



CycloMedia's aerial and ground-based image databases

NCG – December 18, 2008

Dr.ir. Frank van den Heuvel

cyclomedia

Overview

- Introduction
- Aerial imagery
 - LuchtfotoNL project
 - Image database
- Terrestrial imagery
 - Mobile Mapping System DCR7
 - System Calibration
 - Panorama database
- Research at CycloMedia
 - Future of the databases
- Conclusions



cyclomedia

Introduction to CycloMedia

- Spin-off (1989) T.U. Delft, Faculty of Geodesy
- Specialized in large-scale, systematic geo-imaging:
 - Aerial: The Netherlands complete, except Schiphol area
 - Terrestrial: The Netherlands completed, now updating
- Aerial:
 - LuchtfotoNL project in 2008
- Terrestrial:
 - Georeferenced 360° panoramic imagery from all public roads
 - Mobile mapping systems developed in house
 - Up to date imagery (Netherlands of 2006 or more recent)
 - History (recordings of previous years are kept)

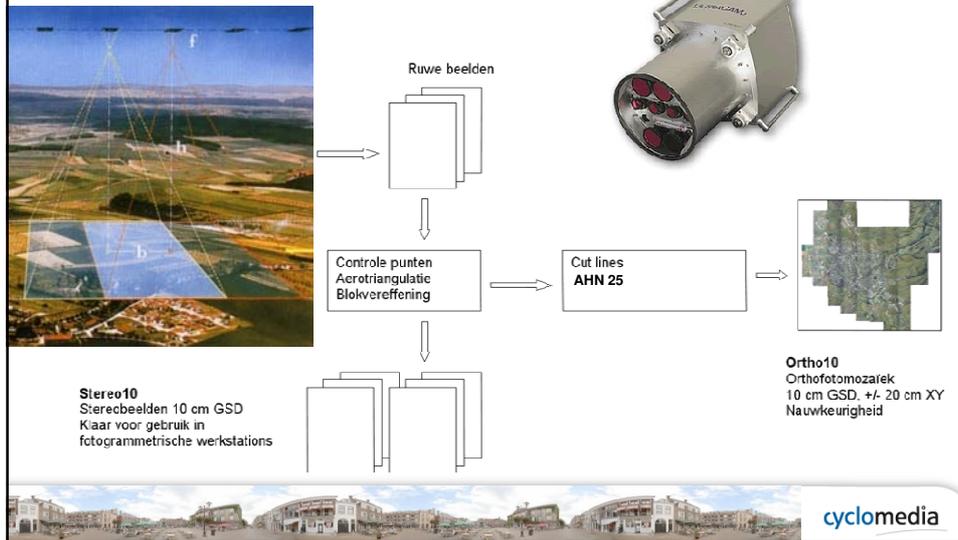


Aerial Imagery: LuchtfotoNL 2008

- Unique project: 10 cm resolution of the entire Netherlands
- Data is captured by Blom Aerofilms Ltd. 
- Specifications and quality control by ingenieursbureau **Geodelta**
- Stereo imagery
- Ortho photo mosaic
- One season: 4 planes
- Yearly updating



LuchtfotoNL 2008 - Workflow



LuchtfotoNL 2008 – some numbers

- Camera: Vexcel Ultracam D & X:
 - D: 90 Mpixel & X: 140 Mpixel
- Overlap: 60% / 30%
- 150,000 stereo images: ~ 40TB
- Orthophoto: ~ 10 TB
- Total storage > 50 TB



LuchtfotoNL 2008 – current status

- 92 % photographed
- Schiphol area missing ...
- Ongoing:
 - Orthophoto production
 - Delivery
- Planning for next year:
 - Higher resolution?
 - More overlap?
 - Demand?



cyclomedia

Aerial photography 10 cm resolution



cyclomedia

LuchtfotoNL 10 cm resolution (Google)



LuchtfotoNL 10 cm resolution (CycloMedia)



Overview

- Introduction
- Aerial imagery
 - LuchtfotoNL project
 - Image database
- **Terrestrial imagery**
 - **Mobile Mapping System DCR7**
 - **System Calibration**
 - **Panorama database**
- Research at CycloMedia
 - Future of the databases
- Conclusions

