An open-source approach for the vulnerability assessment of archaeological deposits using GPR data in QGIS environment

Philip Fayad, Alma-sistemi, pkf@alma-sistemi.com
Matteo Serpetti, Alma-sistemi, mse@alma-sistemi.com
Stefano De Angeli, University of Tuscia (UNITUS), deangeli@unitus.it

Introduction

A specific tool for GPR data processing has been designed in the context of the project RESEARCH (REmote SEnsing techniques for ARCHaeology – H2020-MSCA-RISE- 2018 n. 823987). The project addresses risk assessment procedures for archaeological sites threatened by environmental pressures, as land-use change, land movement and soil erosion, and the creation of a Web-GIS Platform able to automatically perform the risk assessment procedures (www.re-se-arch.eu). The methodology adopted by the project required data about the depth of the archaeological deposit and the distance from the ground of its most superficial layer, in order to precisely evaluate the vulnerability of buried archaeological features to threats acting on soil (in particular soil erosion). To do so, an innovative method of GPR data processing has been designed, that can automatically recognize subsurface features depth. The challenge was to implement in a GIS environment an automatic open-source tool that can replace the manual interpretation of archaeological features detected with GPR investigation by automatically working on pixel values. The study illustrates the specific methodology adopted to automate the GPR data processing procedure. The GIS-based tool was tested in the case study of the Roman town of Falerii Novi.

Methods and Materials

RESEARCH risk assessment procedure give prominence to unexcavated archaeological heritage, focusing on main buried features, such as structures (which can be more easily identified through geophysical survey) and stratigraphy. The burial depth of structures and possibly intact stratigraphy is the principle on which vulnerability values are assigned, since the more a feature is far from the soil surface, the less it is impacted by pressures acting on it, such as agricultural activities and soil erosion. The goal was to identify an interface that represents the superficial extent of the undamaged layer affected by agricultural activities, and to assign the vulnerability values on small scale, in order to more precisely evaluate the risk for the preservation of the archaeological deposit. In our study, we translated the vulnerability assessment methodology proposed by RESEARCH into specific processing steps creating in this way a GIS workflow. The whole chain of operations was wrapped into a single process, a single algorithm, in order to make it convenient to execute it later with different sets of inputs, thus saving time and effort. The algorithm resumes the entire process

of pixel-based vulnerability mapping of archaeological deposits, starting from processing raster GPR time-slices to produce the most superficial layer of the archaeological deposit, up to finally assigning vulnerability values to each pixel. The tool was developed inside QGIS platform, the most popular geographic information system (GIS), Open Source, licensed under the GNU General Public License, which is part of the Open-Source Geospatial Foundation project (OSGeo). The high-resolution GPR data concerning the site of the roman town of Falerii Novi, recently published in open-access, were used for the first testing of this procedure (Millett et al. 2019; Verdonck et al. 2020).

Results

This automated procedure allows to produce good results in a short time, with no need for manual intervention of the user, all within QGIS environment. Usually, manual interpretation of detected features mostly concerns structures, overlooking stratifications. This algorithm allows for a very detailed representation of the archaeological deposit considered in its wholeness. It also allows for the production of detailed vulnerability maps, where vulnerability values are assigned to pixel-size areas in color scale. This level of detail ensures project RESEARCH a more reliable risk assessment, where risk is calculated on very small scale, therefore with more accuracy.

Discussion

The paper presents the specific procedure designed for producing the upper layer of archaeological deposits detected with GPR, within QGIS environment, highlighting the opportunities and obstacles of this type of procedure and approach. Further development of the tool will be also discussed, such as the possibility to fully automate the procedure for archaeological features recognition and structures representation.

References

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