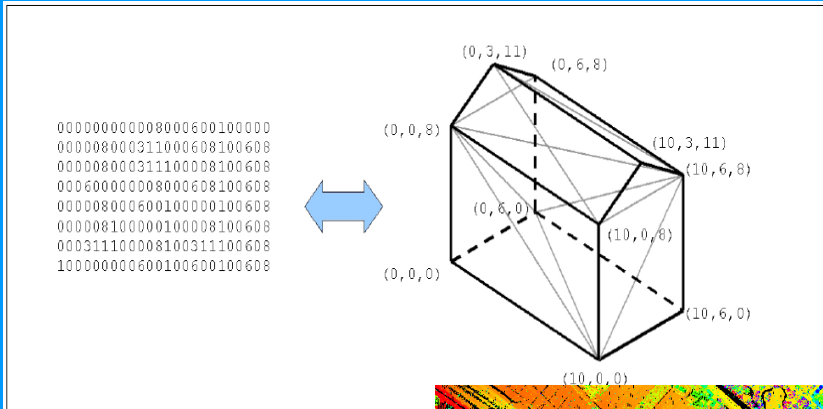




# 3D Topography



Peter van Oosterom, project leader (TU Delft)



# Agenda

- Project goal
- Facts and figures
- Position within RGI/NGII
- Approach and status
- Results, successes
- Relevance scientific/society
- Future perspective





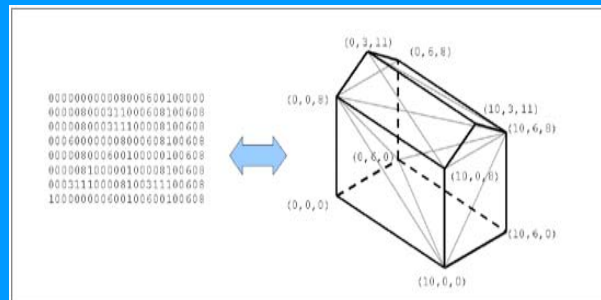
# Project Goal

- Enforce major break-through in the application of 3D Topography in corporate ICT environments due to structural embedding of 3D methods and techniques
- So: more than ad-hoc model visualization
- Two international top-ups:
  - RGI-011A: model comparison
  - RGI-011B: tetrahedron network computation



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# Facts and figures - Partners

- TU Delft
- ITC
- Topografische Dienst Kadaster
- Rijkswaterstaat – Adviesdienst Geoinformatie en ICT
- Oracle USA & NL
- NedGraphics CAD/GIS B.V.
- Stuurgroep AHN



# Facts and figures – Added

- RGI-011A, 3D model comparison:
  - TU Vienna (Andrew Frank)
  - City University London (Jonathan Raper)
  - University College London (Paul Longley)
  - University of Glamorgan (Chris Gold)
  - Sweco (private company) Sweden (Ludvig Emgård)
  - Queensland Government (Rod Thompson)
- RGI-011B, tetrahedron computation:
  - Weierstrass Institute for Applied Analysis and Stochastics, Berlin (Hang Si)



# Facts and figures - Management

- Consortium-wide meeting two times per year (prepared agenda, elaborated meeting notes with clear action points,...)
- Smaller meetings: more often as required
- One KPMG accountant statement for whole consortium (not easy with many partners)
- Professional project management support for reporting (TUD/OTB, Elfriede Fendel)



# Facts and figures – Budget

- RGI-011, 3D topography:  
899,836 Euro
- RGI-011A, 3D model comparison:  
198,136 Euro
- RGI-011B, tetrahedron computation:  
97,620 Euro





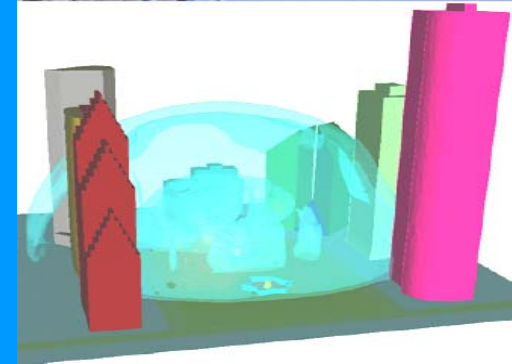
# Facts and figures – Period

- RGI-011, 3D topography:  
Period 11-01-2005 – 31-12-2008
- RGI-011A, 3D model comparison:  
Period 01-01-2007 – 31-12-2008
- RGI-011B, tetrahedron computation:  
Period 01-09-2007 – 01-09-2008