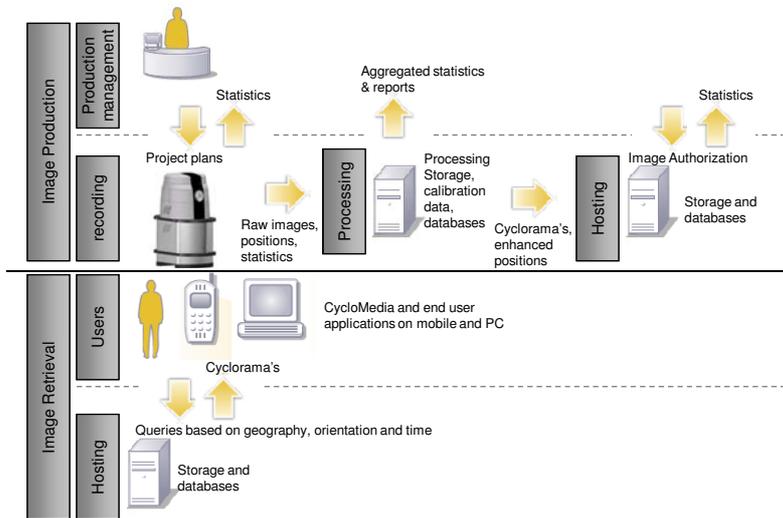


Terrestrial Imagery

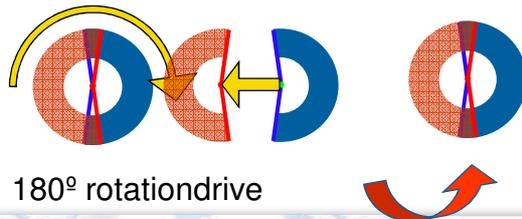
- CycloMedia develops mobile mapping systems in-house:
 - Bringing aerial photogrammetric principles “to the ground”
 - Including elaborate system calibration
- And CycloMedia develops:
 - Cyclorama production and hosting software
 - Tools for viewing, GIS-integration, 3D measurement
 - Content analysis tools (new!)
- Core product: 360° spherical panorama's
- 16 mobile mapping systems in operation (end 2008)
- Yearly updating



