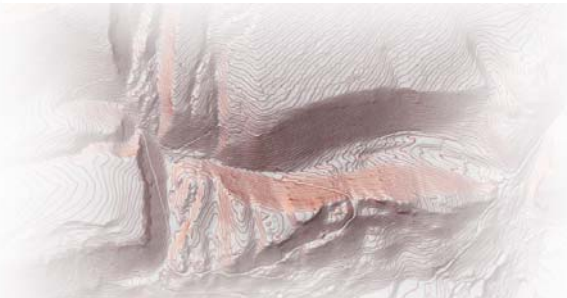


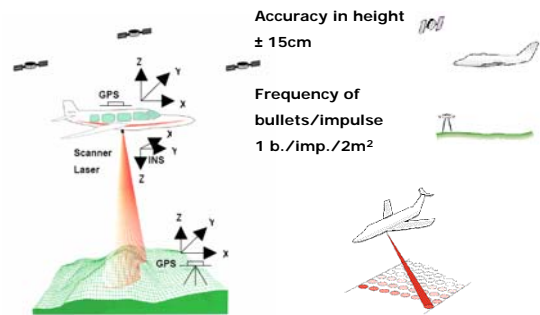
Representing the relief of Orienteering maps with the aid of airborne laser scanning



Thomas Hohl
Gymnasium Kirschgarten Basel

Airborne Laser-Scanning

Basic principle

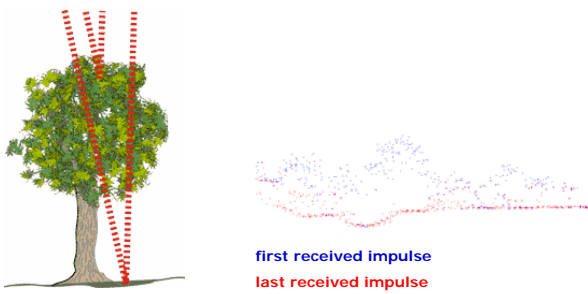


Accuracy in height
 $\pm 15\text{cm}$

Frequency of
bullets/impulse
1 b./imp./2m²

Airborne Laser-Scanning

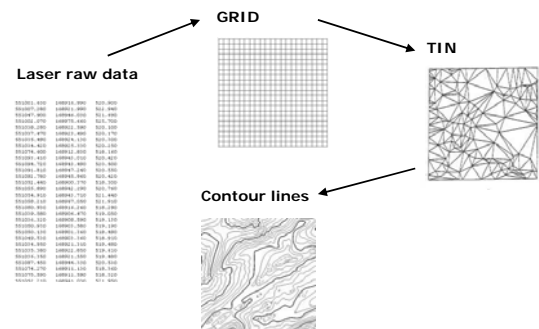
Laser impulse in forested areas



first received impulse
last received impulse

Airborne Laser-Scanning

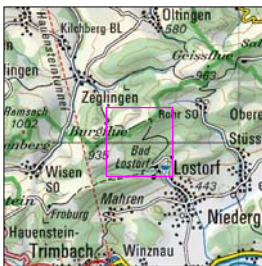
Method of analyzing



Comparison of contour reliefs

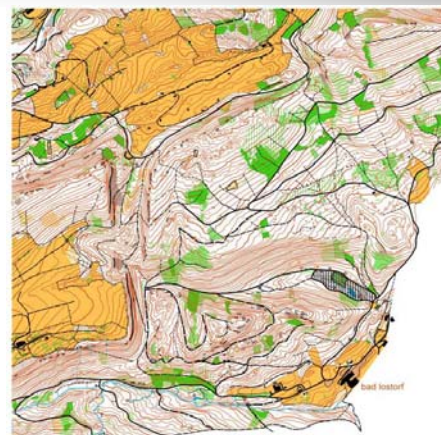
Criteria for the test area

- existence of an orienteering map
- existence of a photogrammetric base map
- an area with detailed terrain (depressions, knolls, rocky features)