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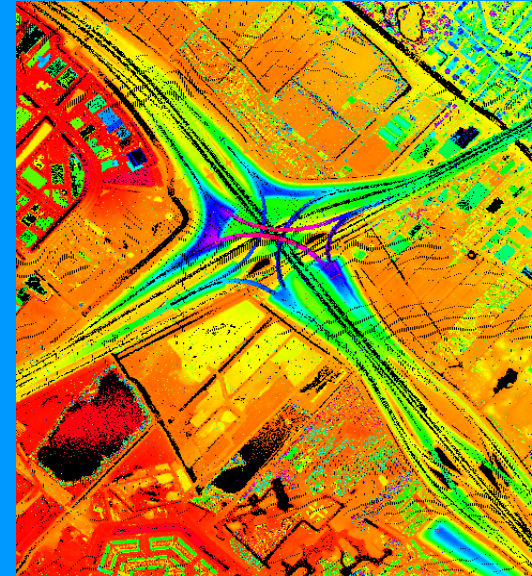
# Position within RGI/NGII

- Many indications of growing need of 3D topography as part of NGII framework data
- Our project analyses 4 use-cases: (Municipality Den Bosch, Google Earth at RWS, Lekdijk dike control, TOP10NL) support this
- Same is true at international level, both from demanding side (e.g. INSPIRE) and research side (→ top-ups)



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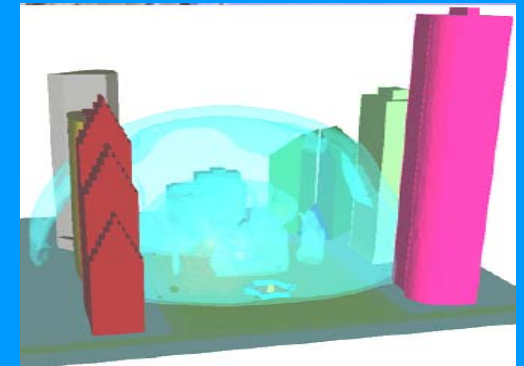
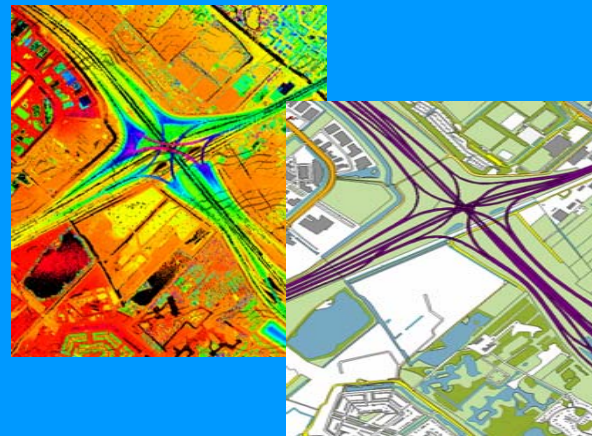
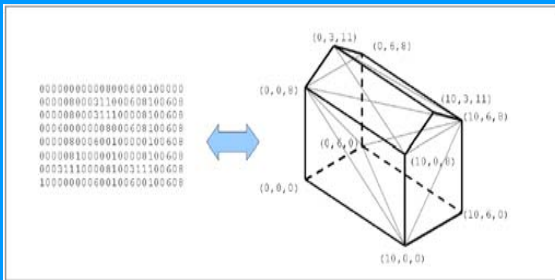




# Approach and status

## Project work packages:

- 1 User requirements of 3D topographic data and systems
- 2 3D topographic data model
- 3 3D conversion and acquisition techniques
- 4 3D DBMS and analysis
- 5 Knowledge distribution and communication



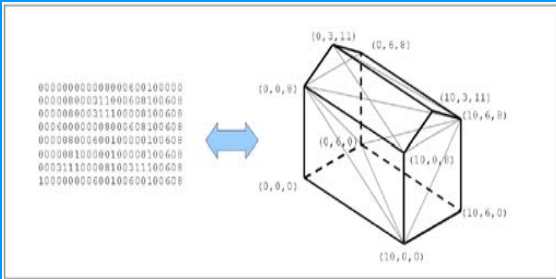
3D data modelling

3D data acquisition

3D DBMS Analysis



# 3D data modelling (1/2)



**Objective:** develop a data structure capable of handling large data volumes and offers support for querying, analysis and validation.

