3D GIS for the Archeological Excavation at Karambournaki, Thessaloniki

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SUMMARY

The paper is about the creation of a 3D GIS for the excavation site at Karabournaki, inside the urban area of Kalamaria, a part of the second largest city of Greece Thessaloniki, which is situated in the Region of Central Macedonia in Greece. The purpose was to create a 3D representation of the artifacts. The extent of the excavation covers an area of approximatelly 4,000 square metres.

ΠΕΡΙΛΗΨΗ

Περιγράφεται η δημιουργία μιας τρισδιάστατης (3Δ) αναπαράστασης της ανασκαφής εντός του αστικού ιστού, στο Καραμπουρνάκι Θεσσαλονίκης, με τη χρήση Γεωγραφικού Συστήματος Πληροφοριών. Σκοπός ήταν η δημιουργία της 3Δ αναπαράστασης των ευρημάτων τα οποία έχουν εκσκαφεί. Το συνολικό εμβαδόν της ανασκαφής είναι περίπου 4.000 τετραγωνικά μέτρα.

Aknowledgements

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1. THE PURPOSE

The Cultural and Education Technology Institute (C.E.T.I.) was founded in 1998 in Xanthi (Greece) as an independent research institute under the auspices of the General Secretariat for Research and Technology (Ministry of Development). In November 2003 it was integrated into the Centre of Integrated Research for the Information Society (I.R.I.S.), which in February 2006 was renamed to "Athena" - Research and Innovation Center in Information, Communication and Knowledge Technologies. The Institute constitutes an integrated research environment with continuous interaction with the academic community, in particular with the Democritus University of Thrace, the national and European educational and cultural technology industry, the international scientific community and the public sector.

The aim of CETI the is the strengthening of research and technological activities and the application of new technologies to the sectors of humanitarian science and culture and to education. More specifically, the Institute concentrates its scientific activities a) to the application of Information Technology to the study of texts, analyses, study and registry of languages, works of art, monuments etc. b) to the study of related material, particularly ceramics, paper and parchments and c) to the application of information technology to the area of Education such as Distance Learning and Education-on-Demand.

To achieve these objectives the Institute:

- Conducts research programs into the area of the application of new technologies to culture and education.
- Provides information technology support for scientific and developmental activities of the region by creating databases, electronic storage facilities, network connections etc.
- Provides scientific and research networks and international joint ventures with the emphasis on co-operating with academic foundations in the Balkans and Black Sea countries and for exchanging information on subjects of mutual interest.
- Collaborates with research establishments and faculties of other Universities of similar interest and particularly with all those, which are already operating in the area.

- Collaborates with technological and industrial establishments of the region and of the country in general, with the aim of coordinating research and production and the exploitation of research results.
- Provides special training for calculation and with the funding of interested organizations. It trains scientists especially in the above mentioned sectors with the organization and funding of research programs both in Greece and abroad, by conducting post graduate seminars and workshops and through various publications and presentations.
- Supports initiatives for the utilization of the position of Thrace as the meeting point and the South-Eastern gate of the European Union to the Balkans and the Black Sea.
- Undertakes initiatives for keeping up-to-date the scientific manpower of Thrace.
- Can take part in any enterprise by producing products or providing services for sectors relevant to its aims.
- Collaborates both within Greece and abroad with experts and organizations specializing on topics relevant to its activities, with the purpose of the advancement of its objectives, and if needed, subcontract them for research topics of special interest.

Figure 1. The excavation

To this end, it tries to create the necessary technical infrastructure and to attract experienced scientists. Its objective is to create high technology laboratories (multimedia, distance learning, archaeometry e.t.c.). In the past the main emphasis was placed in the creation and operation of the Multimedia Laboratory and the Archaeometry Laboratory. In the new interests are increasingly included the Geographical Information Systems.