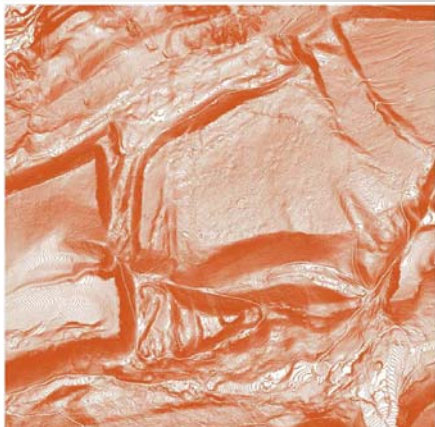


O-maps
'Leutschenberg-Schafmatt'
Area
2km x 2km = 4km²
Coordinate
636/251 638/249
Geoinformationssystem (GIS)
Idrisi 2.2 and ArcGIS 8.3

Comparison of contours reliefs



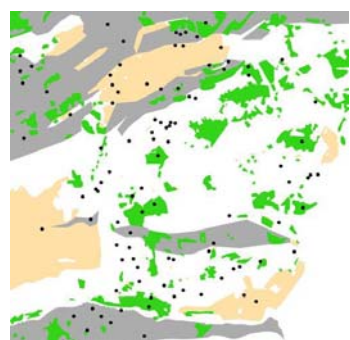
Comparison of contours reliefs



Comparison of contours reliefs

Photogrammetric map is not in digital form available → only spot samples

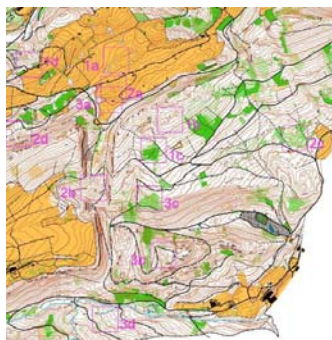
Comparison of contours reliefs



- Legend
- open terrain
 - forest
 - dense vegetation
 - north sides of slopes

Map with samples

Comparison of contour relief

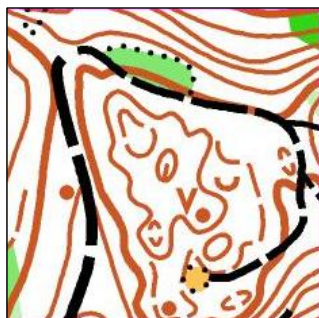


Size of 1 spot sample
150m x 150m

Distribution of spot samples

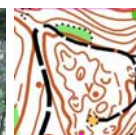
Comparison of contours reliefs

example: spot sample 3b



Comparison of contour relief

example: spot sample 3b



Comparison of contour relief

example: spot sample 3b



Comparison of contour relief

example: spot sample 3b



Comparison of contour relief

example: spot sample 3b



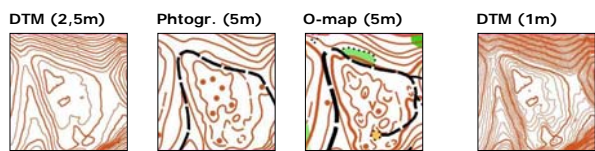
Comparison of contour relief

example: spot sample 3b



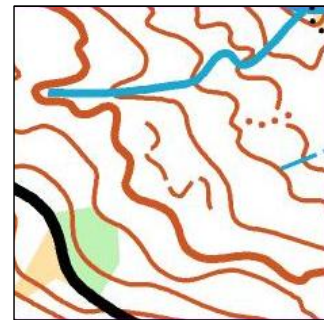
Comparison of contour relief

example: spot sample 3b




Comparison of contour relief

example: spot sample 3b




Comparison of contour relief

example: spot sample 3b




Comparison of contour relief

example: spot sample 3b



Comparison of contour relief


example: spot sample 3b




Comparison of contour relief

example: spot sample 3d

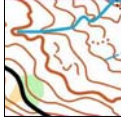
DTM (2,5m)




Photogr. (5m)



map (5m)



DTM (1m)



Comparison of contour relief

Conclusion

2,5m-DTM

- In detailed terrain not sufficient → 1m-DTM
- precise contour lines in dense vegetation

Photogrammetric base map

- not suitable in dense vegetation and north sides of hills
- very good representation of the terrain in open terrain

O-map

- often features are represented with objects instead of contour lines → bad legibility