More than a recording system: the workflow



Principle of old versus new recording system



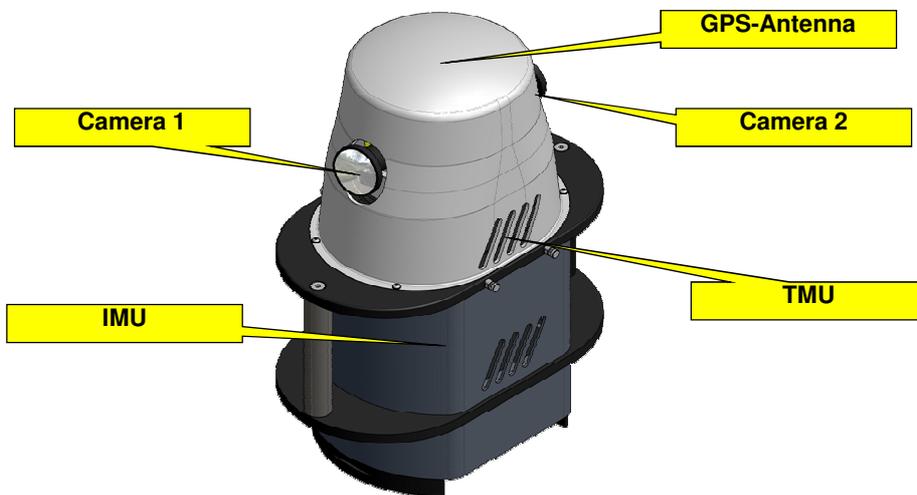
Prototype DCR7a



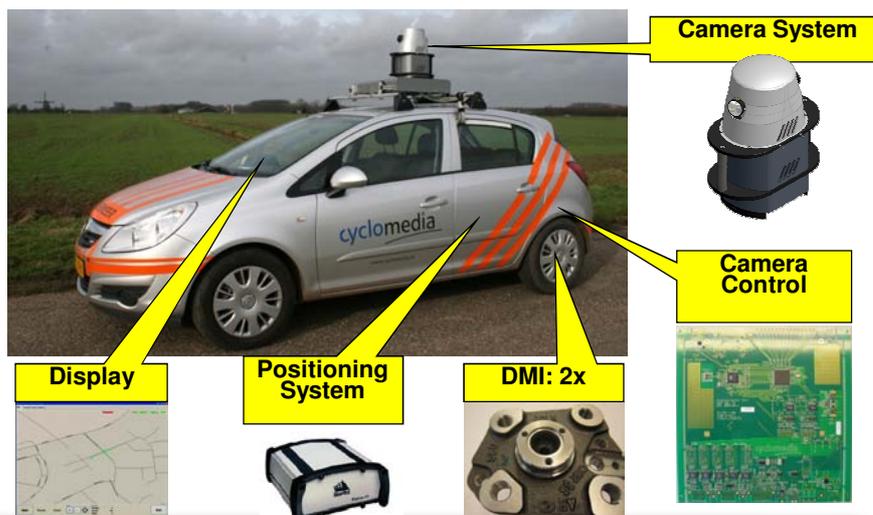
DCR7 production version



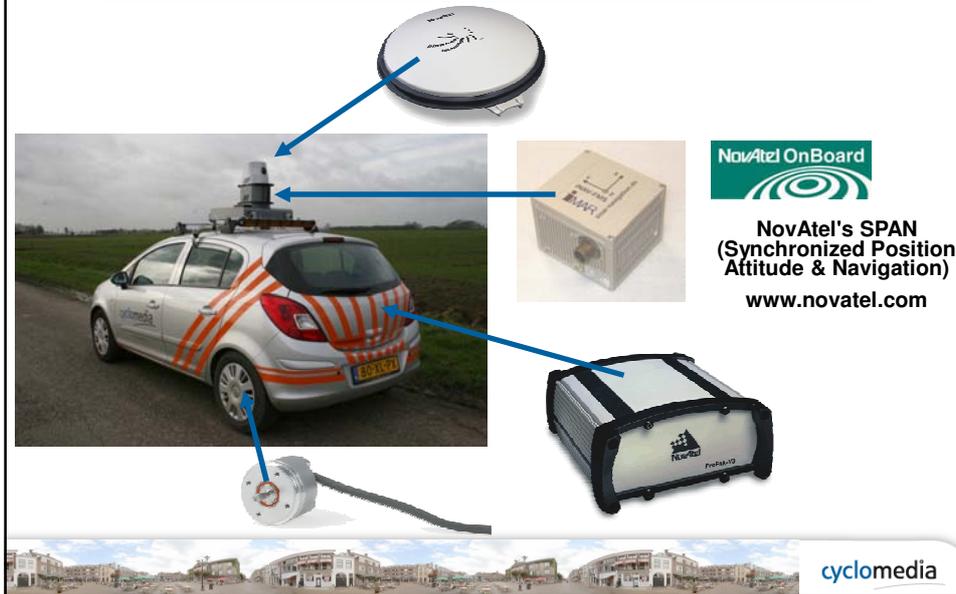
DCR7 Camera System



DCR7 main components



DCR7 Positioning System: GPS + IMU + DMI



DCR7 Panorama Specifications

- Resolution ~ 10 Mpixel (13 mm pixel at 10 m)
- Seamless and parallax free (<1 pixel)
- Known image geometry: suitable for photogrammetry
- Georeferencing: position 0.1m, orientation 0.1°

Only possible after system calibration



DCR7 Calibrations: goals

- geometrically correct Cycloramas:
 - accuracy < 1 pixel
 - invisible stitch
 - accurate 3D photogrammetric measurement
- correct orientation of Cyclorama relative to IMU
 - accuracy < 0.1 degree
 - leveled Cyclorama
 - correct horizontal orientation
- correct position of Cyclorama relative to IMU:
 - eccentricity vectors of cameras
 - eccentricity vector of GPS antenna

Positioning system SPAN results in correct position and orientation of IMU.



cyclomedia

Calibration steps

Calibrations consist of two main steps:

1. Indoor:
 - **Camera/lens parameters** per camera
 - **Relative boresight** (= orientation) of both cameras
 - Location of fiducials and grey card
2. Outdoor:
 - **Absolute boresight** of the cameras in relation to the IMU

No need for calibration of eccentricity vectors:
design values are accurate to mm-level.



