

THE CONTRIBUTION OF REMOTE SENSING IN IDENTIFYING CULTURAL HERITAGE REMAINS

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ABSTRACT

This study examines the use of time-series aerial images in identifying archaeological and cultural heritage remains. Time-series aerial photos and satellite images can be used to identify temporal changes and retrieve geo-spatial information. For the site selected, time series aerial images from 1963, 1993 and 2014 were chosen to identify changes in order to uncover any information of the site. The site selected for this study was the Church of Panagia Karmiotissa, located in the Polemidia, Limassol District, Cyprus. The origin of the church is unknown, but evidence of ruins located in the north area of the church, indicate that there is an extension of the church and the presence of a small monastery or accommodations. Historical references [1, 2] indicate that it was likely a Carmelite monastery, that was abandoned in the 16th century and recently restored as a Greek Orthodox Church. The investigation of the aerial photos retrieved from the time-series analysis and ground penetrating radar led to an archaeological excavation that was done in October 2023 for further investigation.

Index Terms - Time Series Analysis, remote sensing, ground penetrating radar, archaeological excavation

1. INTRODUCTION

In the effort to investigate the history of the area using remote sensing and archaeological excavations of the area around the Panayia Karmiotissa Church located in Polemidia, Limassol District, Cyprus, an extensive remote sensing survey and documentation of the church and surrounding area was performed [3,4]. Remote sensing techniques, such as UAVs, photogrammetry, thermal imaging and ground penetrating radar (GPR) were used to gain insight into the site to create digital elevation models and 3D models and conduct geo-physical study to document and understand the site [3]. Following the investigation, the areas of interest identified from the remote sensing studies led to the archaeological excavation that was done in collaboration with the Aix-

Marseille Université of Marseille, France. The study found that time series analysis, in combination with in-situ data, is a very useful tool that can be used to identify areas of interest for excavations.

2. SITE INVESTIGATION

The church of Panagia Karmiotissa is the only preserved Gothic church in the Limassol area during the time of the Frankish House of Lusignan in Cyprus. The monastery was likely abandoned in approximately 1570, following the Ottoman Invasion. Today, only the church remains, with the name of Panagia Karmiotissa. To the north of the church, there are ruins of chambers that may be the remains of the monastery. The monastery in the Limassol region at Polemidia was established, according to different sources, anytime between the middle of the 13th century A.D. to the start of the 14th century A.D [1]. However, it is unknown exactly when the monastery was established and when the church was built [5]. According to Enlart, the church is consistent with the architecture of churches built in the 13th Century [1]. From the end of the 12th century to the 19th century, little is known about the site. According to different sources, the site is linked to the Carmelite Order and is one of the first monuments that was protected by the Department of Antiquities as the Ruined Carmelite Church and Monastery. Until today, the general area is referred to as Karmi, which the origin of the name may be associated with the Carmelites.

3. METHODOLOGY

Time series images were acquired from the Cyprus Lands and Surveys Department for the study area for the years 1963, 1993 and 2014 (fig. 1). As is evident in the 2014 image, the lack of vegetation following a fire in 2012 uncovered the remains of the monastery north of the existing church. This showed the extent of the remains and provided important information about the site. However, the site is covered with debris that accumulated during the past 700 years; therefore, an extensive excavation is required to uncover the remains and document the site.

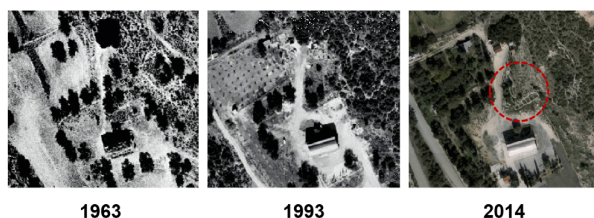


Fig. 1 Time series images 1963, 1993 and 2014

The remains show evidence of the existence of the monastery yet did not provide any information about the extent of the monastery and its connection to the church. Using a drone survey in 2021 to create a photogrammetric study of the area, the remains of the monastery were documented and examined using remote sensing techniques [3, 4].

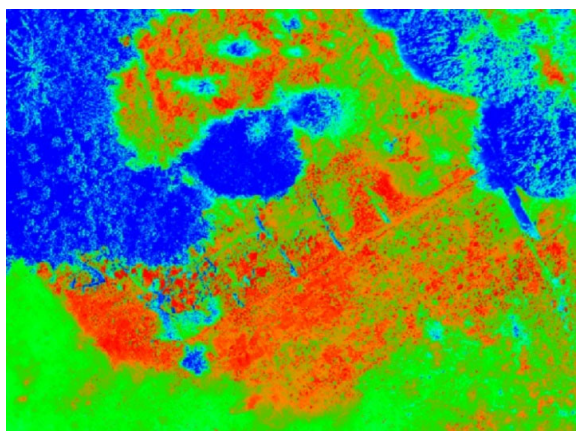


Fig. 2 Ruins of the monastery using remote sensing indices

In 2022, GPR geo-physical analysis was performed in the area around the church of Panagia Karmiotissa (fig. 3). The GPR analysis identified three potential sites for further investigation and archaeological excavation.