Located in North Aegean, on the edge of the promontory in the center of Thermaic Gulf in the area of modern Thessaloniki, Karabournaki or Little Karabournou, preserves the remains of an ancient site including a settlement, a harbour and cemeteries. Around that area there is a dense urban environment. The revealed ancient houses indicate

that the primary section of the settlement was placed on the top of a low mound with its cemetery extended to the area that surrounds the bottom of the hill. Thermaic Gulf reaches the lower part of the mound and remains of the ancient harbor are still distinguishable under the water in the zone of the modern Kyverneion (Palataki). The site preserves a great number of ceramics, local and imported, in a remarkable quantity as well as quality. The material evidence demonstrates that Karabournaki was a commercial and distribution point and a meeting place of influences from the East and the West. Even though no inscription with the name of the ancient city has been found yet, several scholars have argued for the identification of the site with ancient Therma, based upon its location and literary and archaeological evidence.

The site was already known since the late 19th century and although the area was used as a military camp continuously until 1989, the earliest archaeological research there took place already during the First World War. A systematic research of the site, however, began in 1994 as a collaboration project between the Aristotle University and the Archaeological Service of Thessaloniki. The University undertook the investigation of the mound, and that means of the residential area of the ancient site, while the Archaeological Service is in charge for the surrounding area with the cemeteries and the table located nearby. The whole area is destined to become a regional park and also host cultural activities.

2. THE PROCESS

The purpose was to create a 3D representation of the artifacts of the excavation site at Karabournaki at the original position where they were found inside the trench. This representation offers an insight of the "layers" (Z values) that these artifacts belong. These layers are associated to specific time periods and are used by the archaeologists in order to understand the sequence of historical facts. Also if we have thorough knowledge of their spatial distribution, we can make better predictions as to what else lies under the ground, and make calculated guesses as to where we can find it. The latter is very important as excavations are time-consuming and expensive.

The cataloging methods used in the past was a paper catalog of the artifacts with specific coding rules that enabled the archeologists to identify uniquelly each artifact. This catalog is still being prepared elaboratelly at each excavation site. It includes information on the artifact itself, but also to on the position that it was found. This information is coded in relation to the trenches in which it was found. The paper catalogs became excel worksheets, and then tables in a database. These tables consist the thematic data for the 3D GIS.

In the Karambournaki excavation there are 96 trenches sized 4 by 4 metres. Their depths vary from a few centimetres to a couple metres. The distance between each trench and the next is one metre. Inside 18 of the trenches a totality of 145 artifacts have been recpvered. In 73 of the trenches, parts of walls and large pytheons have been excavated. The total extent of the excavation is approximatelly 4,000 square metres.