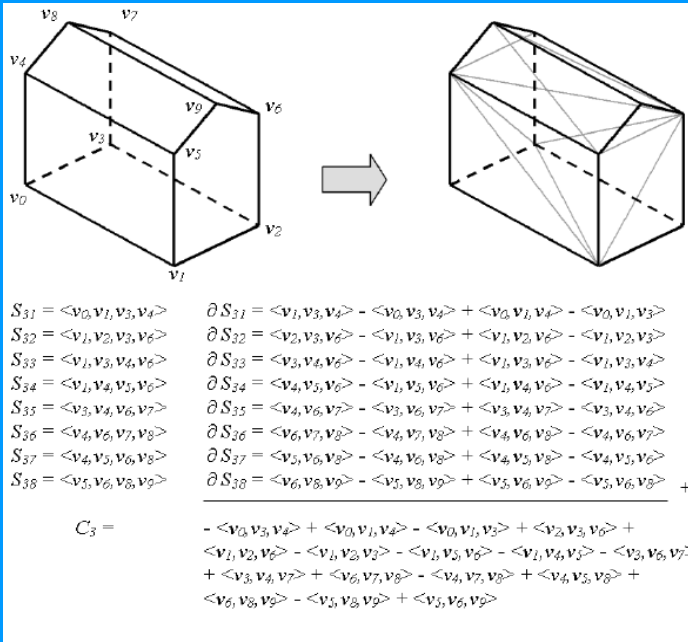
## Model characteristics:

- full 3D decomposition of space;
- apply a tetrahedron structure;
- based on Poincaré simplicial homology as mathematical foundation.

Main researcher: Friso Penninga (TUD)



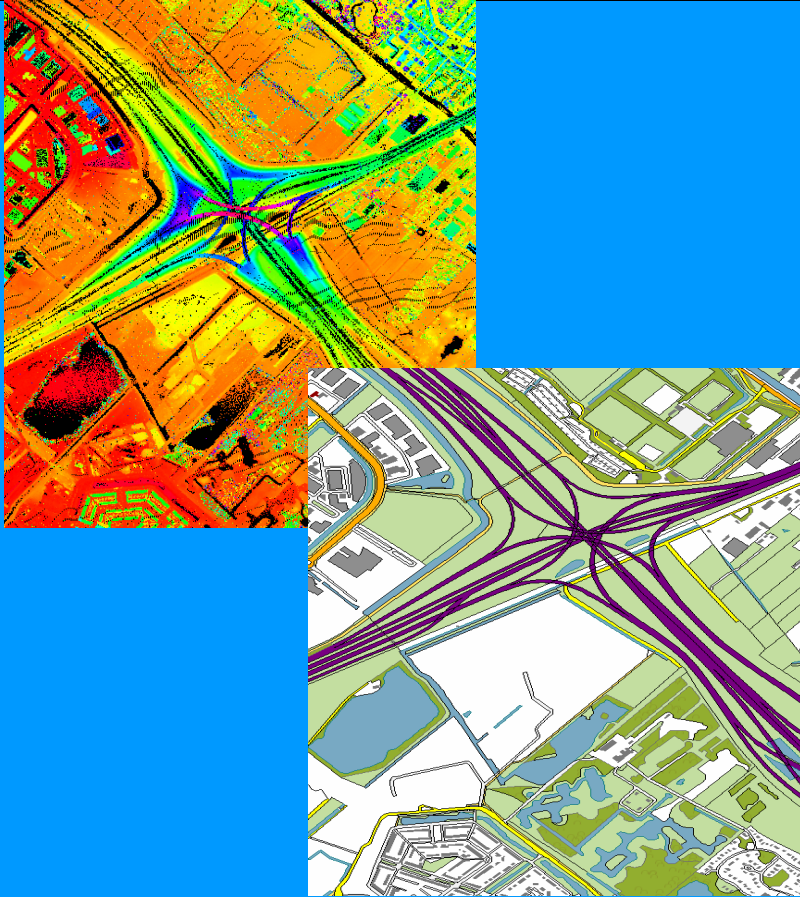
# 3D data modelling (2/2)



- Results:**
- a new innovative approach to 3D data modelling;
  - validation and analysis through topology
  - reduces data storage (stored in one single-column table!);
  - no explicit updates of topology and less dimensional simplexes;
  - full control over orientation;
  - based on a solid theoretical foundation (100 years old math).



