

AERIAL LASER SCANNING IN ARCHEOLOGY

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Abstract:

Technology of aerial laser scanning is often well used for a DTM generation. The DTM (digital surface model) displayed in appropriate form, e.g. shaded surface, can be used as a data source for searching for archaeological sites. Aerial laser scanning data acquisition is unfortunately too expensive for noncommercial projects. It can be a solution to use the ALS data acquired primarily for another purpose by public service. In general, this data has lower density than the expensive custom-made data, but in a limited size can be borrowed for some research purpose. We tested the data from The Czech Office for Surveying, Mapping and Cadastre. The aim was to find if possible to use data characterized by a density of about 1 point/m² for archaeological research. We used the DTM in the form of shaded surface and inspected the data around few well known archaeological sites of different periods. It is also possible to use different outputs from the original DTM to better display terrain discontinuities caused by man's activity.

1. INTRODUCTION

The ALS data seems to be an appropriate tool for documentation or detection of archaeological sites on a larger scale; unfortunately the data is generally too expensive to be commonly used for these purposes. In our research, we try to use ALS data acquired by public service, i.e. data of lower density (about 1 point/m²), which is not as expensive as the custom-made data and can be even borrowed for free for students' projects such as master thesis. The data was made available by The Czech Office for Surveying, Mapping and Cadastre.

2. DATA

The Czech Office for Surveying, Mapping and Cadastre started in 2008 with a project for terrain mapping using the ALS method. The aim of such mapping is to get authentic and detailed DTM of the Czech Republic. Previous DTM in the form of GRID 10x10m is based on digitizing contours ZM 10 (Base Map 1:10 000); these contours were reached by topographic mapping and photogrammetry, its height precision being about 2-5m in a forested area, which is absolutely deficient for archaeological research. About 1/3 of the area is currently covered by the DTM based on ALS, and by 2015 the mapping should be complete. The standard altitude deviation of model points is up to 30cm.

We have used the DTM displayed as shaded surface. The data was prepared in SW SCOP++, and the parameters of shining are as follows: azimuth – 315°, height above terrain – 45°; pixel size is 1x1m. Terrain break lines are highlighted by the method of shaded surface, which is suitable for archaeological research. Remains of buildings and other terrain modifications are characterized by terrain break lines, local tops or pits, which do not fit local geomorphology.

3. MAPPING OF THE KNOWN SITES

We have chosen a few well known archaeological sites to compare the results from ALS data and the results

from some earlier mapping methods used by archaeologists. Archaeological research is a noncommercial activity, which means that cheap methods like stepping were used for mapping. These methods were not very precise, especially if employed by non-professionals.

Compare the visualization of the remains of Mrdice fort near Pardubice, the fort was first mentioned in the will of Herman of Mrdice in the early 14th century and probably abandoned during the 15th century. There is an obvious difference between the sketch from 1989 based on stepping and the situation displayed in shaded surface.



