

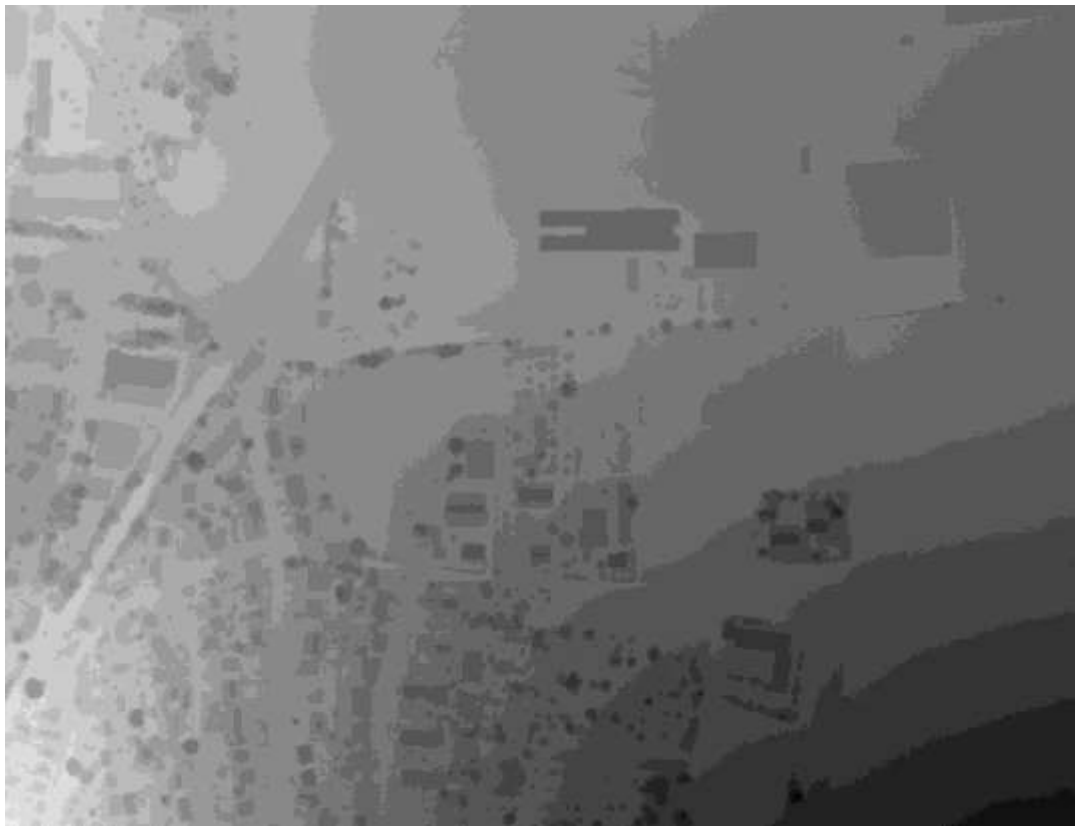
**Microsoft**



Vexcel Imaging / Microsoft Photogrammetry

DGPF Projektsitzung  
Stuttgart

Michael Gruber,  
[michgrub@microsoft.com](mailto:michgrub@microsoft.com)



**VEXCEL**  
**IMAGING** sm  
a Microsoft company

# UltraCamX

**Microsoft**



**VEXCEL**  
**I M A G I N G**  
*a Microsoft company*

## Flightmission Vaihingen/Enz

UltraCamX, Berliner Spezialflug  
SensorHead UCX-SX-1-50810149

### Date/Time

Start 2008-09-11 09:55 UTC

End 2008-09-11 11:26 UTC

### Height\_AGL/GSD

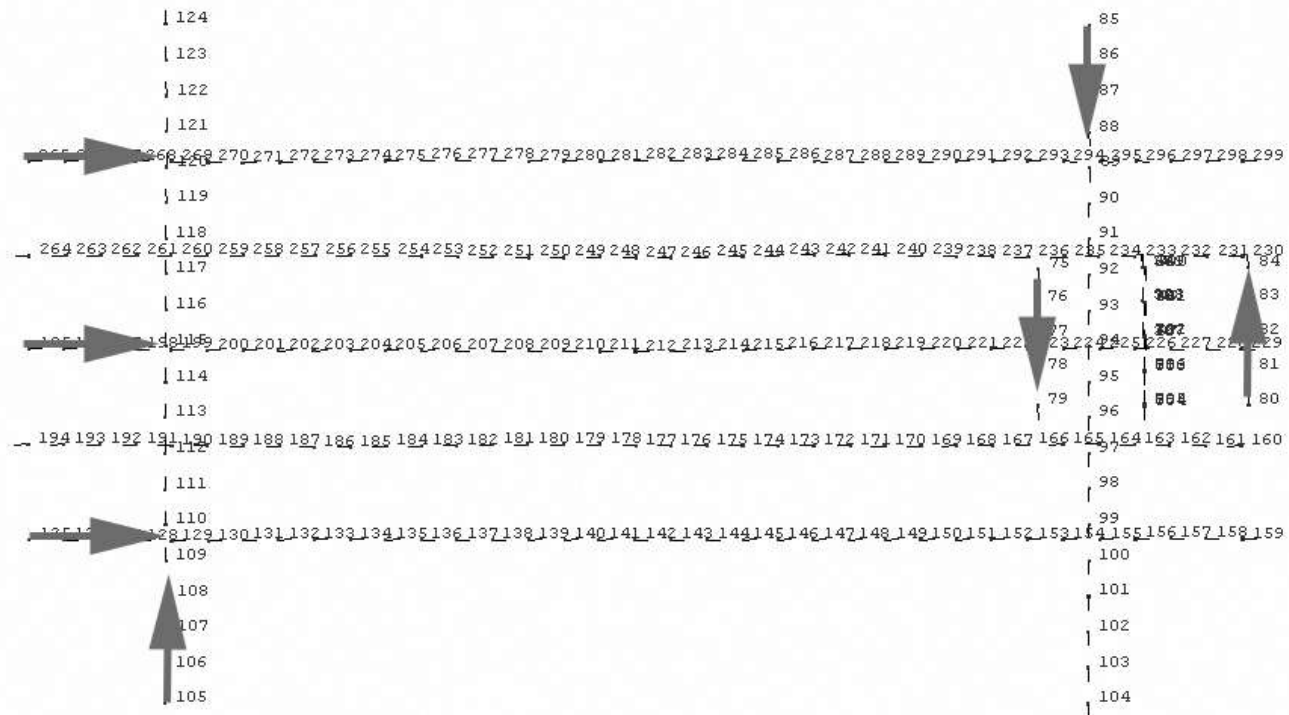
1150 m, 8 cm

2880 m, 20 cm

# Flight 1, 8 cm GSD

5 lines East-West  
2 lines North-South

Line Spacing 400m







UltraCam X image @ 8 cm GSD

## LIDAR Data Vaihingen/Enz

Date

2008-08-21

Line Distance/Pts/sqm

Line Width        500 m

Line Spacing      300 m

5 Pts / sqm



# Height Accuracy Assessment of Laser and Photogrammetric Data

Peter Lerchner

Michael Gruber

# Suitable Areas of Comparison

- Suitable by means of calculation:
  - Soccer Court in the NE of Vaihingen/Enz
  - Parking Lot in the SE of the Testing Area
- Suitable in means of visual comparison:
  - Rooftop with Chimney
  - Church
  - Factory Building with Complex Roof-Structures

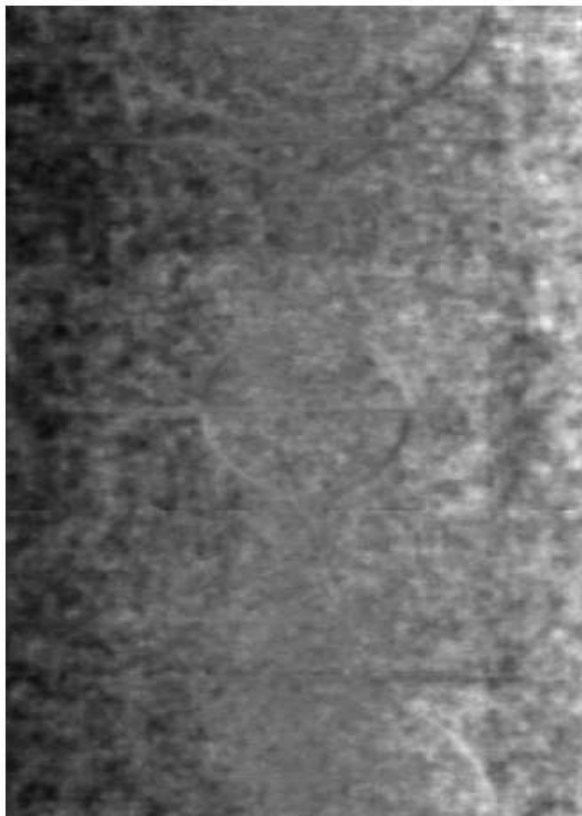


# Data Available

- Dense DSM @ 10 cm GSD (GeoTiff format)
  - Multi Stereo Image Process
  - Global Optimization Process
- Multi Ray (Bundle) Solution of single Points
- LIDAR Data, without any postprocessing