# 3D data acquisition (1/3)



**Objective:** develop an automated 3D data acquisition method, by integrating laser altimetry data with 2D GIS data.

Main researcher: Sander Oude Elberink (ITC)

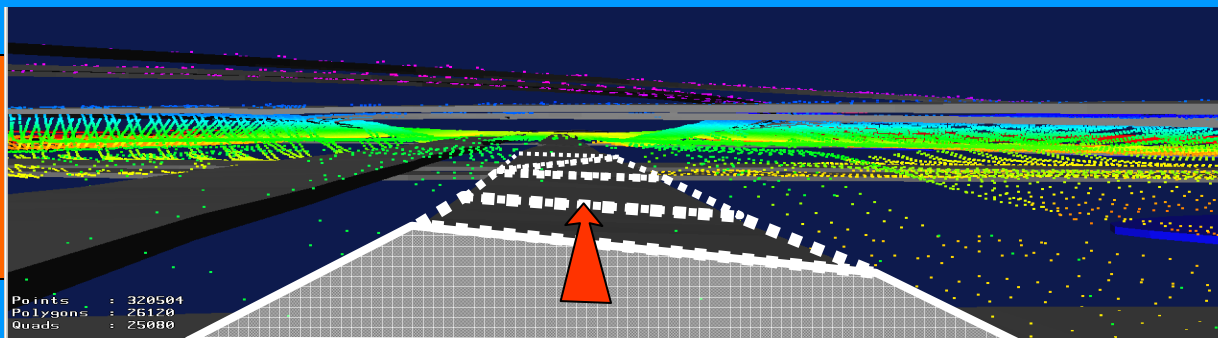
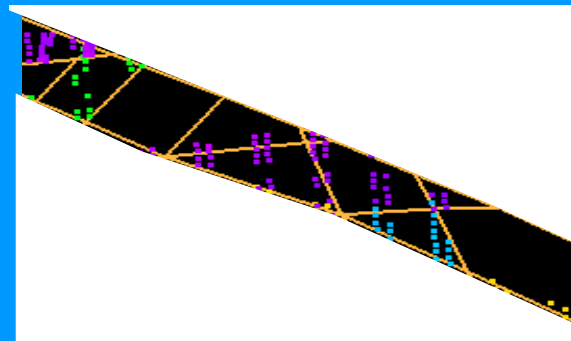
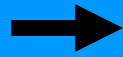
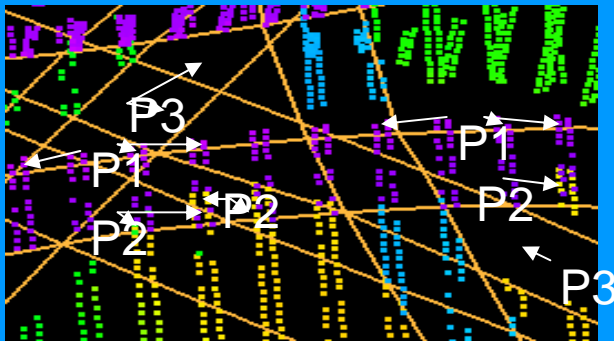




