FIG WORKING WEEK 2017

Helsinki Finland

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Unmanned aerial vehicles in municipality level 3D topographic data production in urban areas

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Surveying the world of tomorrow –
From digitalisation to augmented reality

Motivation for the project

- Topographic data from municipalities will have a significant role in the forthcoming National Topographic Database
- Potential of new mobile mapping methods, such as UAVs, for updating 3D topographic data in urban areas needs to be investigated

- Usage of UAVs have increased rapidly:
  - UAV regulations are not clear to all and they have significant impact on the usability
  - More knowledge of the UAV-photogrammetry is needed in order to understand the benefits and limitations of UAV-photogrammetry
  - **Guidelines and general knowledge of UAV-based methods is needed!**

Project questions:

- Can UAV-photogrammetry:
  - produce accurate- and reliable-enough data for municipality level 3D topographic data?
  - reduce manual labor in the field and provide cost-efficient map updating in urban areas?

Project goals:

- Evaluation of usability of UAV-based mapping in urban areas
- Produce preliminary guidelines for UAV-based 3D topographic data production

Overview of UAV-based 3D topographic data production

1. Planning phase
2. Measurement phase
3. Data processing phase

1 Planning phase

- General planning and measurement method decision
  - Geographcial area, required accuracy, accessibility …
- Legislation and risk management
  - Local UAV-regulations
  - Population density
- Flight planning
  - Safety
  - Accuracy requirements, ground control points (GCPs)
  - UAV and sensor

2 Measurement phase

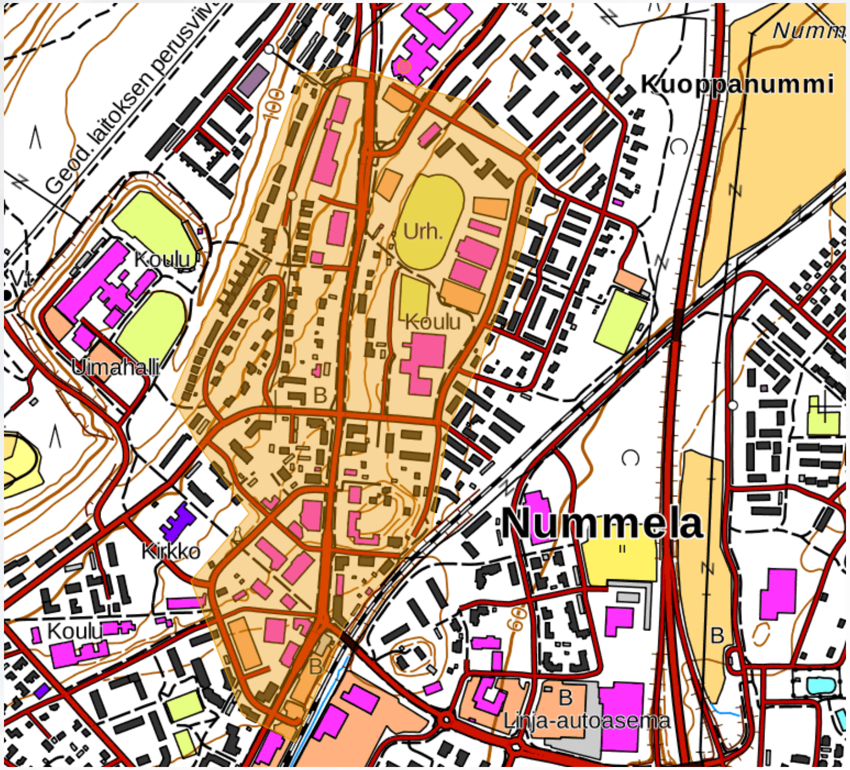
- Final decission of flight and its parameters
- Ground Control Generation
- Aerial imaging

3 Data processing phase

- Photogrammetric processing
- Accuracy Evaluation
- Vecotrizaton of data to a topographic data format

Test-case: Vihti, Finland (October 2016)

- Nummela center, 49 hectares
  - Densely populated area
  - Small airfield
  - Various building types