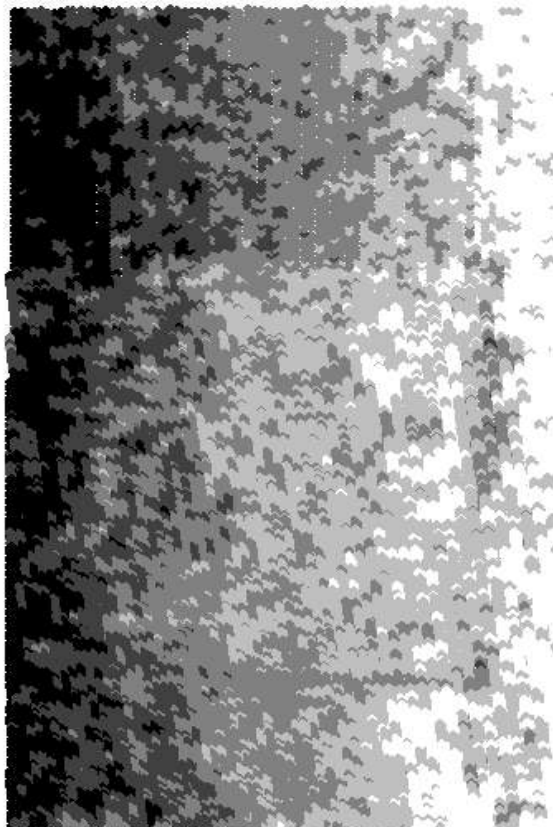
# Soccer Court:

Geo-TIFF Heights



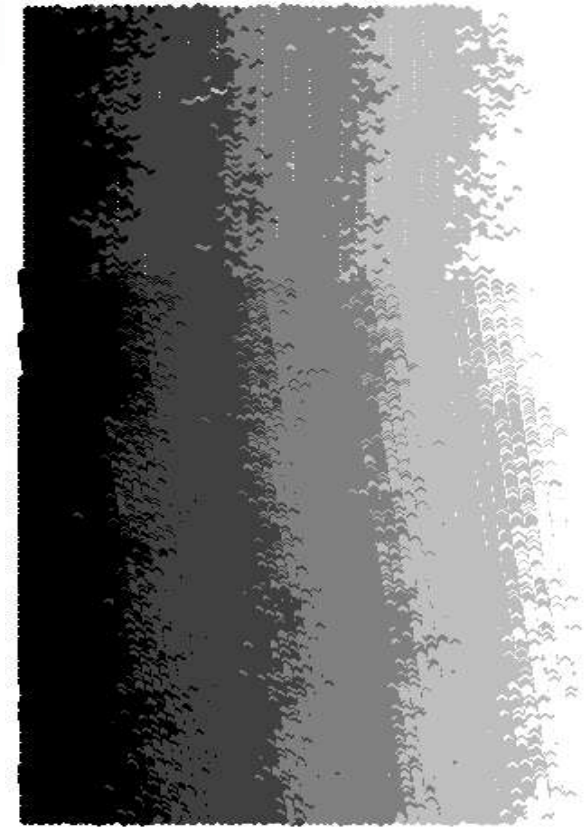
High : 327,881500  
Low : 327,256287

Laser Points with  
Geo-TIFF Heights



- ◆ 327,26913 - 327,45249
- ◆ 327,45250 - 327,53457
- ◆ 327,53458 - 327,60215
- ◆ 327,60216 - 327,67216
- ◆ 327,67217 - 327,86071

Laser Heights



- ◆ 327,46200 - 327,56700
- ◆ 327,56701 - 327,64300
- ◆ 327,64301 - 327,72500
- ◆ 327,72501 - 327,80900
- ◆ 327,80901 - 327,93800

# Height Differences

- Calculations – entire ROI:

- Laser Points with TIFF Heights Subtracted from the Laser Points

• Sample Points	56339
• Min	-0.352 m
• Max	0.074 m
• Difference	0.431 m
• Mean	-0.098 m *)
• Median	-0.093 m
• Stdev	0.057 m

\*) Offset due to prelim EO Data

# Selected Points

- 38 Manual Points vs. Laser Points inside a Radius of 0.4 m



Soccer Court with 38 MTP's

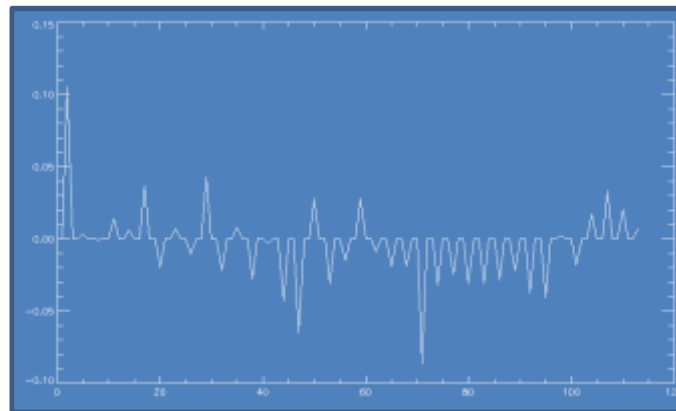
MIN -0.186 m

MAX 0.005 m

DIFF -0.191 m

STDEV 0.033 m

*Korrekturen siehe nächste Folie*

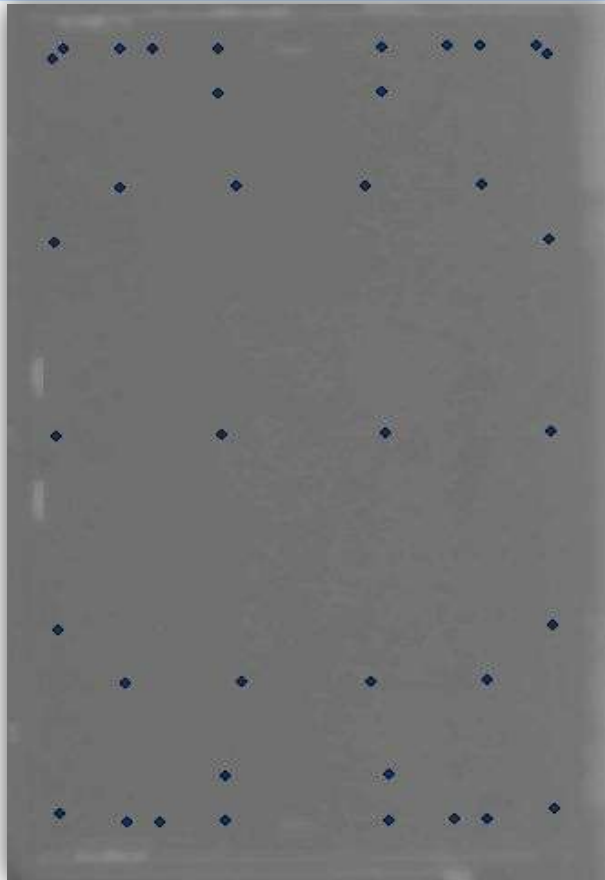


Corresponding Laser Data



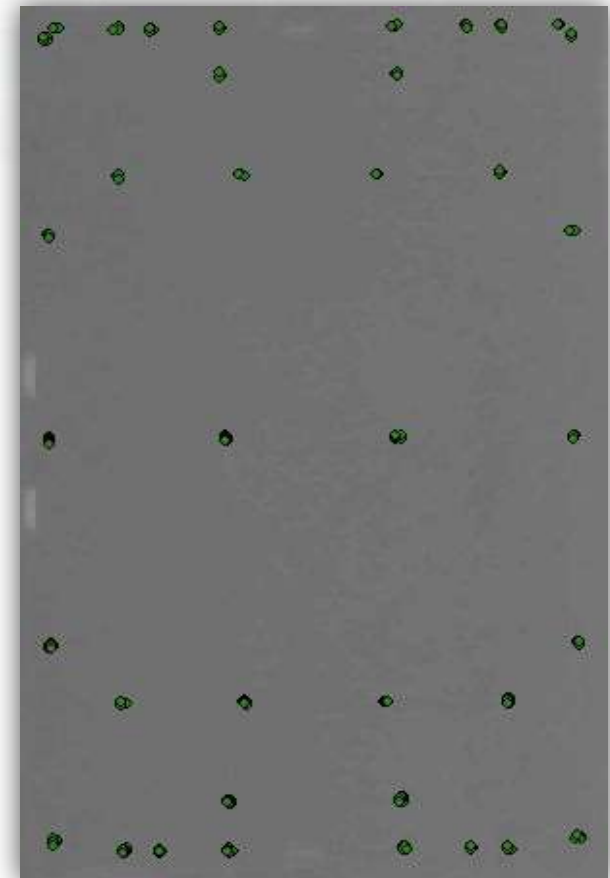
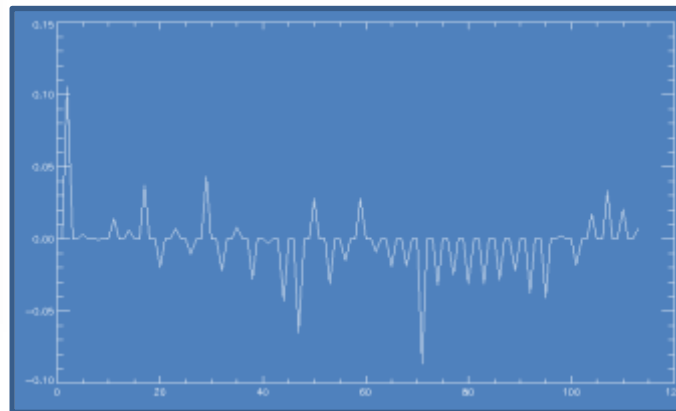
# Selected Points