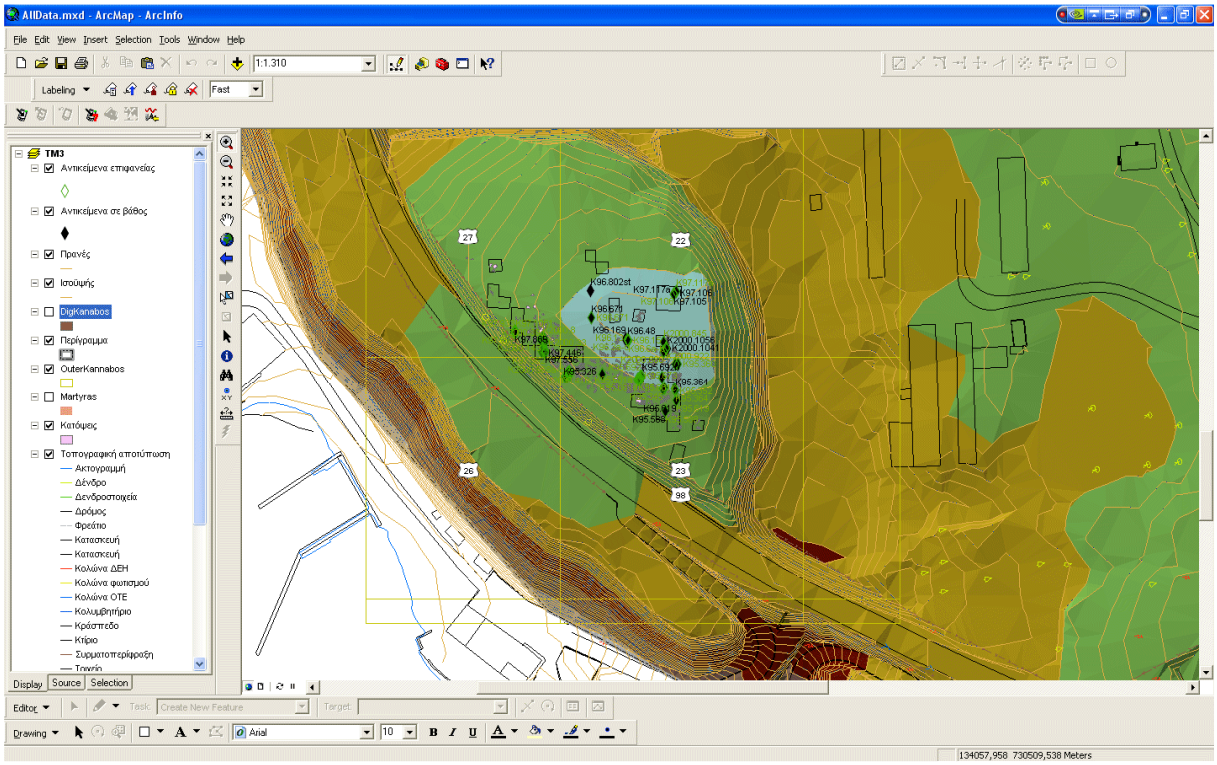

Figure 2. The 3D (TIN) representation of the excavation

The spatial data for the excavation all had to be transformed to the same coordinate system as they were stored in various systems – mainly local. The artifacts were already catalogued and stored in a digital database. A Z value was included in the data which referred to a vertical datum which no longer existed at the site.

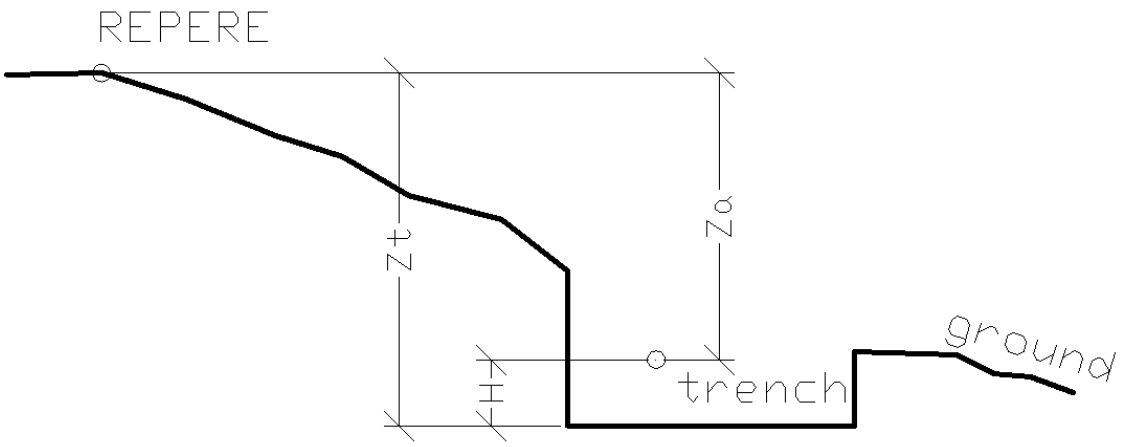

Figure 3. The geometry of the Z calculation

Calculations had to be made in order to refer this Z value to a H value related to the ground that was excavated or to the bottom of the trench, as it was before it was dug, in order to be used as a base height value. The calculation for the final height for the artifact is

$$H = Zt - Za$$

Figure 3. The array of trenches (theoretical and realised)