Figure 1: Mrdice - shaded surface and orthophoto

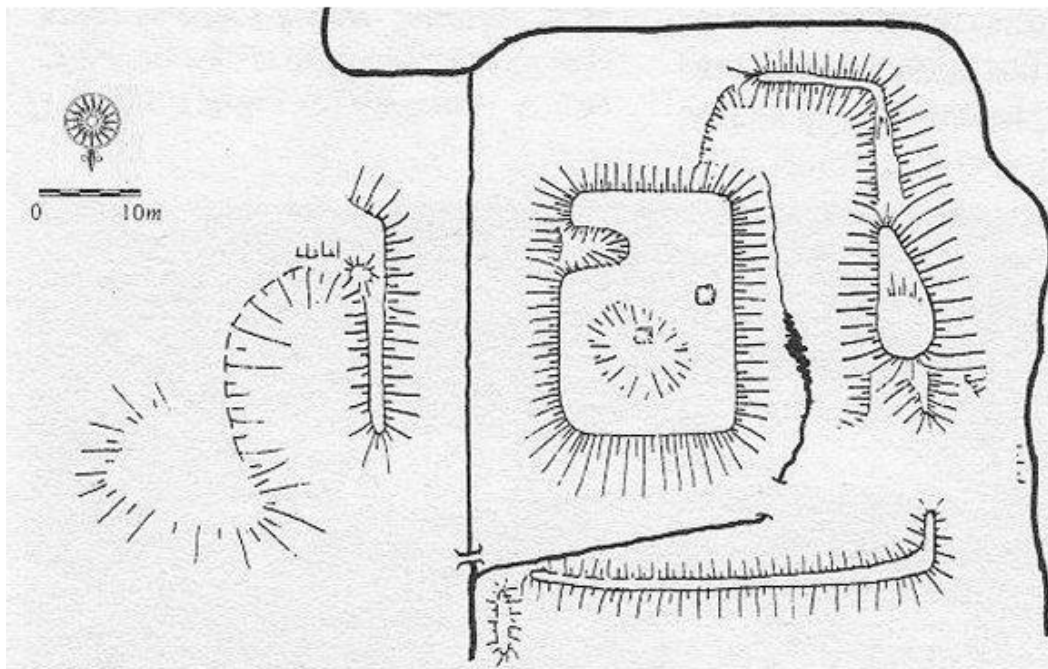


Figure 2: Mrdice - sketch [2]

Near the village of Provodin there is a rampart about 1.5km long along the hill Dlouhy vrch, which can be clearly seen in the shaded surface. The rampart comes from the war between Prussia and Austria in the mid 18th century. However, it was first used later, in the early 19th century, during the French invasion. It is up to 4m high and is now covered by beech forest.