- 38 Manual Points vs. Laser Points inside a Radius of 0.4 m



Soccer Court with 38 MTP's

MIN -0.107 m  
MAX 0.077 m  
OFFS 0.036 m  
STDEV 0.033 m

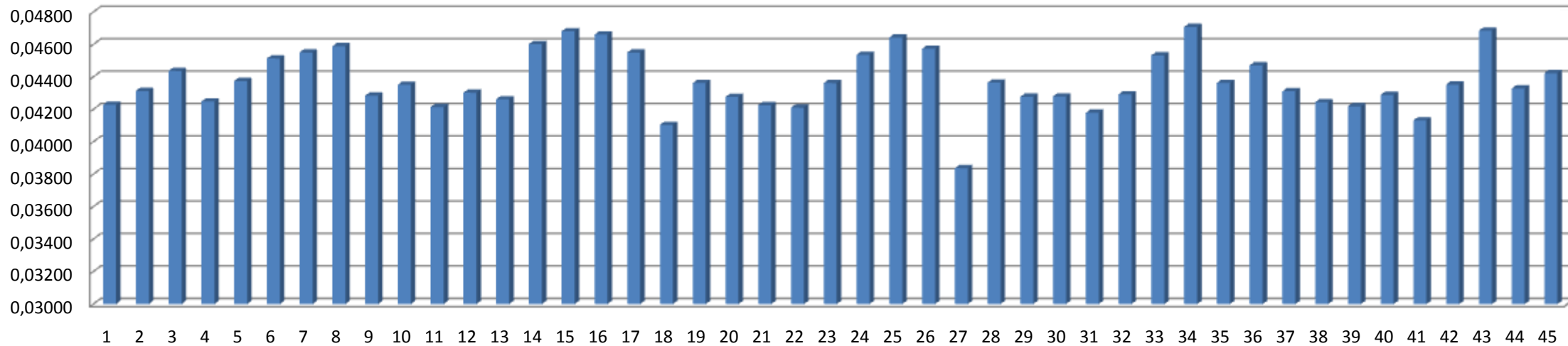


Corresponding Laser Data

# Small Area Analysis

- 45 Measurements all over the Court:

**Standard Deviations**



Mean- Standard Deviation

0,044 m

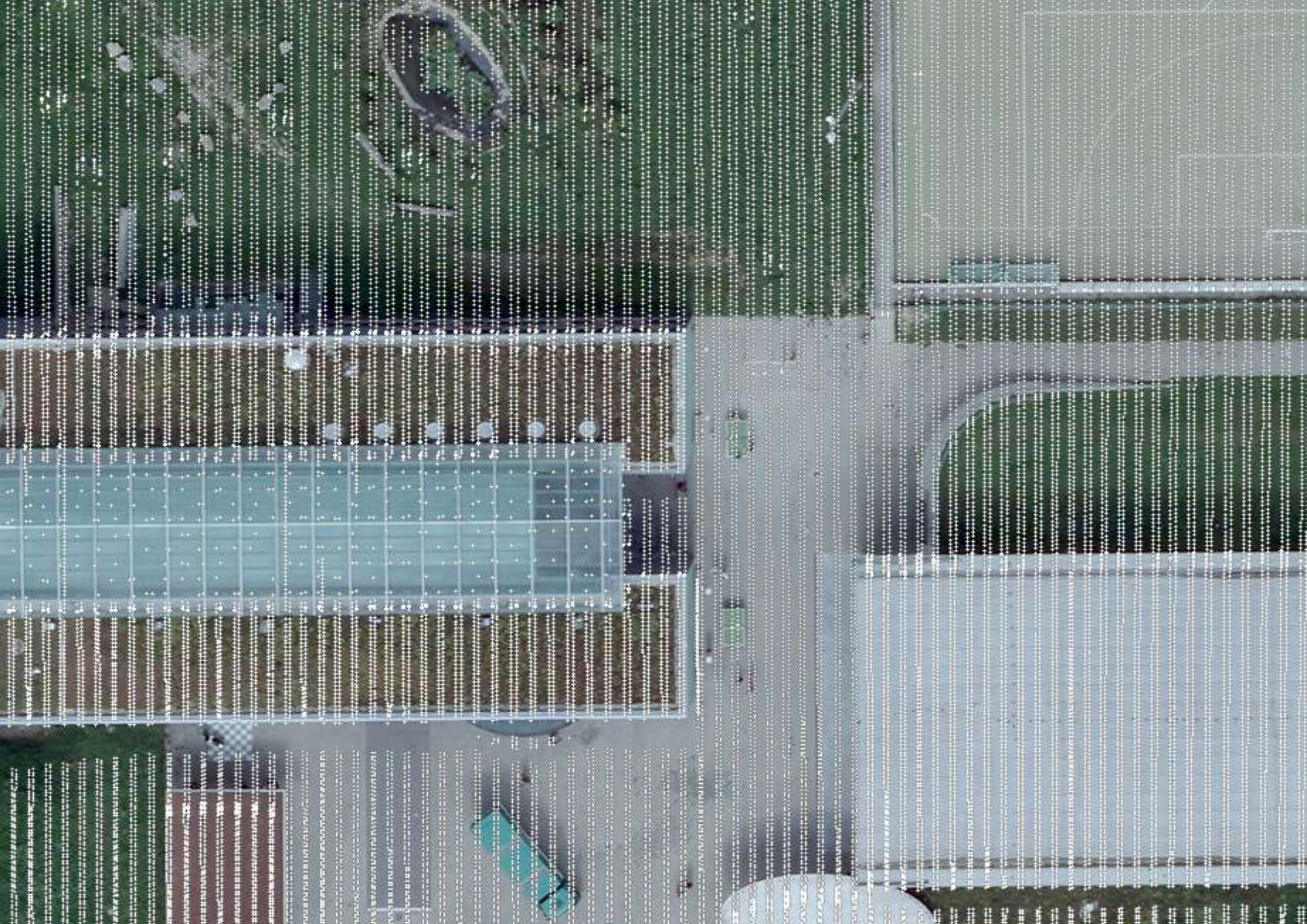






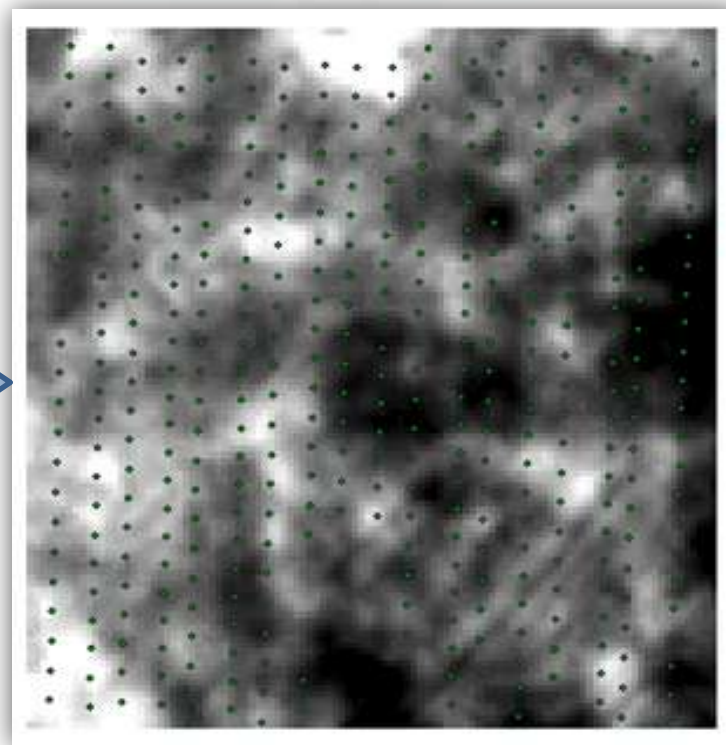




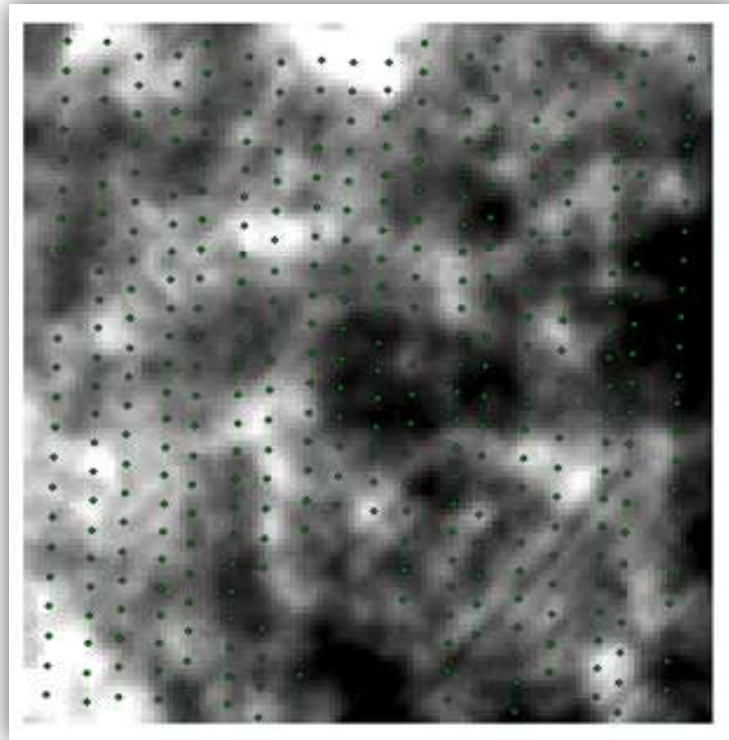




# Parking Lot



# Parking Lot



Samplepoints	403
Min	-0.296 m
Max	-0.067 m
Difference	0.229 m
Mean	-0.187 m *)
Median	-0.186 m
Stdev	0.040 m