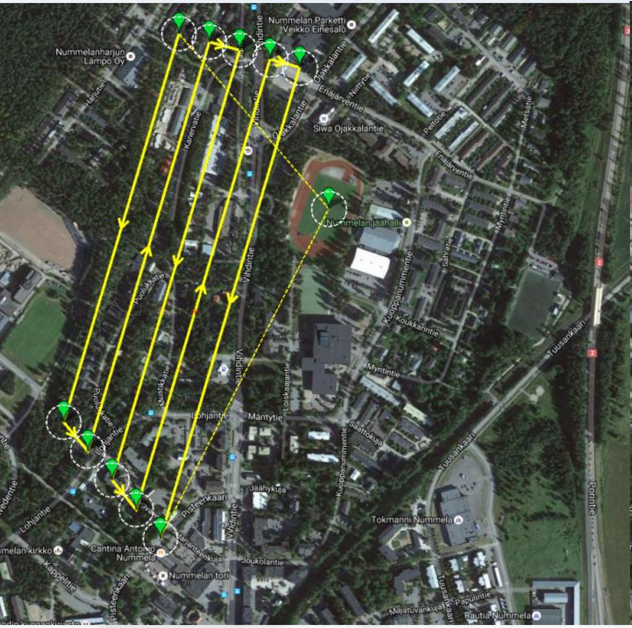
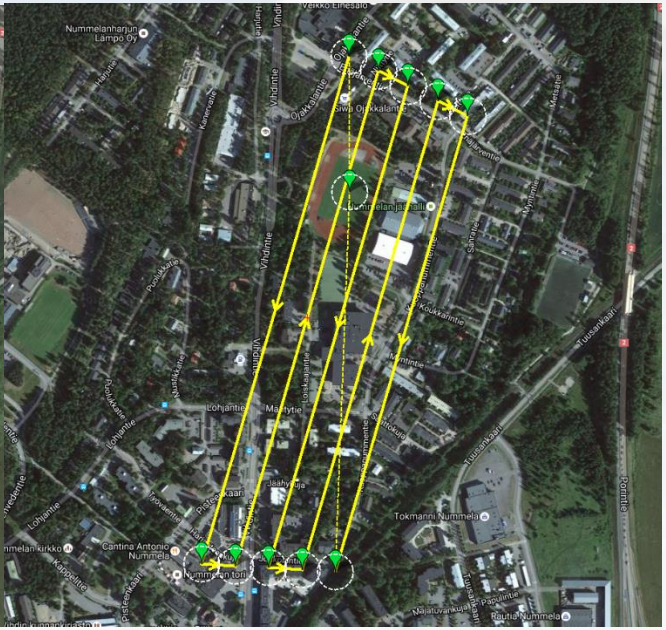
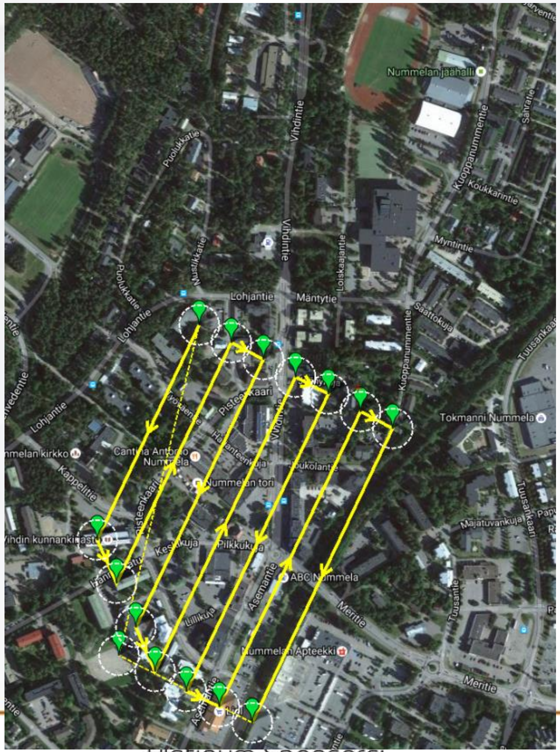


Planning I

- Finnish regulation by the Finnish Transport Safety Agency (Trafi)
- Risk assessment report & UAV manual
- Informing the airfield and creation of aviation warning (NOTAM)
- Notification / bulletin to residents
- Flight planning
  - Flight trajectories, Visual-line-of-sight (VLOS)
  - Lift-off / Landing site