# 3D data acquisition (2/3)

## 3D acquisition algorithm:

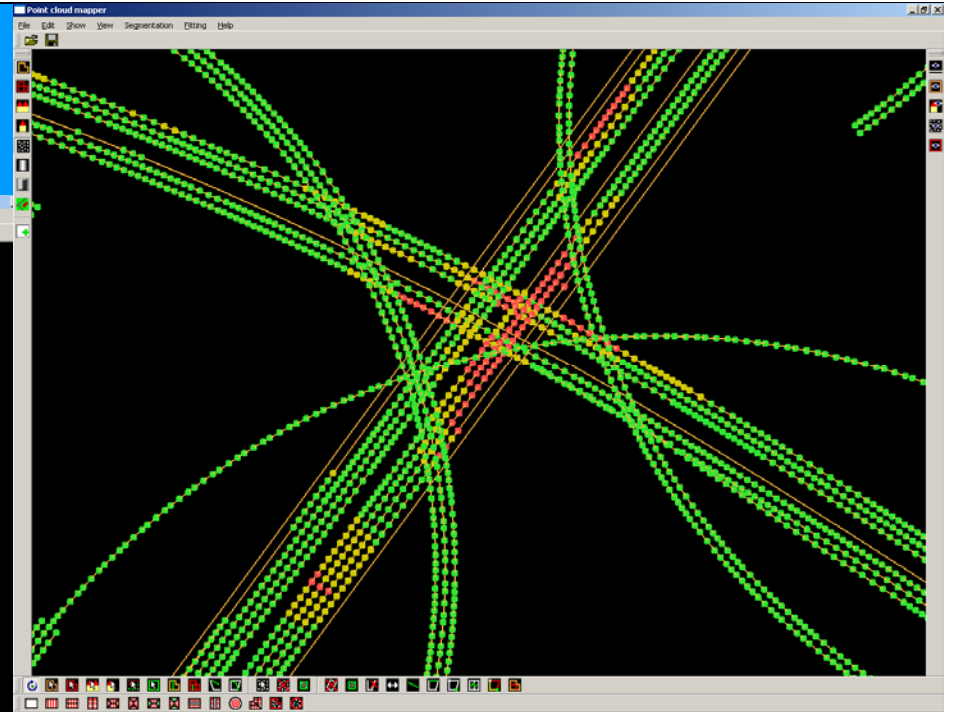
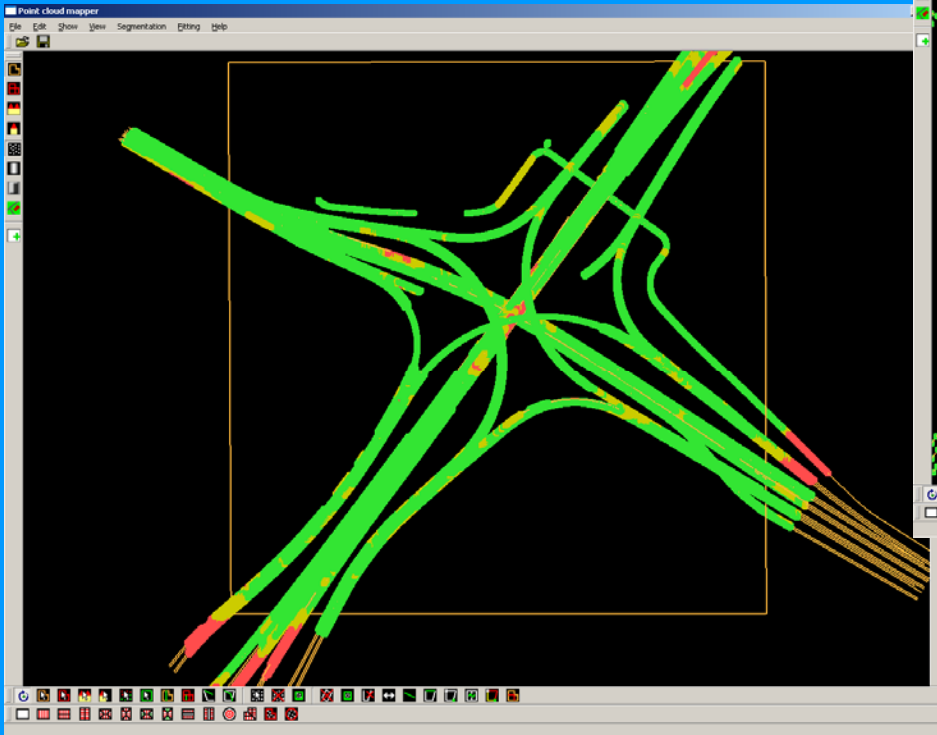
- segmentation based filtering of small objects in laser data;
- assigning laser data to map data in a sophisticated map and laser growing & fusion algorithm;
- integrating object knowledge to produce horizontal lakes and smooth roads;
- additional 3D boundaries have automatically been reconstructed to allow the reconstruction of 3D objects.