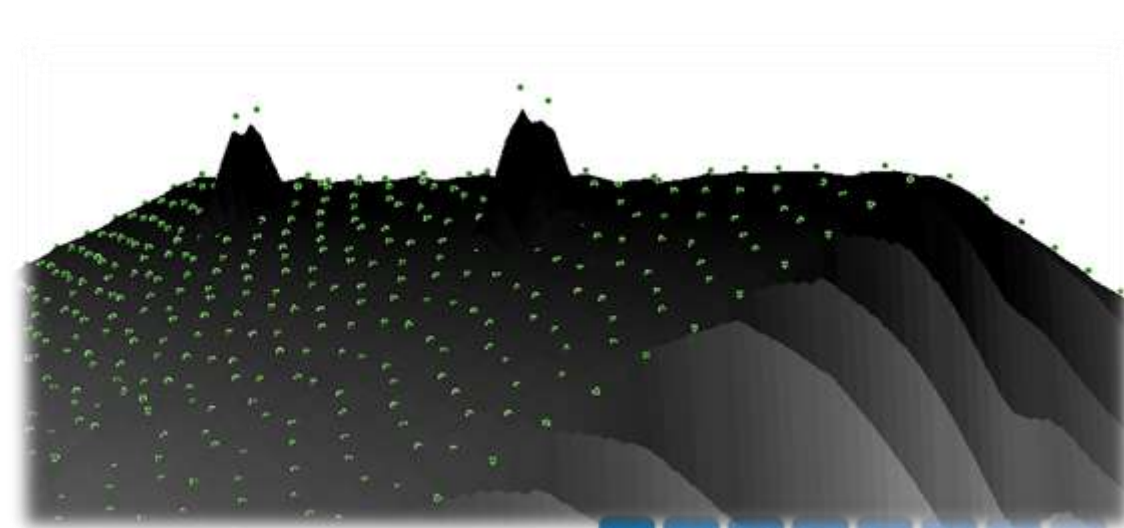
\*) Offset due to prelim EO Data

# Visual Comparison

- Rooftop with Chimney
  - + Chimney is clearly visible in the 3DModel of the Geo-TIFF
  - Only 2 Points for the Chimney in the Laser Data
  - Nearest Neighbor Interpolation results in steep peaked chimneys



TIFF 3DModel

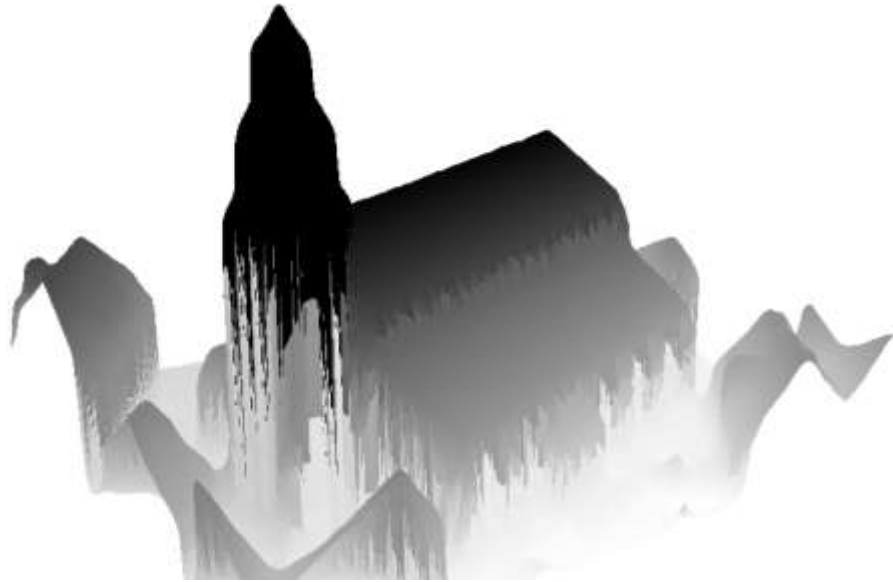


Interpolated Laser Model and Laser Heights

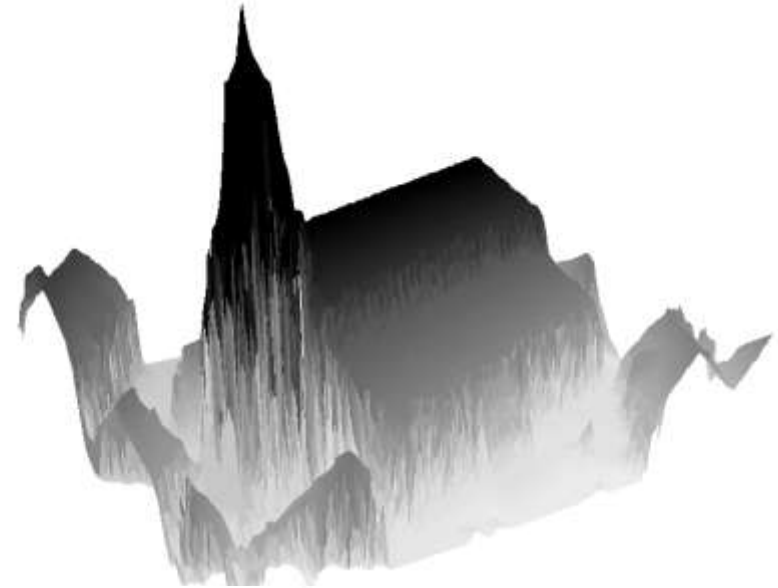


# Visual Comparison

- Church in the Center of Vaihingen an der Enz



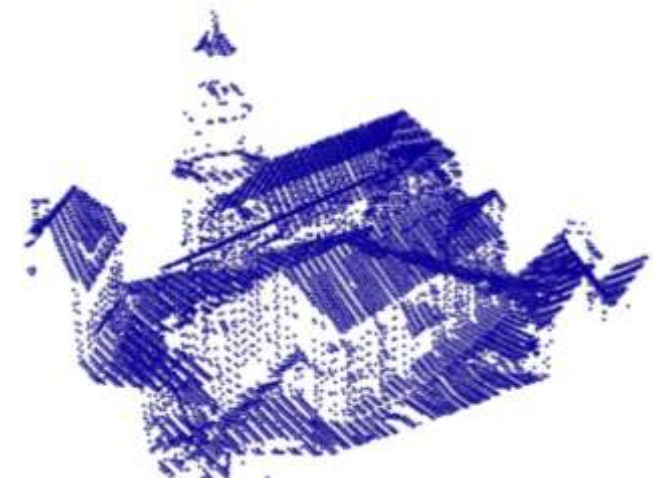
GeoTIFF



Laser Interpolated



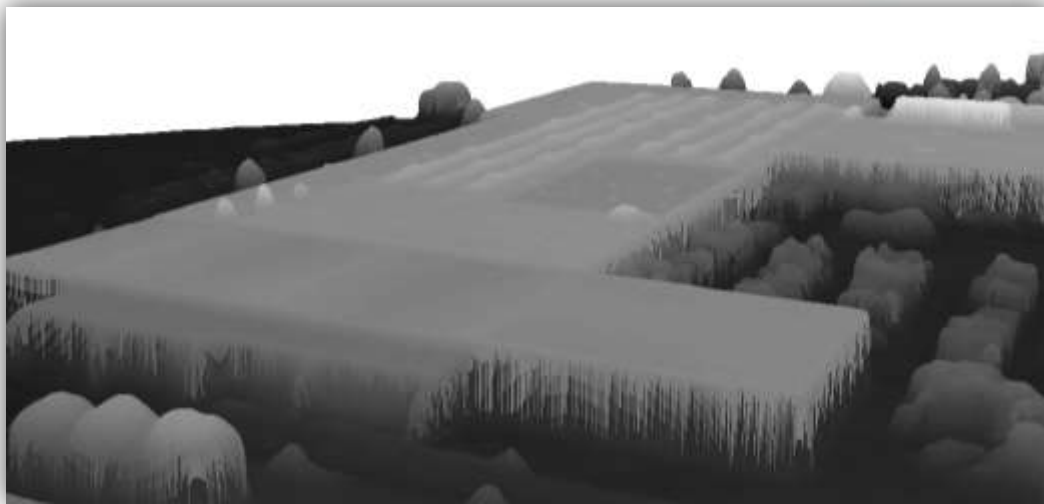
Laser Points with GeoTIFF Heights



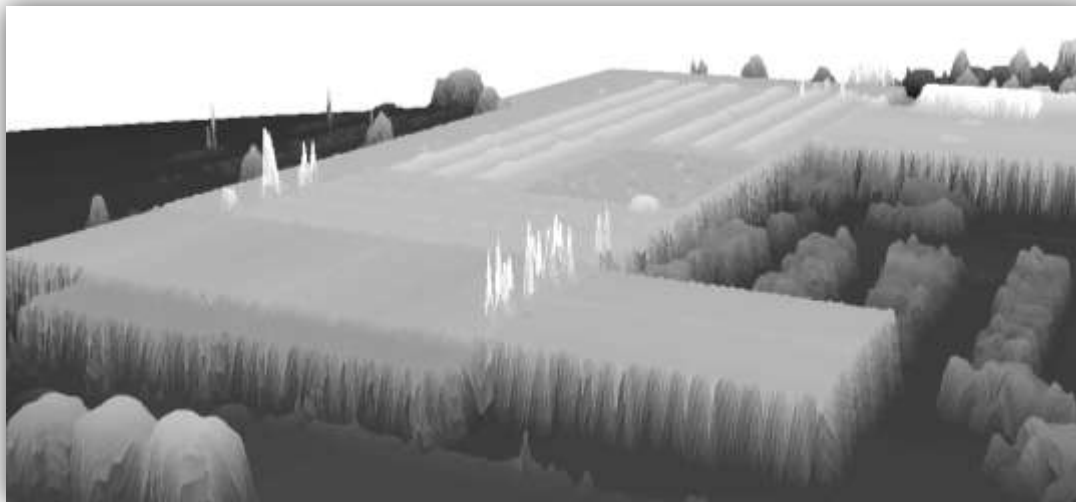
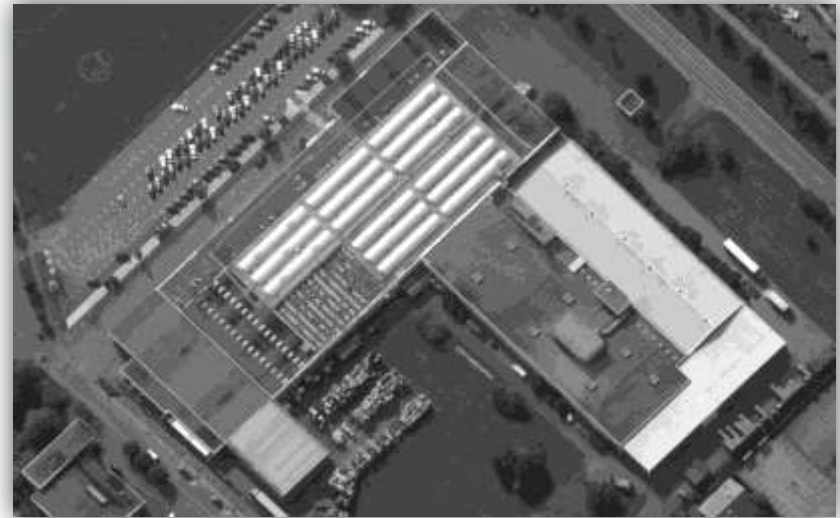
Laser Points with Laser Heights