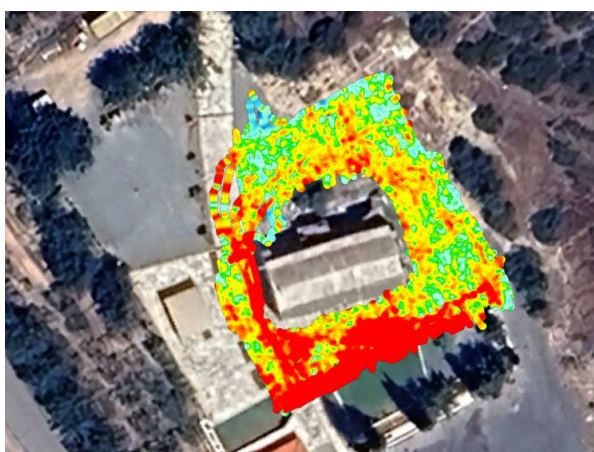


Fig 3. GPR analysis identifying area for excavation

After obtaining the necessary permission from the Cyprus Department of Antiquities and the Bishopric of Limassol, in cooperation with the Karmiotissa Church Committee, in October and November 2023, a team from the Aix-Marseille Université in Marseille conducted excavations in three excavation test pits with the assistance of the Eratosthenes Centre of Excellence Cultural Heritage team (fig. 4).



Fig. 4. The three excavation test pits

4. RESULTS

The results from the remote sensing and GPR analysis were useful in identifying areas of interest with potential archaeological remains. The use of temporal aerial images provided the initial identification of the remains and remote sensing techniques such as the use of photogrammetry, thermal imaging and GPR assisted in identifying and documenting remains to assist the archaeologists in their excavations. The images were acquired weekly to document the site during the archaeological excavation.

During the excavation, many artefacts and structures were uncovered, proving the existence of a 13th century settlement on the site. Using the photogrammetric documentation and generating a Digital Elevation Model (fig. 5), in addition to the results of the excavations, showed that the area south of the church was at the same level as the west, east and north area. This was also supported by the GPR survey that was performed around the church. Figure 5 shows that the original floor elevation around the church was at the same level as the south area of the church.

The study shows that in-situ documentation in combination with remote sensing techniques is vital for understanding the site and identifying future archaeological excavations.

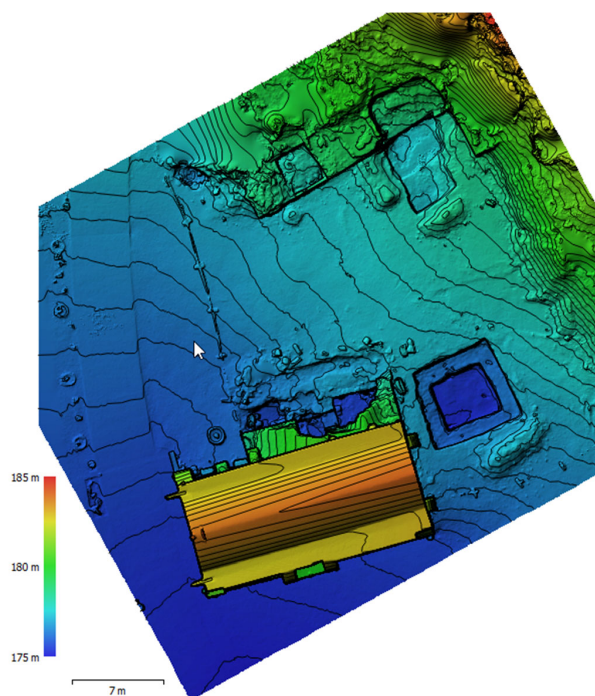


Fig. 5. Digital Elevation Model of Excavation Pits

5. CONCLUSIONS

In the study presented, it is evident that remote sensing techniques can be a useful tool not only for identifying cultural heritage remains [6] but can also assist during the archaeological excavation for documentation and for understanding of the site. In the study, since the excavation had a limited time period, the evidence concluded that further investigation and archaeological excavation is required to uncover the remains of the site.

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