Comparison of contour reliefs

Conclusion

	positive	negative
DTM	<ul style="list-style-type: none"> -very precise position -accuracy - completeness - good for relief representation - only eliminate features, no new measuring 	<ul style="list-style-type: none"> - pseudo features - dithering contour lines - representation without O-symbols
Photogrammetric base map	<ul style="list-style-type: none"> - representation with O-symbol 	<ul style="list-style-type: none"> - inprecise - uncompleted - new measurements necessary

Comparison of price

Calculation for an area of 8km² DTM

DTM-AV:

Basic charge	Fr. 300.--
Fee per km ²	8 x Fr. 80.-- = Fr. 640.--
Cut out, due of less than a 18 km ² tile	Fr. 200.--
Subtotal cost of data DTM-AV	Fr. 1140.--

Analysis DTM-AV wiht GIS-Tool

5h work	5 x Fr. 160.-- = Fr. 800.--
Total	Fr. 1940.--

Comparison of price

Calculation for an area of 8km² Photogrammetric base map

Models	5 x Fr. 100.-- = Fr. 500.--
Subtotal cost of data	Fr. 500.--

Analysis

8km ² Analysis	8 x Fr. 350.-- = Fr. 2800.--
Total	Fr. 3300.--

Preisvergleich

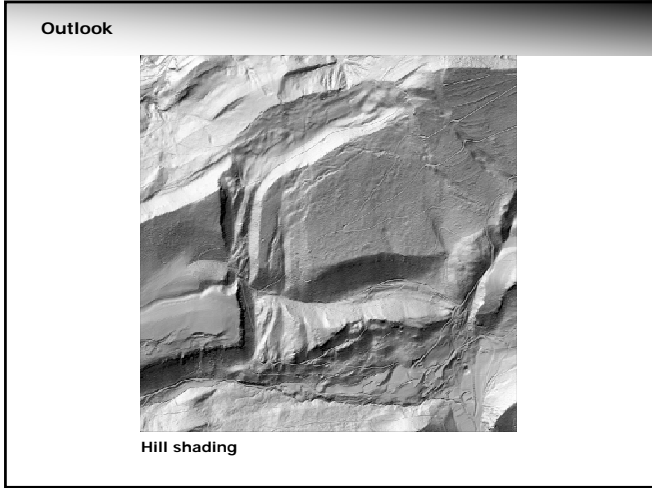
	DTM	Photogrammetric base map
Kostentotal	Fr. 1940.--	Fr. 3300.--

- Conclusion**
- Advantages of laser air borne scanning**
1. Saving of time in the terrain because of its availability without interruption and precisness (elimination instead of measuring).
 2. Raw-data all over Switzerland available. Time consuming work to find photogrammetric pictures are not any more necessary
 3. Significant reduced costs compared to photogrammetric base maps.
 4. Data are available rapidly.
 5. Combination with orthophotos possible (georeferenced)
- Disadvantages of laser air borne scanning**
1. Base map without O-set of symbol
 2. A detailed contour relief could easily lead to an over crowded and badly generalized map image.

Outlook

Automatic generalization

Hill shading perfect to represent the trail and track network



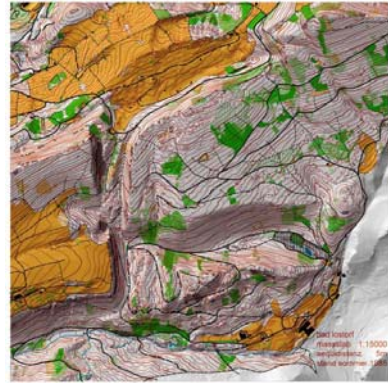
Outlook

Automatic generalization

Hill shading perfect to represent the trail and track network

O-Map with hill shading

Outlook



O-map with hill shading

Outlook

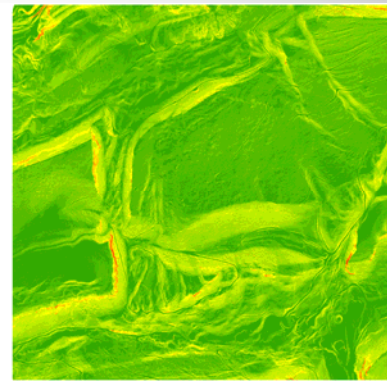
Automatic generalization

Hill shading perfect to represent the trail and track network

O-Map with hillshading

Extraction of cliffs out of the slope map

Outlook



Map hill slope

Questions