# Visual Comparison

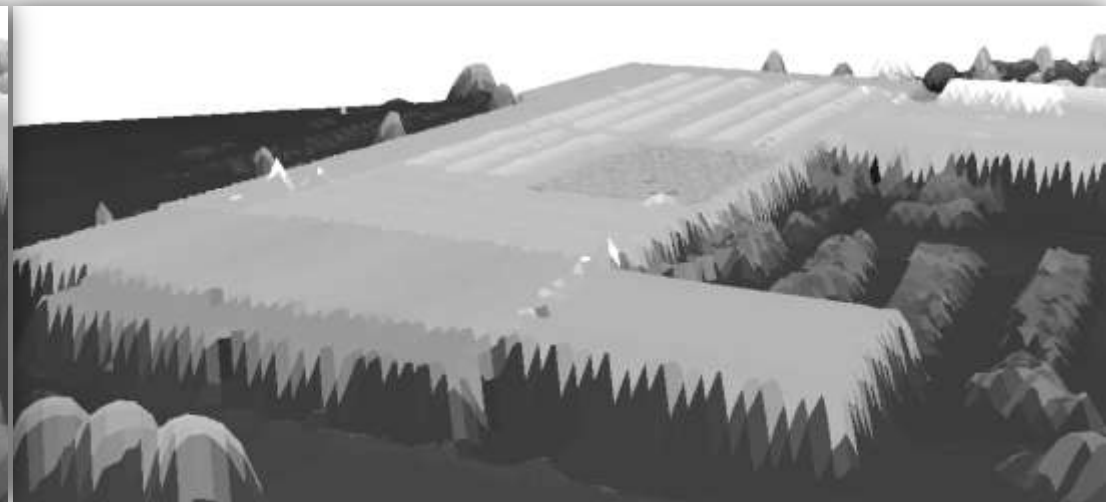
- Factory Building with Complex Roof Structure



3D Model of the GeoTIFF



Laser Data Nearest Neighbor Interpolation, same GSD as GeoTIFF

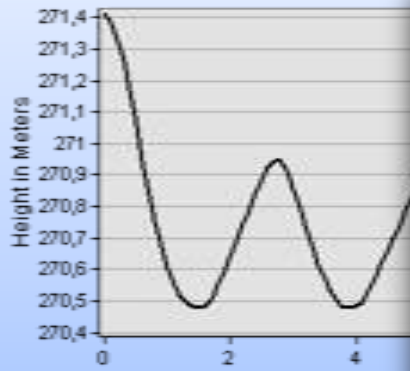


Laser Data Nearest Neighbor Interpolation

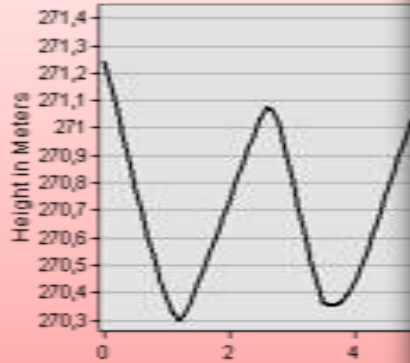
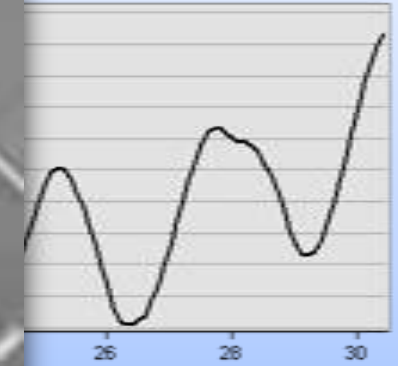
# Roof Structure Profile