Planning II

- Flight plans: Three nadir imaging flights

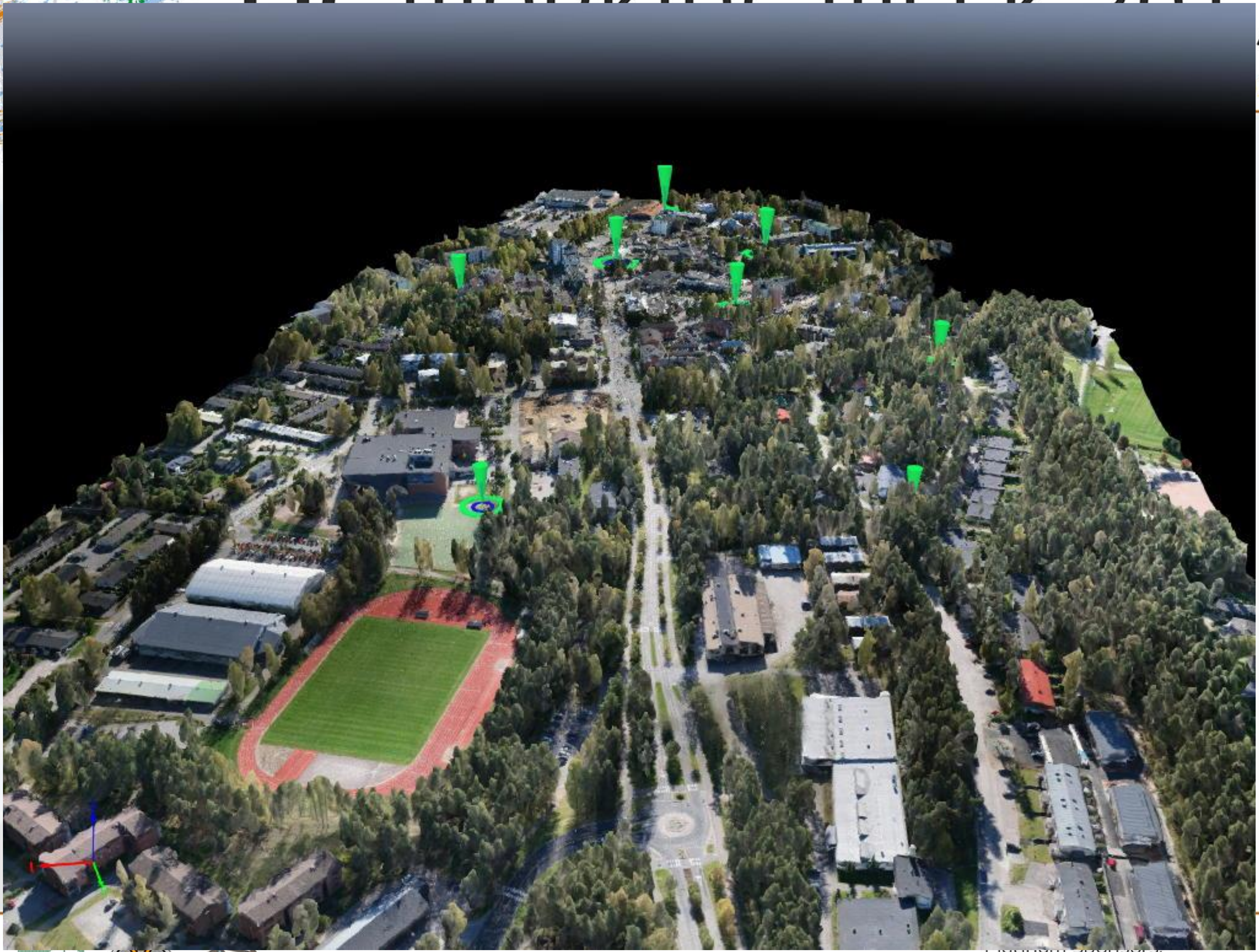




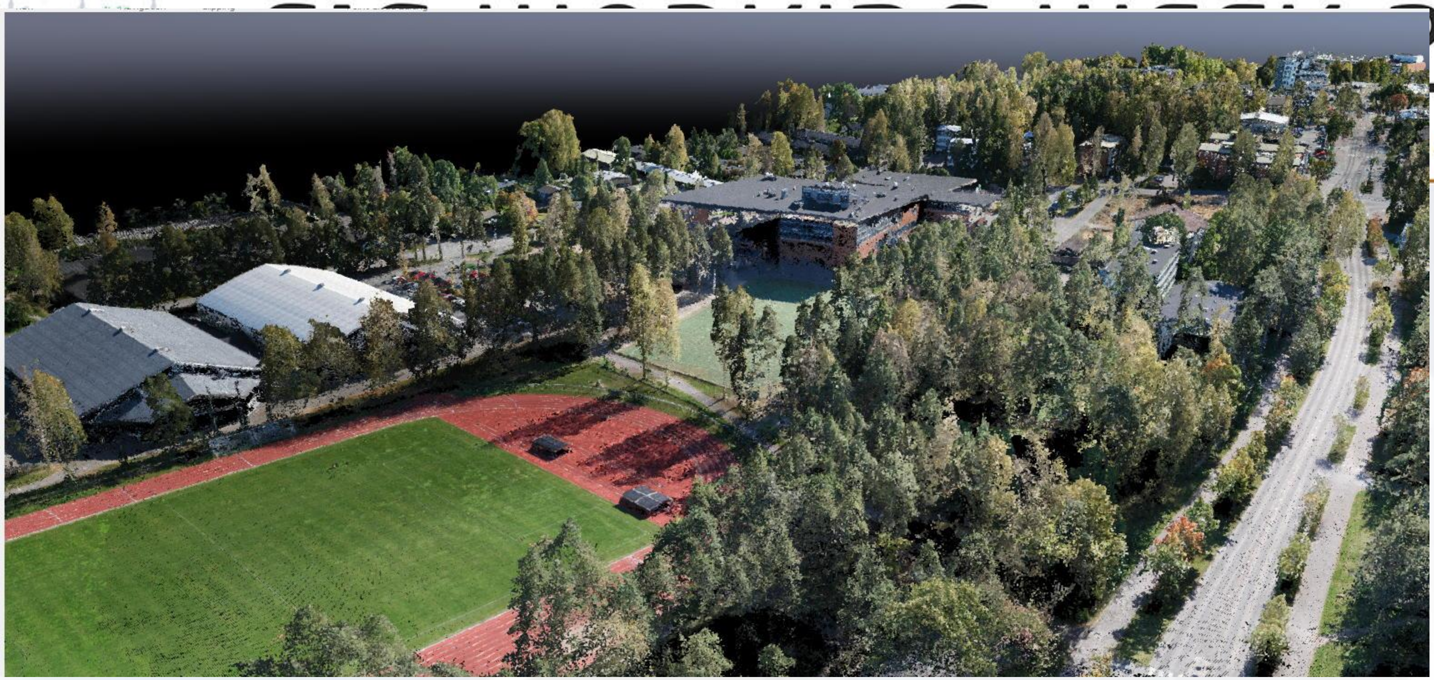
Measurements

- The UAV-system:
  - Tarot 960 foldable frame
  - 3DR Pixhawk with Arducopter
  - Approx. 6 kg
- Samsung NX500 RGB camera
- GCPs measured with Trimble R10 VRS-RTK- GNSS system
- Fully sunny day

Data processing

- Processing using Pix4D
- Ground Sampling Distance (GSD): 2.93 cm
- Number of images: 1334
- Ground control Points (GCP) 10 kpl
  - RMSE: X 0.0021 m, Y 0.0014 m, Z 0.0015 m
- Image overlaps:
  - Forward overlap 90%
  - Sidelap 70%
- > 800 points / m²