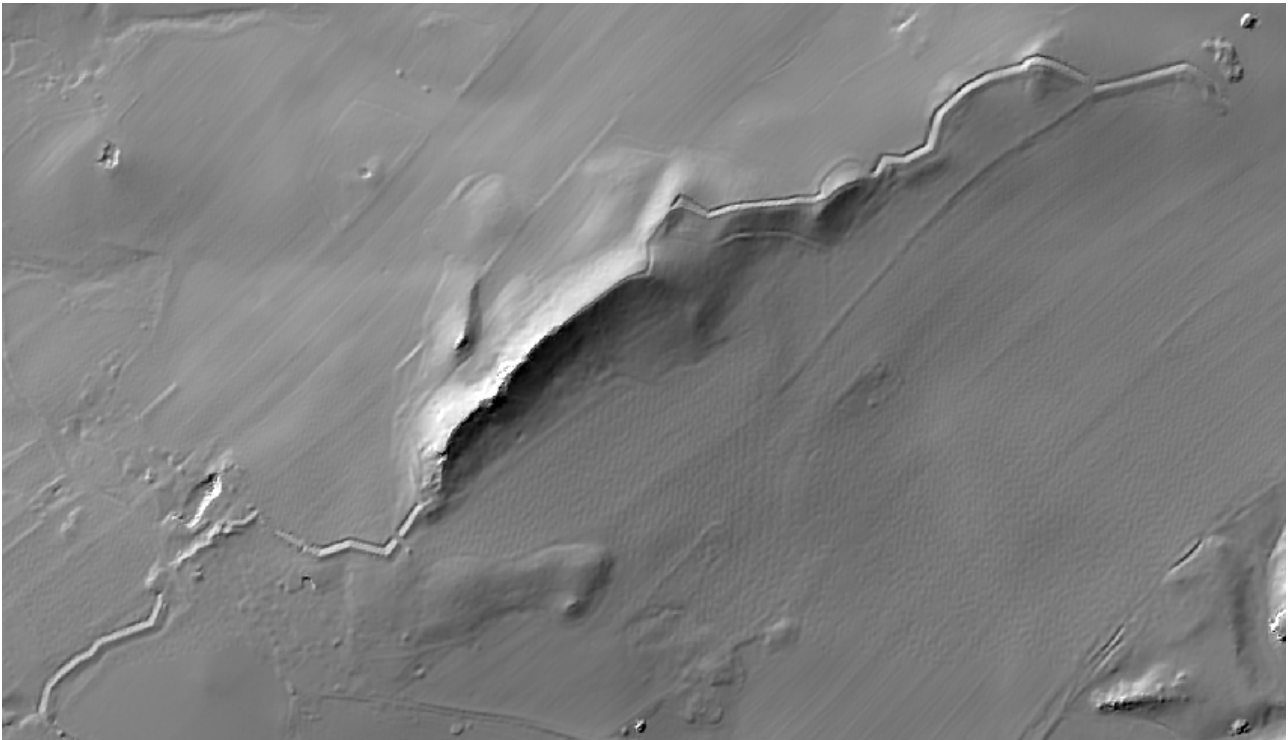


Figure 3: Provodin - shaded surface

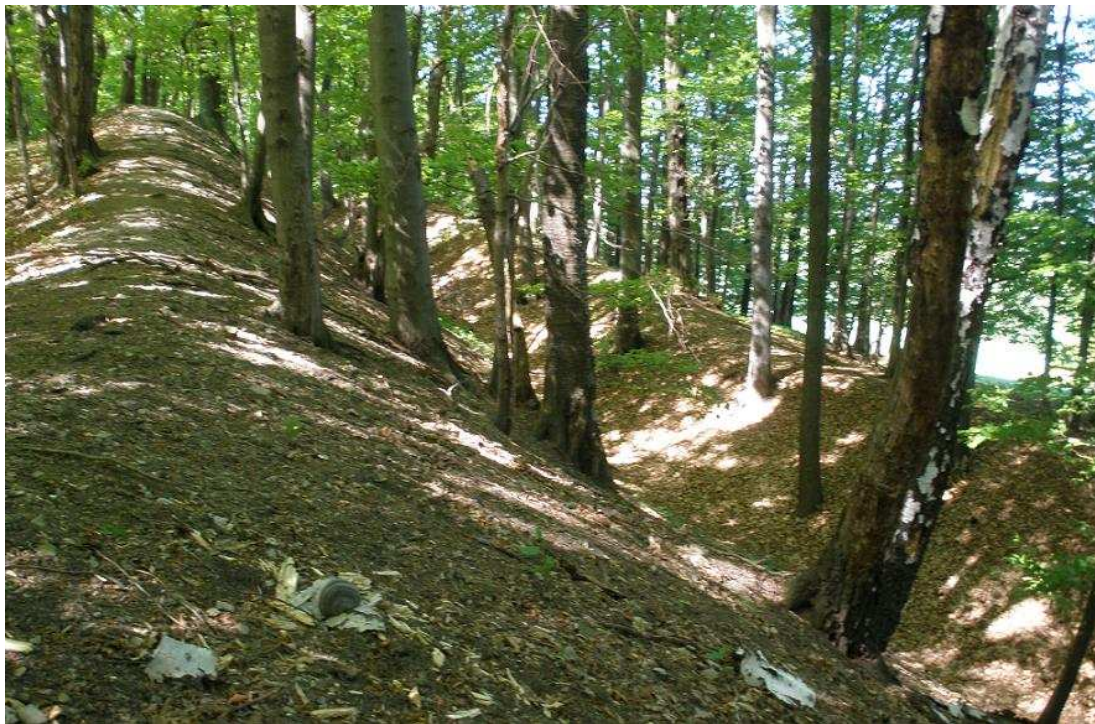


Figure 4: Provodin - rampart

4. SEARCHING FOR UNDOCUMENTED SITES

The ALS data can also be used for more than mapping known sites more precisely. It can serve for searching for unknown historic sites - remains of forts, barrows, etc. Using shaded surface with a resolution of 1m, we are able to descry objects bigger than about 10m. It is hard to differentiate small objects (e.g. barrows) from data noise (see Fig. 5 - probably robbed barrows in the forest near Kojakovice, Southern Bohemia). The chance to find such an object strongly depends on the season in which the data was acquired and

the vegetation cover. It is almost impossible to perfectly classify the returns from a dense deciduous forest in summer.