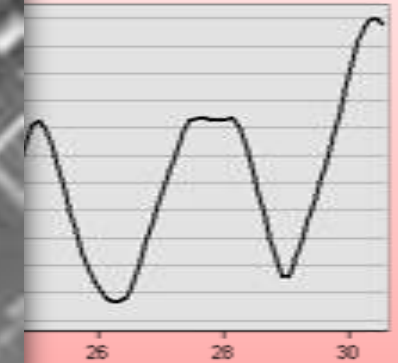
Roof Structure Profile



GeoTIFF



Laser-Interpolated

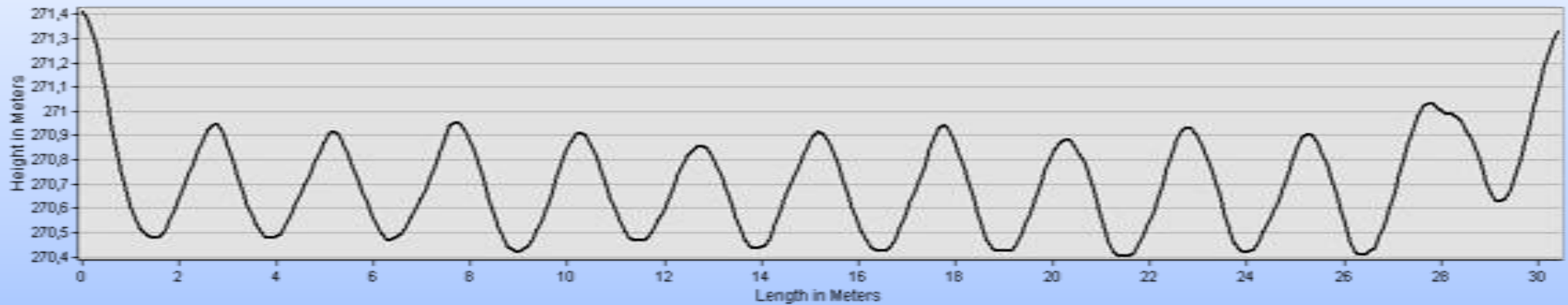




# Roof Structure Profile

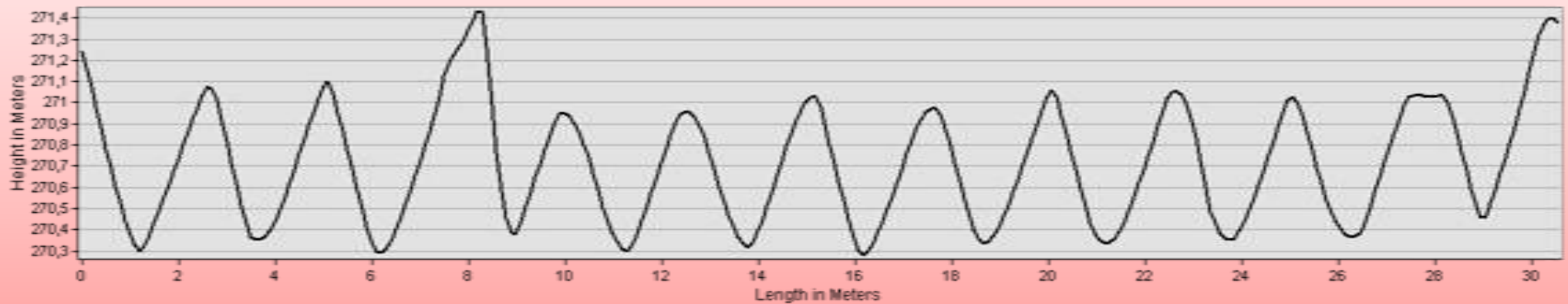


Roof Structure Profile



GeoTIFF

Roof Structure Profile



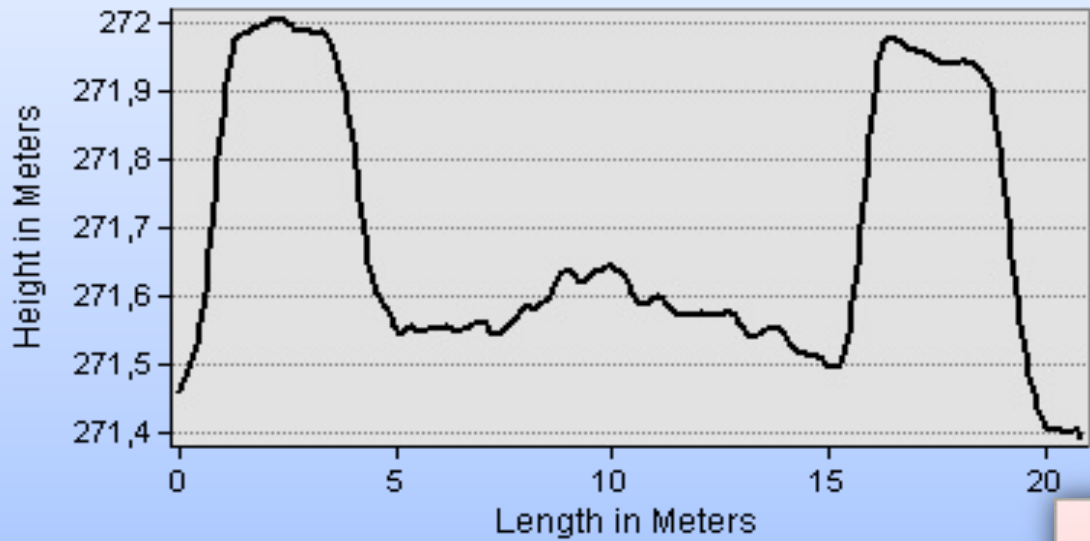
Laser - Interpolated

# Roof Structure Profile



# Roof Structure Profile

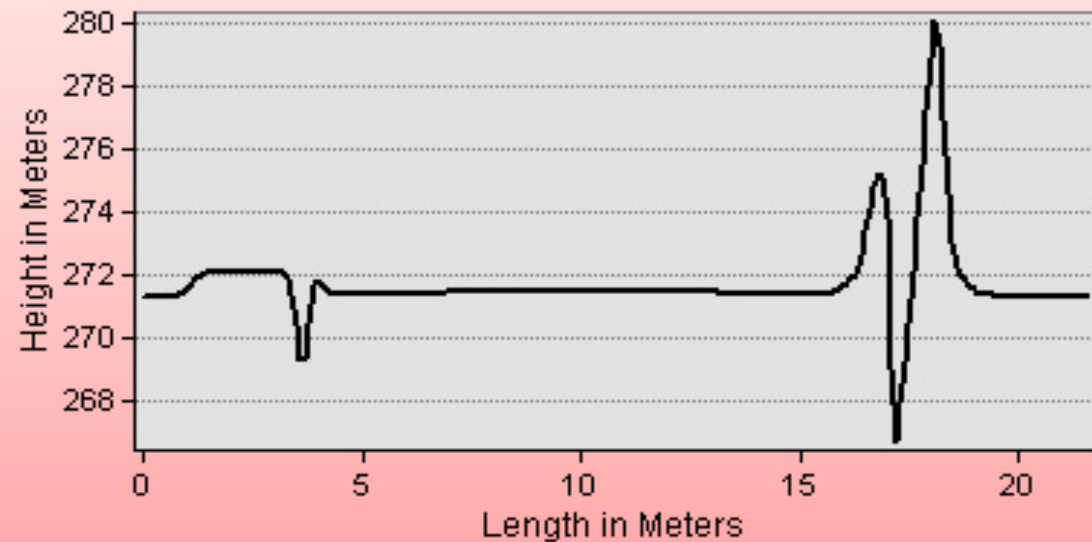
Roof Structure Profile



GeoTIFF



Roof Structure Profile

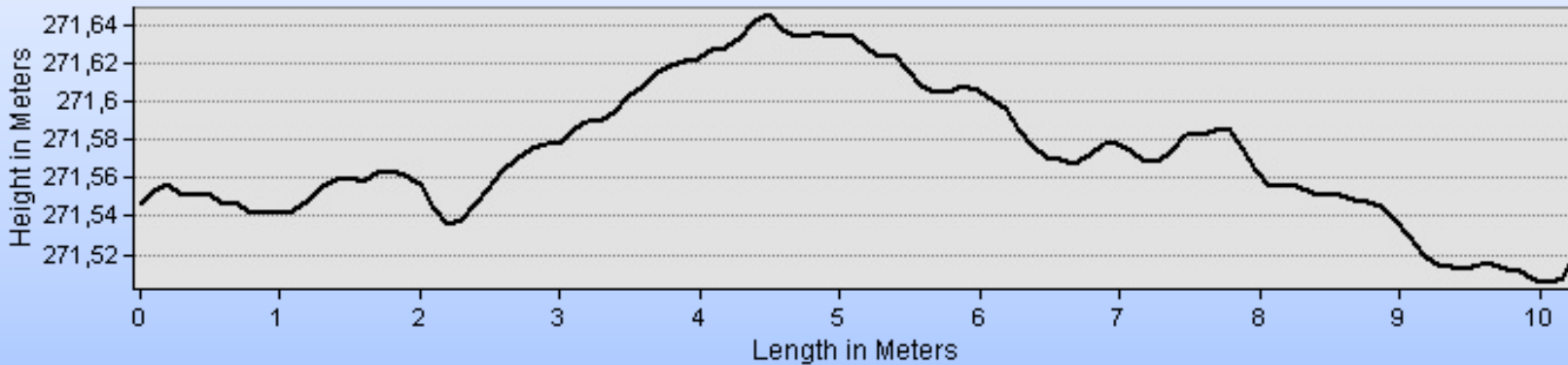


Laser - Interpolated



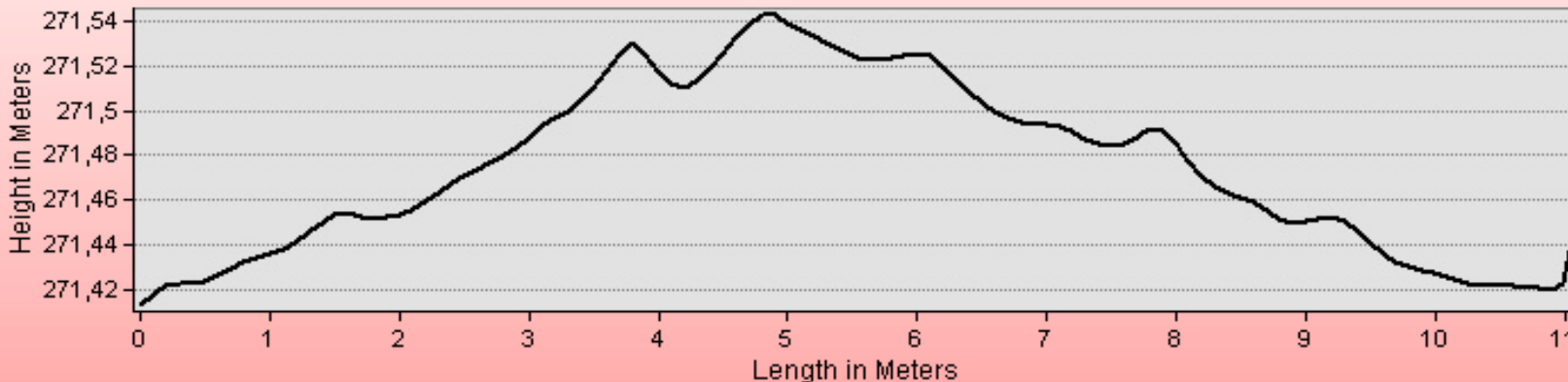
