A Future Perspective for Automated Detection of Archaeology using Deep Learning with Remote Sensor Data

Extended Abstract

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ABSTRACT

An essential aspect of archaeology is the protection of sites from looters, extensive agriculture and erosion. Under this constant threat of destruction, it is of utmost importance that sites are located so that they can be monitored and protected. This is mostly done on the ground or by using remote sensing data such as aerial images or LiDAR derived elevation models. This task is time consuming and requires highly specialised and experienced people and would thus immensely benefit from automation. Within this novel research, the potential of deep learning for the detection of archaeological sites is being assessed.

CCS CONCEPTS

• **Computing methodologies** → Neural Networks; • **Applied Computing** → Archaeology

KEYWORDS

Deep Learning, Transfer Learning, Remote Sensing, Archaeology

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1 INTRODUCTION

Automation of archaeological detection is a highly challenging task where some of the most 'overwritten' signatures of the landscape need to be extracted from petabytes of imagery. Previously presented research has been highly criticized for their accuracy which has slowed down new research and weakened general interest [1]. In this research, a new method is proposed which aims to overcome the main critiques by creating a robust method which allows for the inclusion of multiple remote sensors and is adaptable across known archaeological objects.

2 PROPOSED APROACH

2.1 Case Study

The research is conducted on the English landscape where certain archaeological objects are found across the country. Despite the availability of countywide remote sensing data, we are, as of yet, unable to process the petabytes of data and thus limit our research to the 600 km² area of the New Forest where around 20-600 objects are known for each class. The New Forest is located in southern England and known for a diverse landscape and thus the use of a variety of remote sensor applications is key for the detection of archaeology.

2.2 Deep Learning on Remote Sensor Data

The desire for this automated task on remote sensing data is not unique to archaeology. For example, the TerraPattern Project created a visual search tool for satellite imagery which uses deep learning to quickly classify complete cities [2]. Different from the known examples we aim to include multidimensional data and transfer learning to compensate for the limited number of known objects.

2.3 Preliminary results

In the first stage of this research 287 barrow locations were used to train a fully convolutional network on 3-band aerial imagery with 0.5cm ground resolution. By fine-tuning the model with data augmentation and transfer learning (using only the last convolution layer of VGG trained on ImageNet) we were able to reach a validation accuracy of 85%. This is a significant improvement to the known automated methods, but does not compare well to human-level accuracy. Nevertheless, it is likely to improve with the addition of other remote sensing data such as LiDAR derived elevation models which are renowned to unveil the archaeology hidden under the forest canopy.

3 FUTURE PERSPECTIVE

In this research, a deep learning approach is proposed that defeats the main critique on automated detection of archaeological sites on remote sensing data. When considering the flexibility of our approach to new object classes and remote sensing input, it is believed that in the long term we can now look forward to a countrywide detection model.

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