Geophysical Research Abstracts
Vol. 17, EGU2015-2365-1, 2015
EGU General Assembly 2015

Integration of modern remote sensing technologies for faster utility mapping and data extraction

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Analysis of the application of modern remote sensing technologies in current research shows a significant increase in interest in fast and efficient detection of underground installations. The most important reasons of the said application are preventing damage during excavation works, as well as the formation of the cadastre of underground utilities suitable for operating and maintaining of such resources. Given the wide area of application in the detection of underground installations, ground penetrating radar scanning technology (GPR), in this instance, is used as prevalent method for the purpose of the acquisition radargram of pipelines and the comparison with the results of the acquisition of Unmanned Aerial Vehicle - UAV drone Aibot X6 equipped with Optris PI Lightweight Kit (which consists of a miniaturized lightweight PC and a weight-optimized PI450 Optris LW infrared camera).
The aim of the research presented in the this paper is to analyze the benefits of integrating a mobile system capable of very fast, reliable and relatively inexpensive detection of heating pipelines using thermal imaging aerial inspection and GPR technology for control sampling of radargrams on specific locations of routes in order to achieve following: a simple identification of the characteristics of heating pipelines, prevention and registration of damage, as well as automated data extraction. The results of integrated application of the above-mentioned remote sensing technologies have shown that, within 10min of planned flight, it is possible to detect and georeference routes of heating pipelines in the area of 50.000m2 by application of thermal imaging inspection that assigns an adequate temperature value to each pixel in an image. The experiment showed that the registration is also possible in the case of pre-insulated and conventionally insulated heating pipes, and the difference in temperature measurements above the routes and the environment was up to 4 degrees. It should be noted that it is necessary to perform imaging in the working period, which is when the water is heated in the heating pipelines. Analysis of the efficiently defined heating pipeline routes defined by using thermal imaging inspection shows the point of temperature anomalies where it is necessary to perform control measurements using GPR technology. The control radargrams are further interpreted by applying realized automatic identification strategies software. Since the heating pipes are characterized by a distinctive method of installation (two pipes within or without concrete channels), they form a characteristic reflection in radargram, from which it is possible to identify the dimensions of the heating pipes. The dimensions of heating pipes are determined either based on estimation of standard dimensions of a concrete channel of heating pipes or based on hyperbolic reflections of the two pipes.
The research results show that by using integrated application of the above-mentioned technologies it is possible to achieve efficient and high-quality inspection of heating pipeline system with estimation of the most relevant parameters.

This abstract is a contribution to the 2015 EGU GA Session GI3.1 "Civil Engineering Applications of Ground Penetrating Radar," organised by the COST Action TU1208