# Roof Swelling

Roof Structure Profile

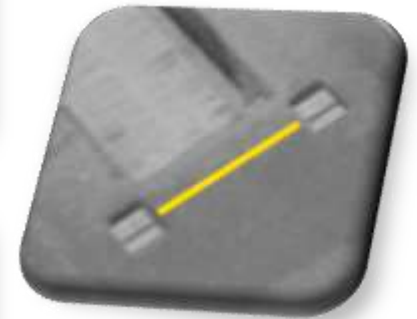


GeoTIFF

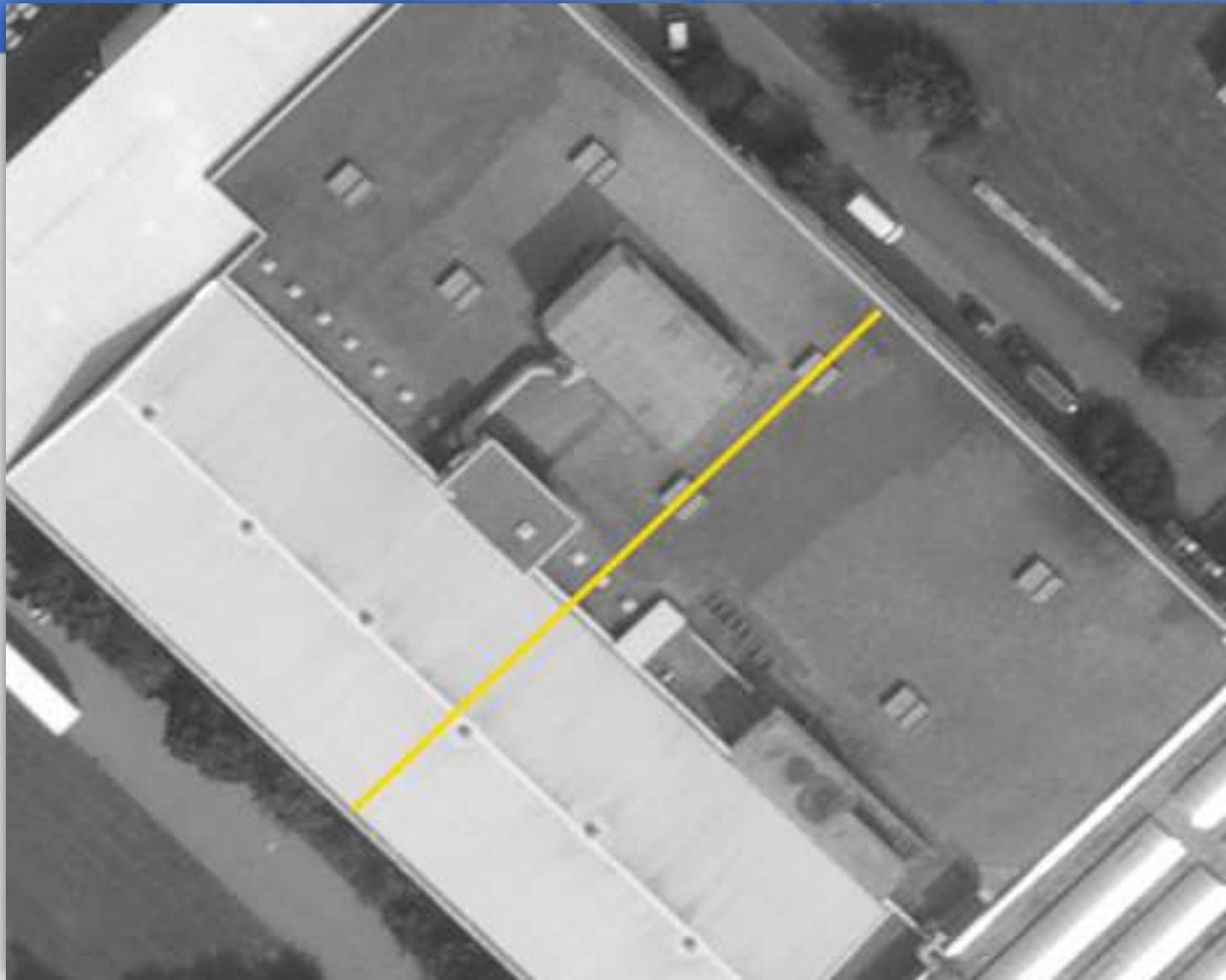
Roof Structure Profile



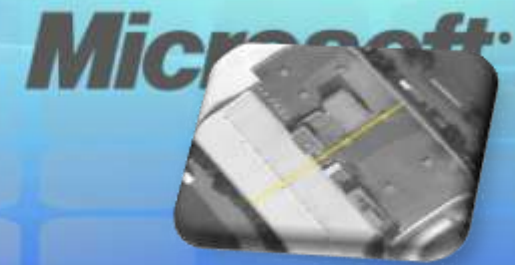
Laser - Interpolated



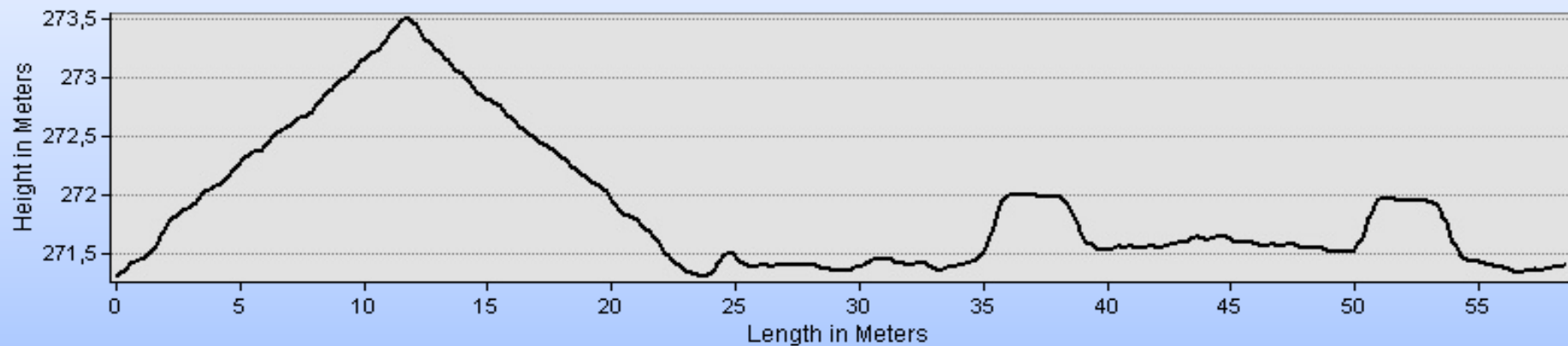
# Roof Structure Profile



# Roof Structure Profile

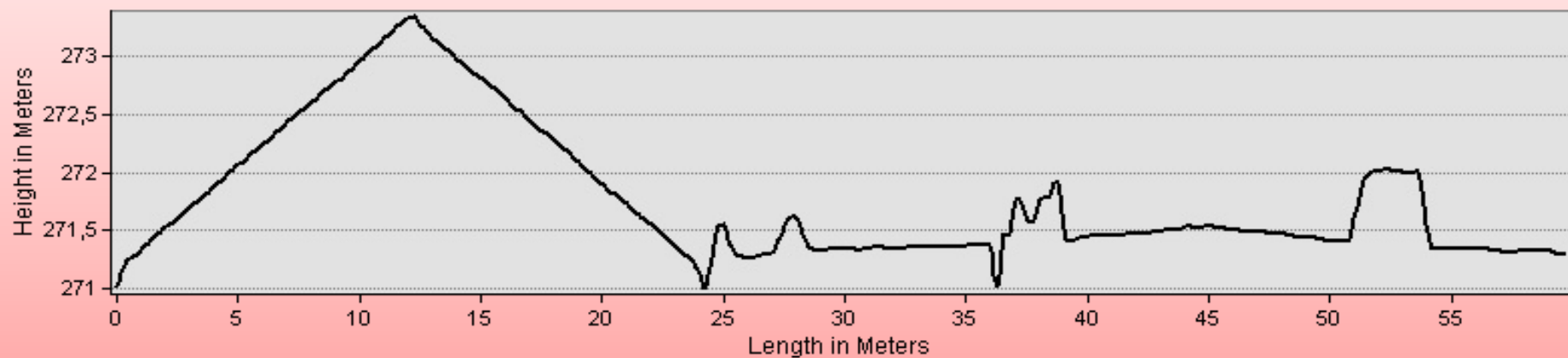


Roof Structure Profile



GeoTIFF

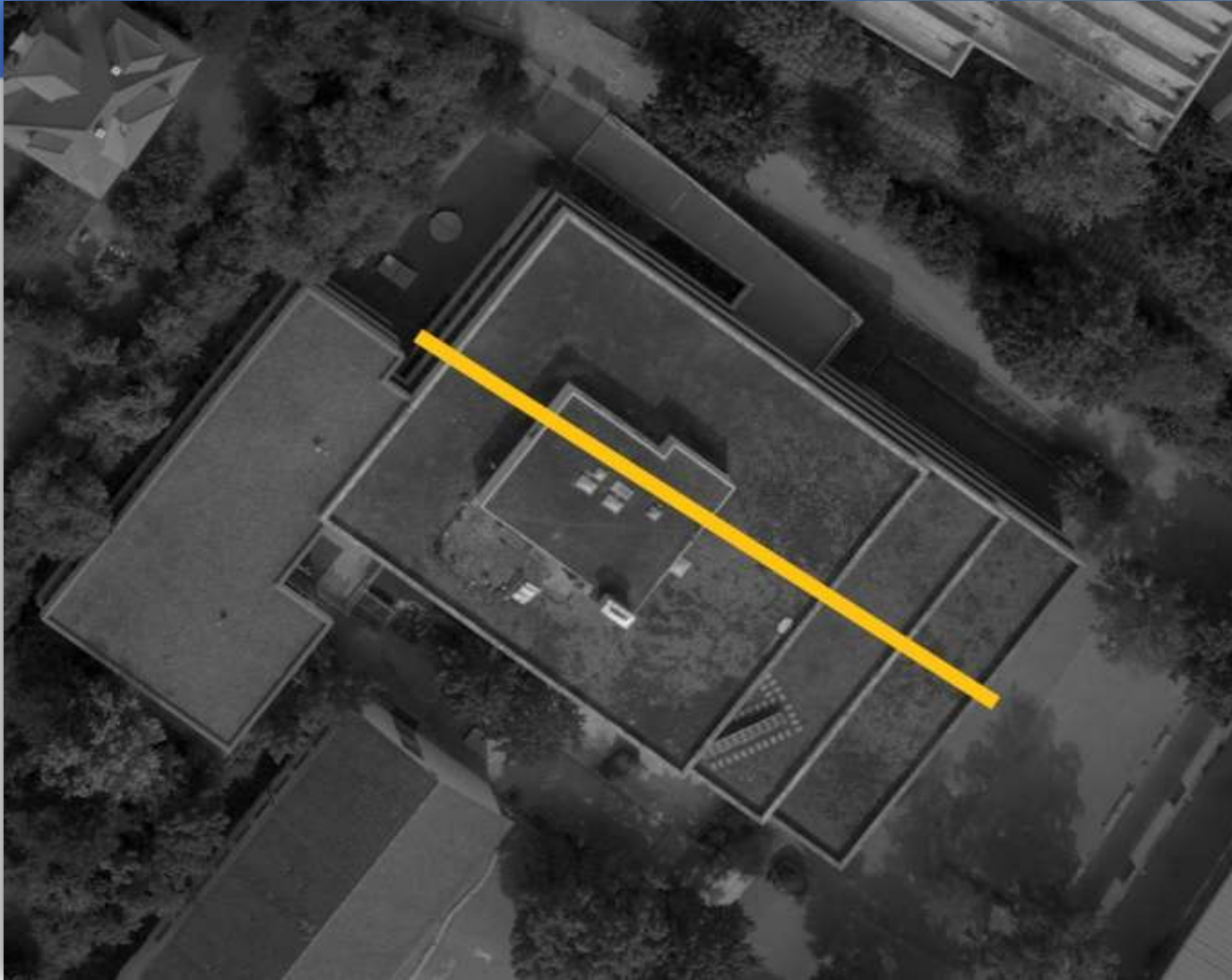
Roof Structure Profile



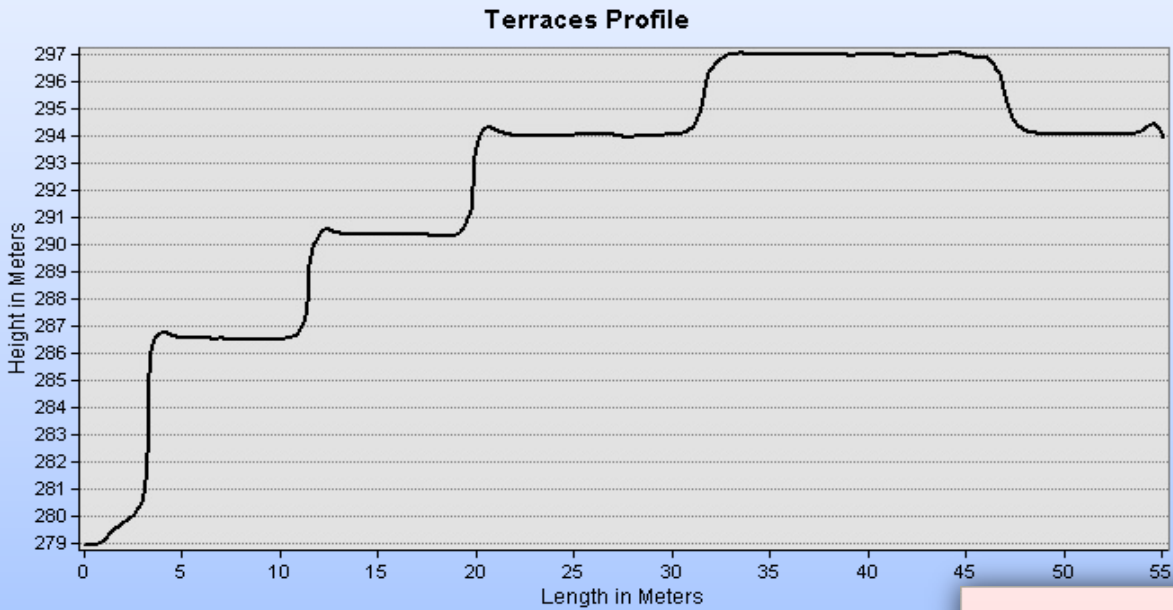
Laser - Interpolated



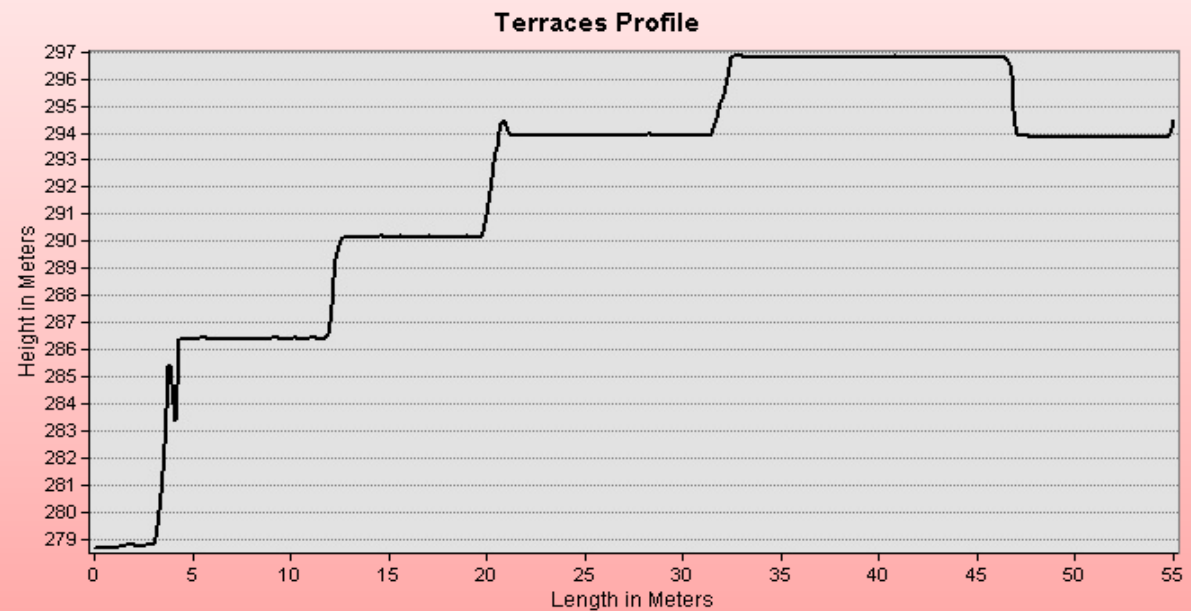