cyclomedia

Panorama database – some numbers

- In database for The Netherlands:
 - Cyclorama's taken before 2006
 - > 10 milion Cycloramas at 10 m interval (2006, 2007)
- > 10 milion DCR7 Cycloramas at 5 m interval (2008)
- International projects:
 - Sweden
 - Litunia
 - Switzerland
 - UK
 - Belgium
 - Germany
 - Middle East
- Total storage: order 100 TB



cyclomedia

Overview

- Introduction
- Aerial imagery
 - LuchtfotoNL project
 - Image database
- Terrestrial imagery
 - Mobile Mapping System DCR7
 - System Calibration
 - Panorama database
- **Research at CycloMedia**
 - **Future of the databases**
- Conclusions



cyclomedia

Research at CycloMedia

- DCR with significantly higher image resolution
- Development of applications:
 - New viewers
 - Integration with GIS and mapping tools
 - Automatic content analysis
- Large-scale 3D reconstruction:
 - Automated 3D reconstruction and modeling
 - 3D Cyclorama production

Integrated use of Cycloramas and aerial images



Implications for the database

- DCR with significantly higher image resolution
Data amounts will grow much faster
- Development of applications:
 - New viewers
 - Integration with GIS and mapping tools
 - Automatic content analysis**New types of data to be accommodated**
- Large-scale 3D reconstruction:
 - Automated 3D reconstruction and modeling
 - 3D Cyclorama production**Shift from 2D to 3D data models**