# 3D data acquisition (3/3)

Quality check



<0.2 m green  
0.2 – 0.5 m yellow  
>0.5 m red

Quality check: compare with accurate DTB



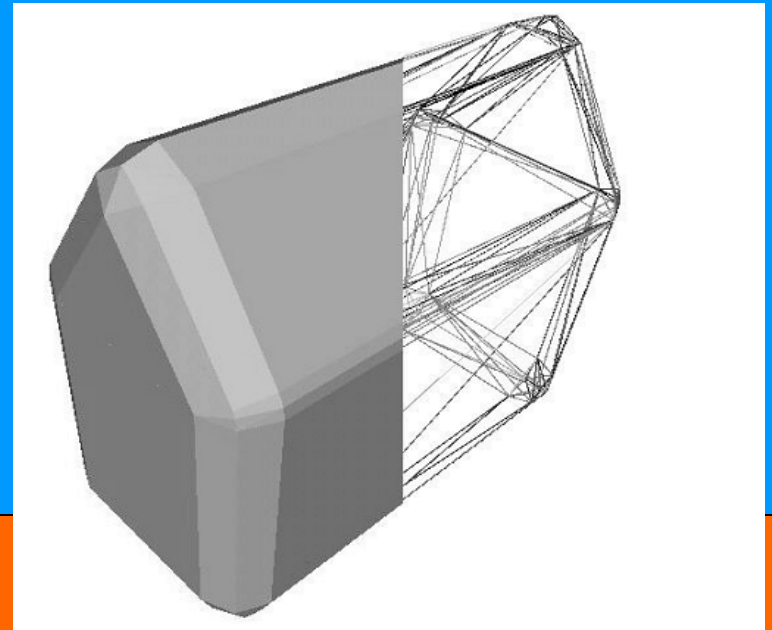
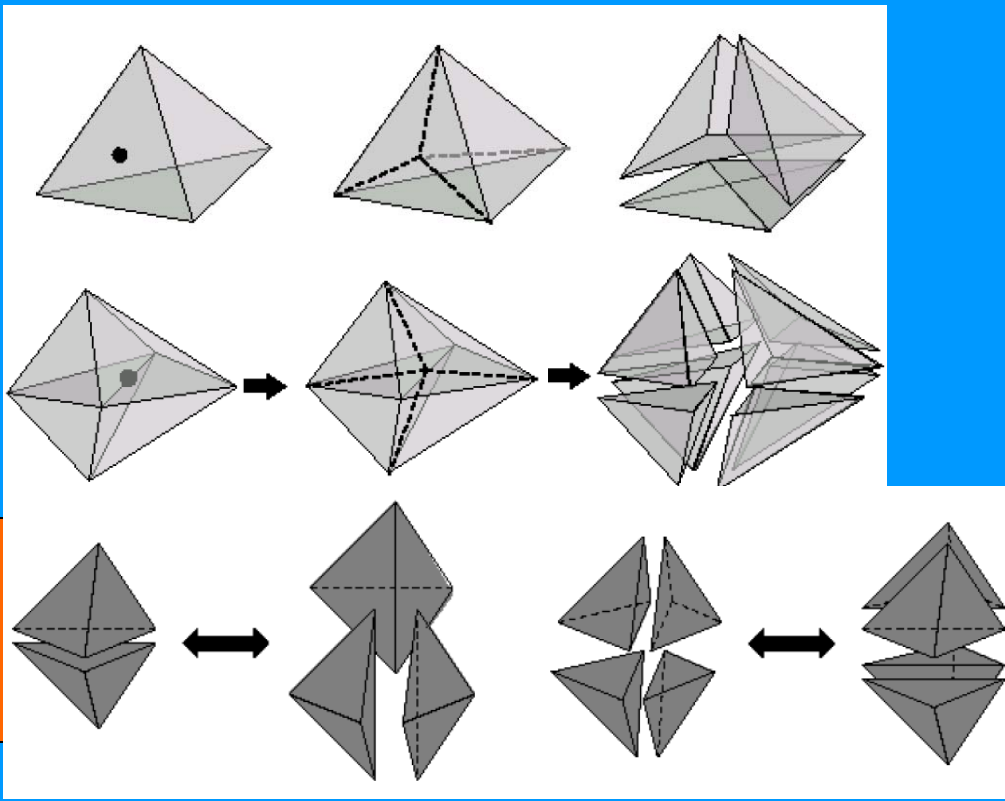
# 3D DBMS analysis

Updating and querying the DBMS with 3D data

Compare TEN structure to alternative (top-up RGI-011A)

Initial computing and updating TEN (top-up RGI-011B)

Types of operations: buffer, overlay, topology, metric (volumes, distance),...