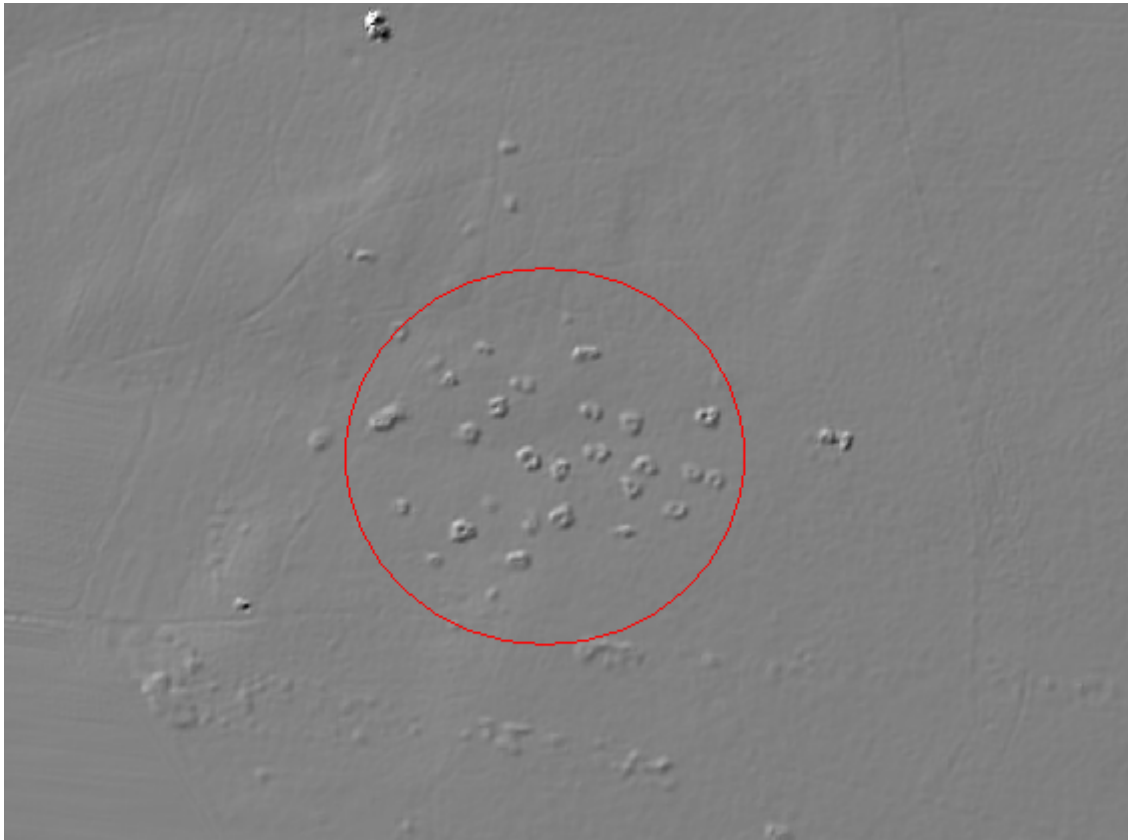


Figure 5: Kojakovice

Unfortunately, the forests are almost the last places where it is possible to find some sites not destroyed by an agricultural activity. An example of this are the remains of fort in Hvezdov (Ceska Lipa). There are evident remains of walls along the access way and two circumvallations with a moat in between (see Fig. 8). A great part of this site is covered by a young pine forest, which complicated the field survey. We have found no information about the fort, but the remains are drawn in maps of IInd Military Survey (1836-1852).