Next: status on the above research topics



DCR 8: 5 times higher resolution locally



No gaps with 5 meter
Cyclorama interval

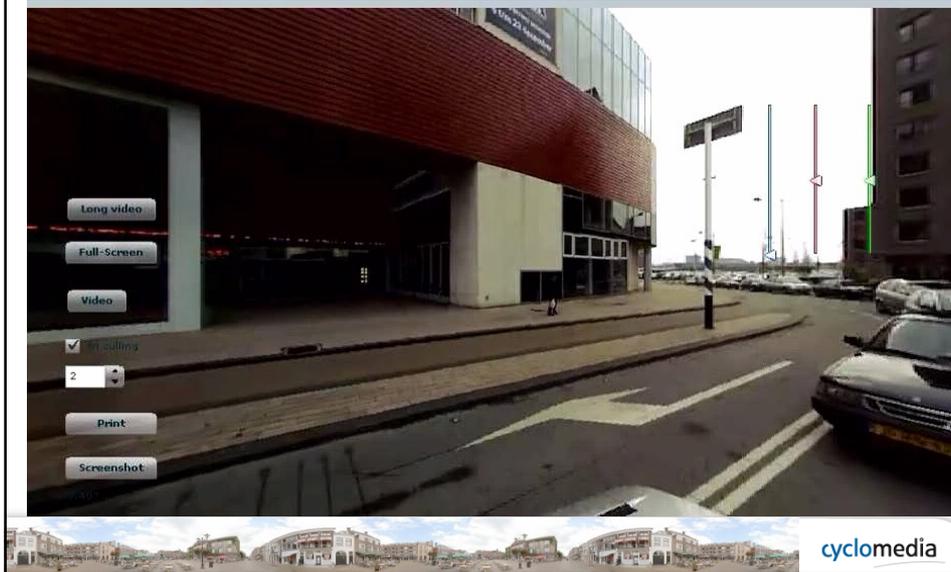


New Viewer: integration with aerial imagery

cyclomedia Flashviewer + Maps

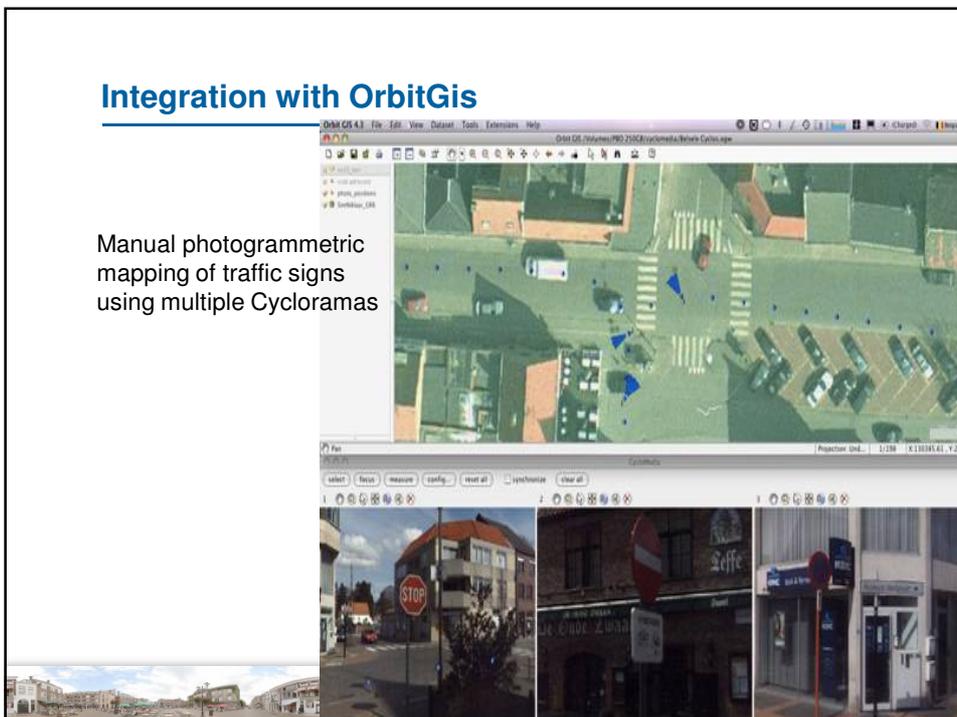


New Viewer: movie option



Integration with OrbitGis

Manual photogrammetric mapping of traffic signs using multiple Cycloramas



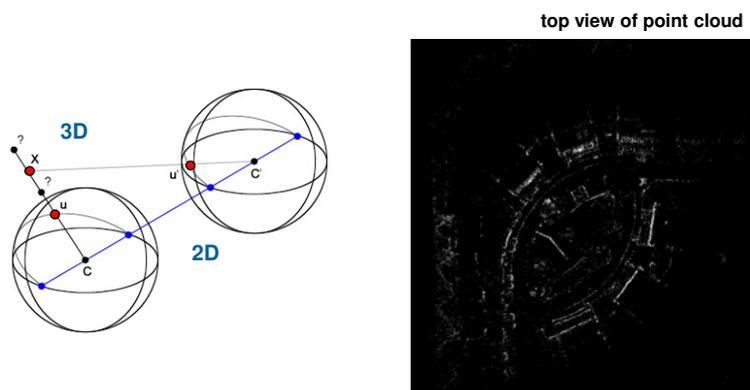
Automated Content Analysis: Traffic Signs

- New algorithm for automatic sign detection and recognition
- Detection score above 99%!
- Patent application pending
- To be extended to other objects and semi-automatic mapping



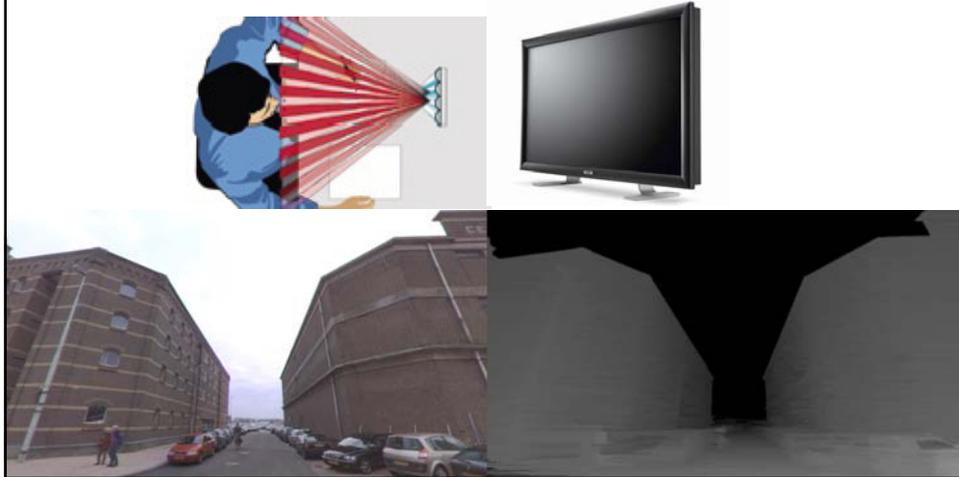
Large-scale 3D reconstruction

- Currently: Automated 3D reconstruction of point cloud
- Future: semi-automatic 3D modeling



Large-scale 3D reconstruction

- Large-scale 3D Cyclorama production
- Displayed on Philips 3D display (WowVX technology)



Conclusions

- Now: Core spatial image data is available
 - High quality
 - Continuously updated
 - Data amounts increasing fast
- Future: Information extraction
 - Large-scale: what can be automated?
 - Object detection and recognition, 2D and 3D
 - Automated mapping/modeling from aerial and terrestrial images



40

cyclomedia