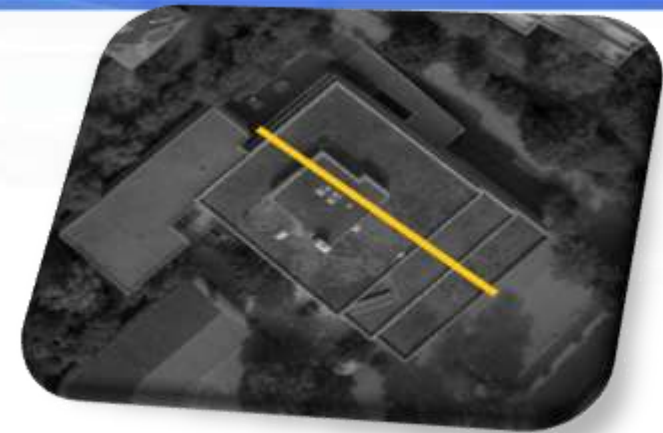
# Terraces Profile



# Terraces Profile



GeoTIFF



Laser - Interpolated

# CONCLUSIONS

- Image
  - Textur at high resolution, multi spectral data
  - Classification, Segmentation, Edge Detection
  
- Multiple Overlap
  - Redundancy, Robustness
  
- .....



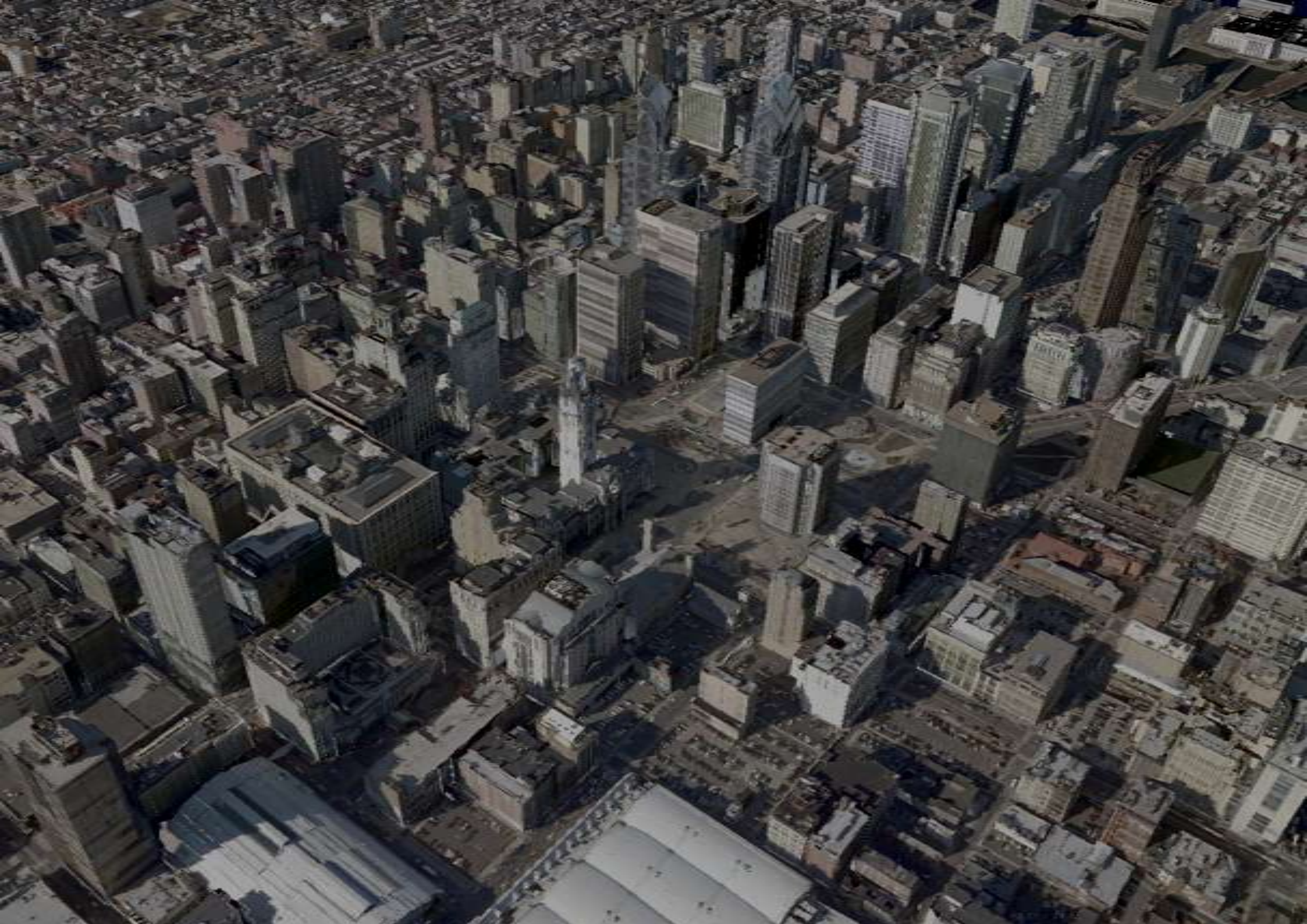
# Outlook

## 3D city model Philadelphia

DSM from digital aerial images

Textur at high resolution, multi spectral data

Edge Detection









**Microsoft**



*Thank You*

**VEXCEL**  
**I M A G I N G** SM  
a Microsoft company