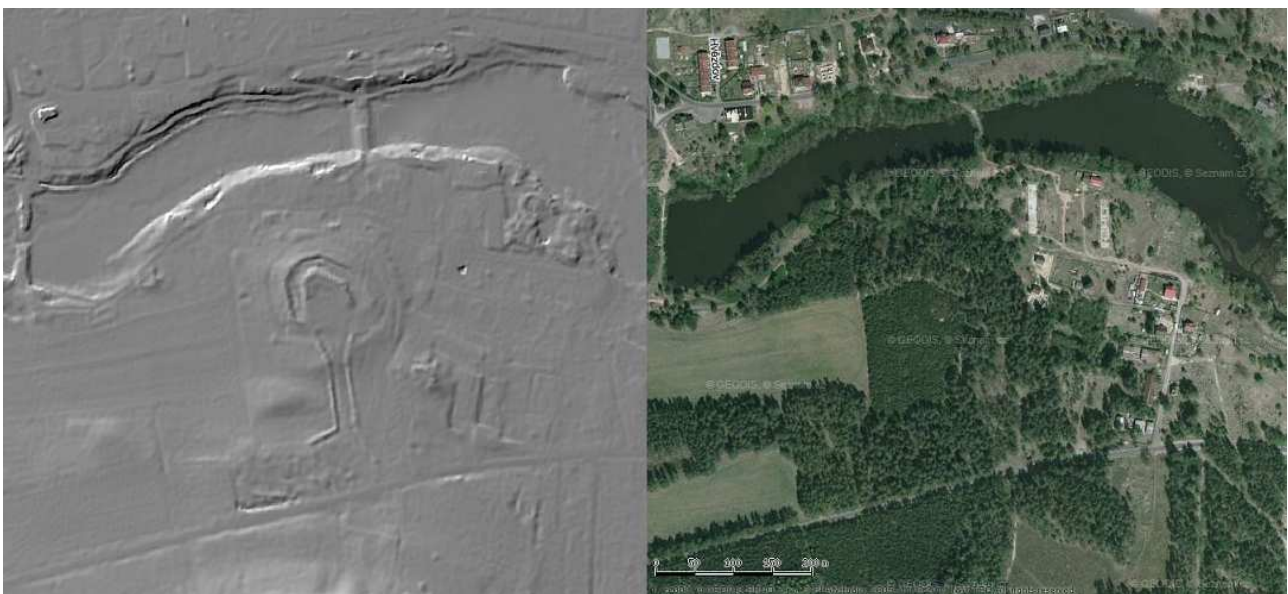


Figure 6: Hvezdov



Figure 7: Hvezdov - IInd Military Survey [5]



Figure 8: Hvezdov - view of the circumvallation

There are two more examples of objects that can be found in ALS data with a resolution of 1m. The first are remains of circumvallation on the hill Certovina near Mnichovo Hradiste and the second is a barrow in a forest above the city of Mlada Boleslav.



Figure 9: Mnichovo Hradiste - circumvallation



Figure 10: Mlada Boleslav - barrow

There are few other localities, which we want to inspect:



Figure 11: Svobodin (Dolni Bousov) - probably fort

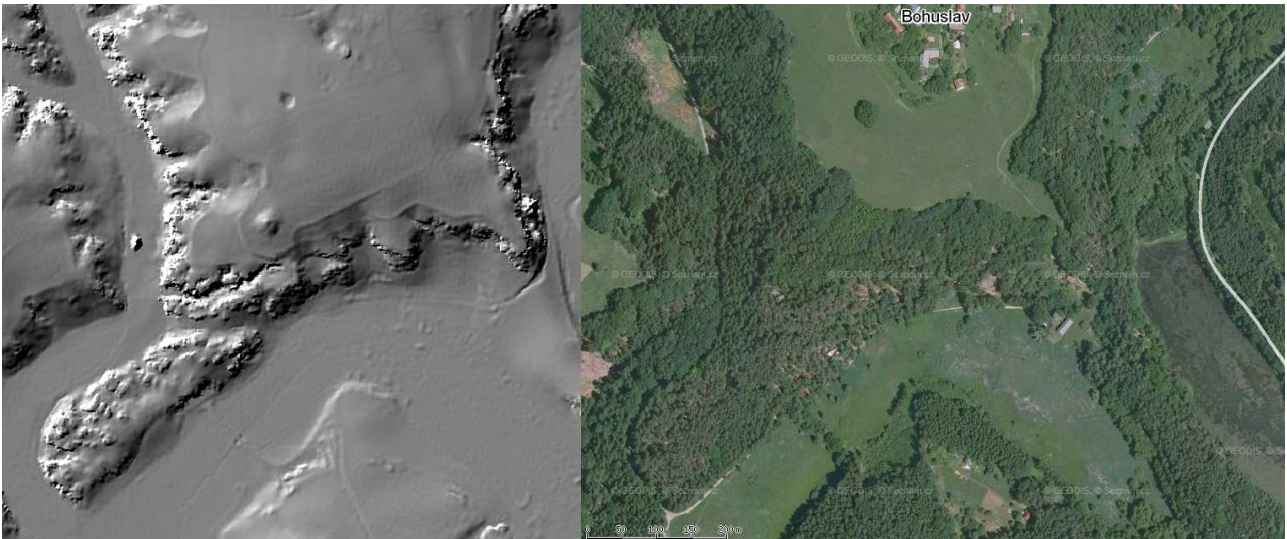


Figure 12: Bohuslav - barrow (about 1km north from well-known prehistoric settlement Semin)



Figure 13: Brtev - circumvallation (1km southwest from known fortified Kal)

5. CONCLUSION

The ALS can be an excellent tool for archaeologists and other persons interested in history. In spite of the lower resolution as against the possibilities of commercial custom made data, the ALS data produced by public survey has a huge advantage because of its price. After finishing mapping by the ALS project, the data will be available for the whole Czech Republic. The resolution seems to be sufficient for large scale archaeological research as well as a potential for using this data for research.

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