# Agenda

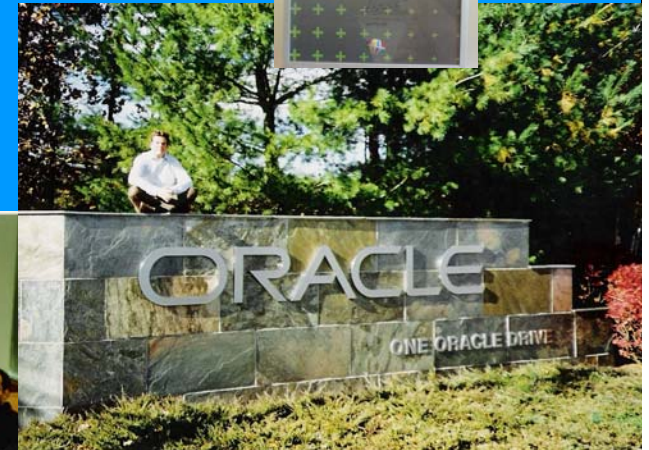
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# Results, successes

- Geo-Innovation award, category Science
- Geo-Info prize best paper
- Oracle 11g with functionality
- Automated reconstruction  
Prins Clausplein
- TUD campus  
test data
- TEN prototype





# Results

- First TEN structure in DBMS
- Simple toy world

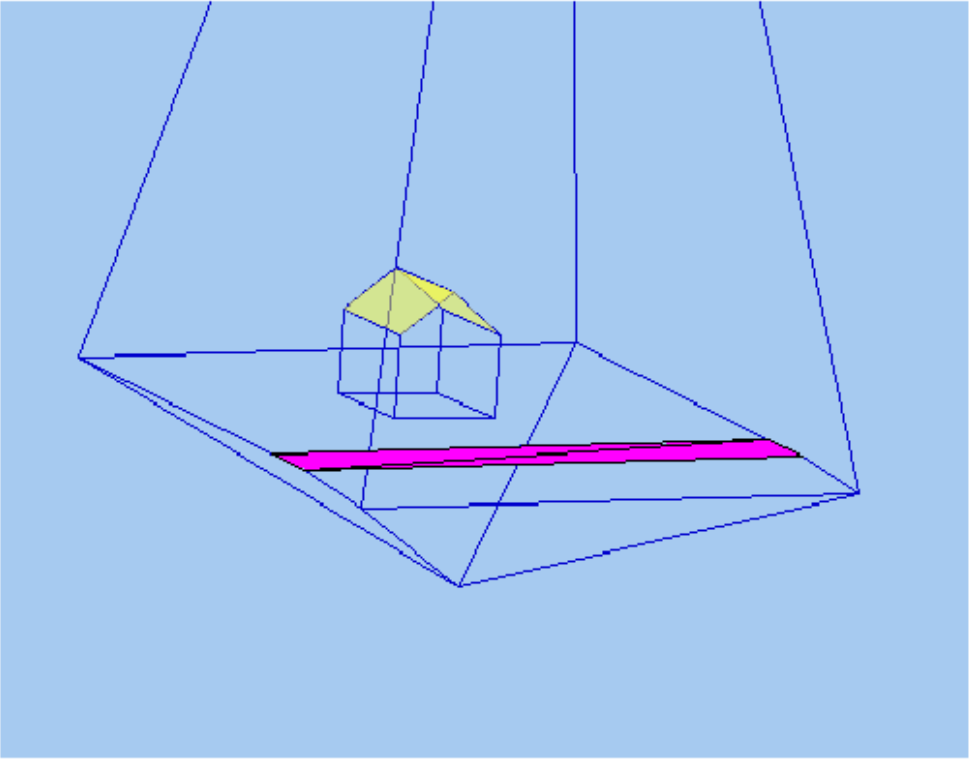
Simple Geometry Visualizer - Microsoft Internet Explorer






File Edit View Favorites Tools Help

ORACLE 10<sup>g</sup>  
APPLICATION SERVER

MapViewer

Simple Spatial Query Visualizer [source file](#)



Click on the map to:     

Datasource:  map width:  height:   AA

```
select rotate_geom(rotate_geom(edge_geometry, -80, 0),25,1) from full_edge where isconstraint=1
```