Kuvia aineistosta

Vectorization

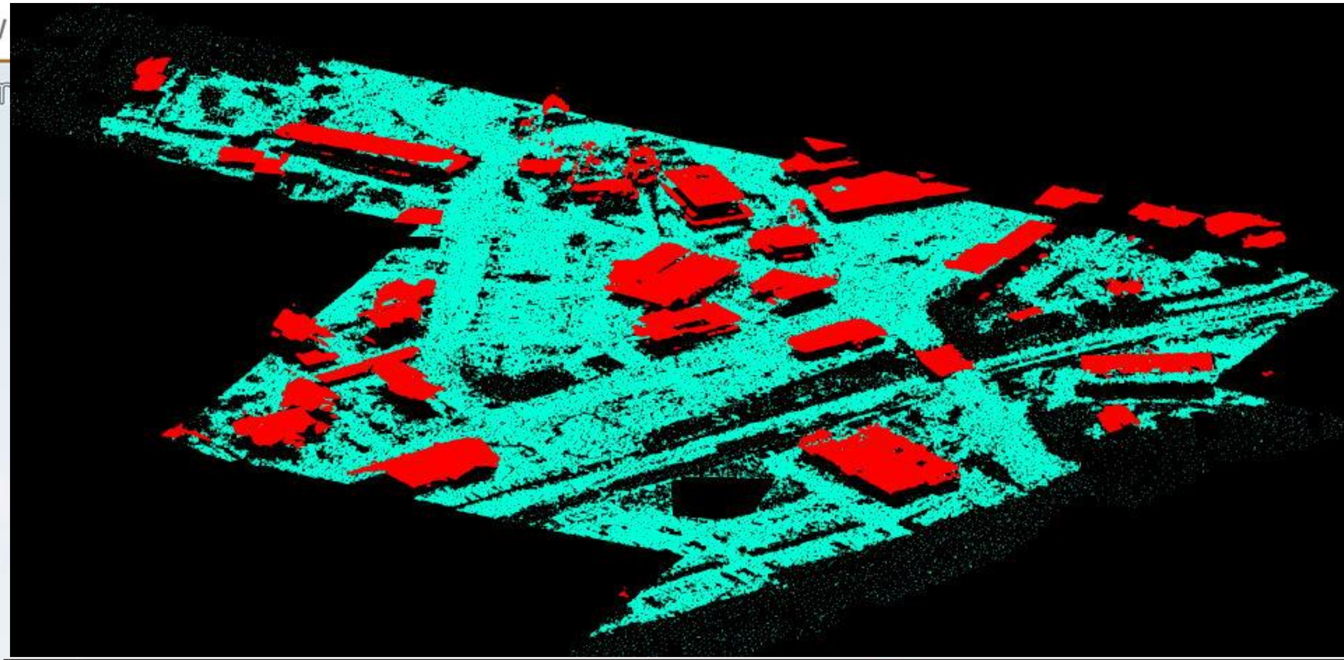
- Work has been concentrated on buildings and automatic methods
  - Automatic building vecotrization using TerraScan software (Terrasolid Ltd., Helsinki)

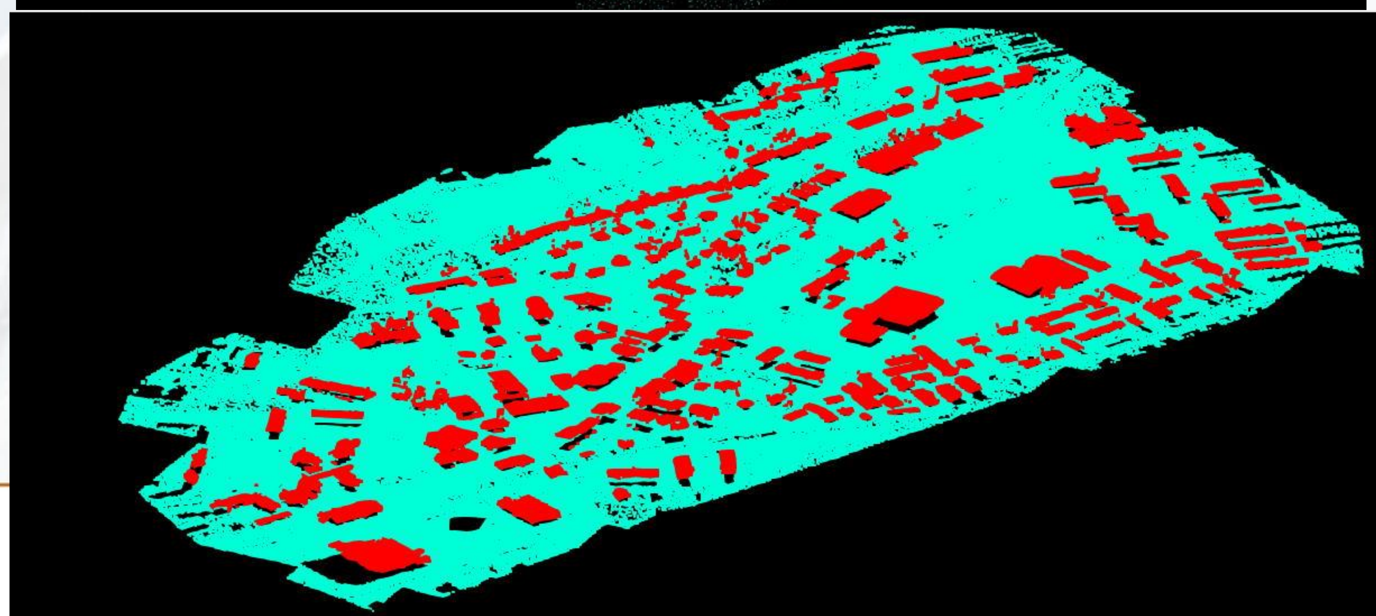
- There's a lack of automatic methods for others targets than buildings
  - Manual labor is still required a lot in the data vectorization