Line:  translucent



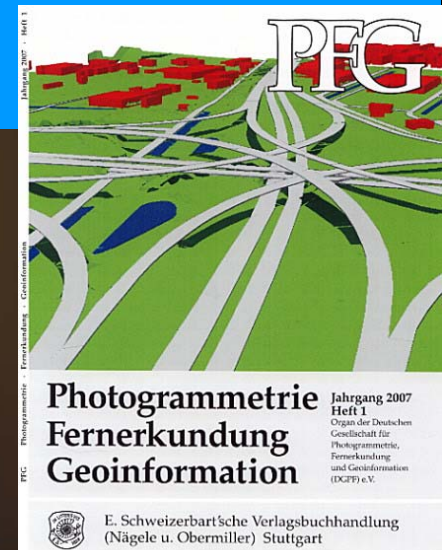
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# Relevance scientific/society

- So far: 17 conference papers, 6 professional publications, 6 reports and still counting!
- 1 accepted paper for peer-reviewed journal
- Upcoming event:  International Workshop on 3D Geo-Information: Requirements, Acquisition, Modelling, Analysis, Visualisation 12-14 December 2007, Delft, the Netherlands
- Workshop User requirements 3D Topography (April 2006):  
(in Dutch, about 80 attendants, good press coverage)








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# Future perspective

-  workshop: forum for international discussion
- 11 December 07: international top-up day: comparison 3D approaches with TU Delft campus model
- Top-up Rod Thompson, December 07 PhD defense
- Spring 2008: PhD defense on 3D modelling (first RGI PhD?)
- 2009: PhD defense on 3D acquisition
- more publications in the pipeline: PhD-theses, peer-reviewed journals, international conferences

## **Overall perspective:**

3D topography project delivers promising, relevant results according to both planning and budget!



# 3D Topography

[www.rgi-otb.nl/3dtopo](http://www.rgi-otb.nl/3dtopo)  
[www.3D-GeoInfo-07.nl](http://www.3D-GeoInfo-07.nl)

Contact: Peter van Oosterom

**RGI-011: 3D Topography**

e- click here

HOME  
project home  
partners  
events  
publications  
intranet  
links

**NEWS -- 3D topography project initiates international workshop 3D GeoInfo 07**

**3Dgeoinfo07**

From 12-14 December 2007, TU Delft will host 3D GeoInfo 07, the 2nd International Workshop on 3D Geo-Information: Requirements, Acquisition, Modelling, Analysis, Visualisation. The Workshop aims at bringing together international state-of-the-art research in the field of 3D geo-information. It offers an interdisciplinary forum to researchers in the closely related fields of:

- Data collection and modelling: advanced approaches for 3D data collection, reconstruction and methods for representation.
- Data management: topological, geometrical and network models for maintenance of 3D geo-information.
- Data analysis and visualisation: frameworks for representing 3D spatial relationships, 3D spatial analysis and algorithms for navigation, interpolation, etc. Advanced Virtual Reality and Augmented Reality visualisation.

The Workshop is intended as an interactive platform for both presentations on state-of-the-art research and discussions on open problems. The workshop will consist of a mixture of single-track presentations and discussion (PD) sessions and parallel working group (WG) sessions on specific themes (Requirements, Acquisition, Modelling, Analysis, Visualisation), according to the following format: current problems to be solved, potential solutions, and recommendations by WG (discussion under coordination of a chair and final presentation of the results at the closing plenary session). The presentations will be selected based on their quality by the scientific program committee (peer review of full papers).

**Project home 3D topo**

Space for Geo-information, project RGI-011 '3D topography':

There is an increasing need for real 3D topography due to a broad range of applications. Four prototypical applications are analysed with regard to the user wishes and the resulting 3D model requirements. On this basis, a new 3D topographical product model is further developed together with new methods and techniques and for data collection, storage and analysis. The project is spread over the period 2005-2008 and consists of the following sub-projects:

SUB1 Research on accessibility and user requirements of 3D topographic data and systems

Home / Background / Organisation / Workshop topics / Call for papers / Paper submission / Registration / Program / Venue / Contact

**3Dgeoinfo07**

**NEW:** the preliminary program can be found at [Program](#)

**2nd International Workshop on 3D Geo-Information: Requirements, Acquisition, Modelling, Analysis, Visualisation**

12-14 December 2007, Delft, the Netherlands

The Workshop aims at bringing together international state-of-the-art research in the field of 3D geo-information. It offers an interdisciplinary forum to researchers in the closely related fields of:

- Data collection and modelling: advanced approaches for 3D data collection, reconstruction and methods for representation.
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home