RPAS-aineiston automaattinen luokittelu

TerraScan

- buildings
- ground

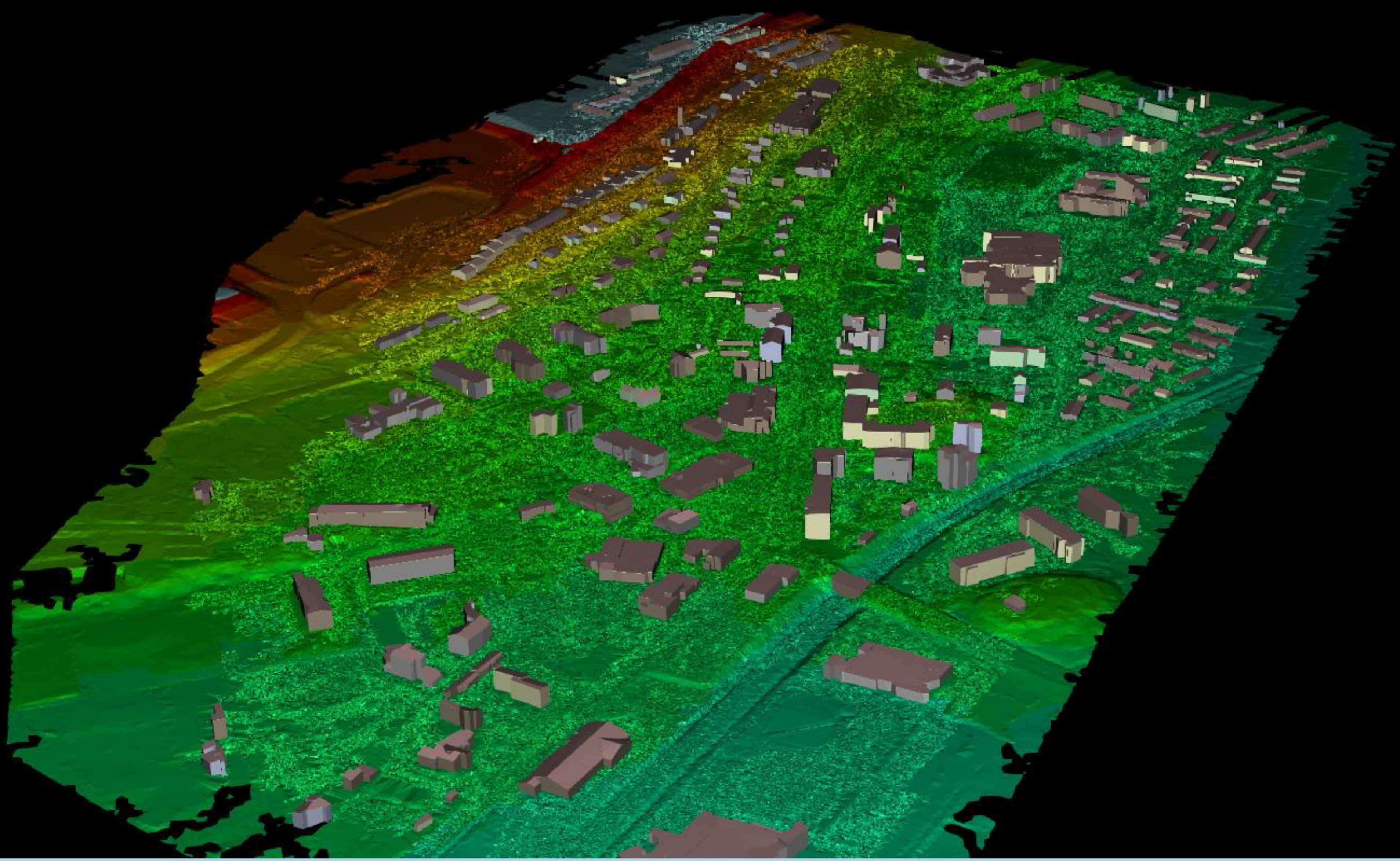




Kuvat: Tomi Rosnell

Automaattinen vektorointi (1/2)

Kuvat: Tomi Rosnell



Conclusions

- UAV-photogrammetry provides low cost tool for producing 3D topographic data in urban areas, especially when small areas are of concern
- Automated methods for point cloud vectorization needed
- The use of UAVs in topographic data production will increase
- UAV-based laser scanning will also increase as the sensors are getting smaller and prices are going down

Kiitos!
Questions?

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KMTK
Kansallinen
Maastotietokanta