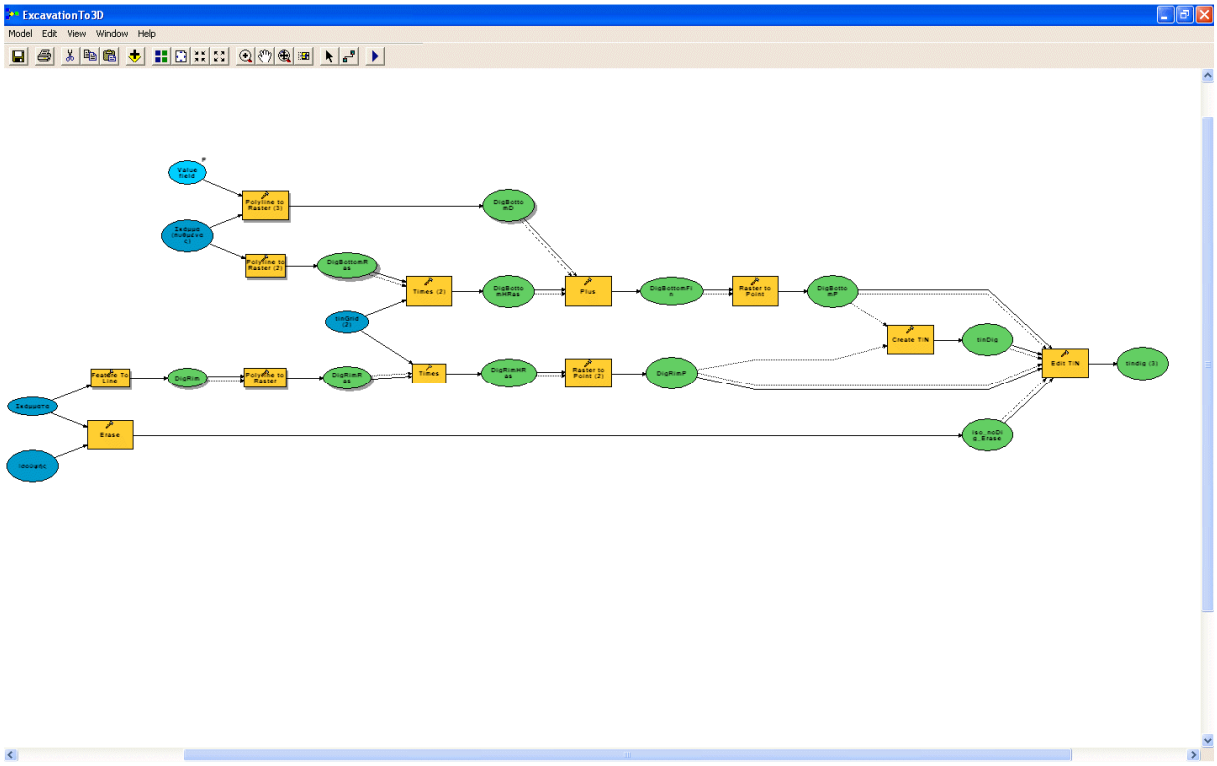

Figure 4. The geoprocessing model for the creation of the 3D representation of the trenches

The process for the creation of the TIN with the trenches dug meant that the initial TIN had to be updated with holes. These trenches are being dug relativelly vertically. However the TIN format does not support multiple Z values for the same location on XY plane. Slopes of 90 degrees are not feasible. This was dealt with by giving a lesser slope than 90 degrees to the rims of the trenches, something which holds true especially for the deep trenches. The suubtraction of the trench depth from the rim of the trench was conducted in raster format so geoprocessing was required in order to perform the digital digging of the trenches. The process was repeated many times until an optimal result was achieved as regards the parametres of the calculation (for example the cell size of the raster datasets). Therefore it was automated with the use of a CASE tool, as can be seen at Figure 4, and can be reused in a similar project.

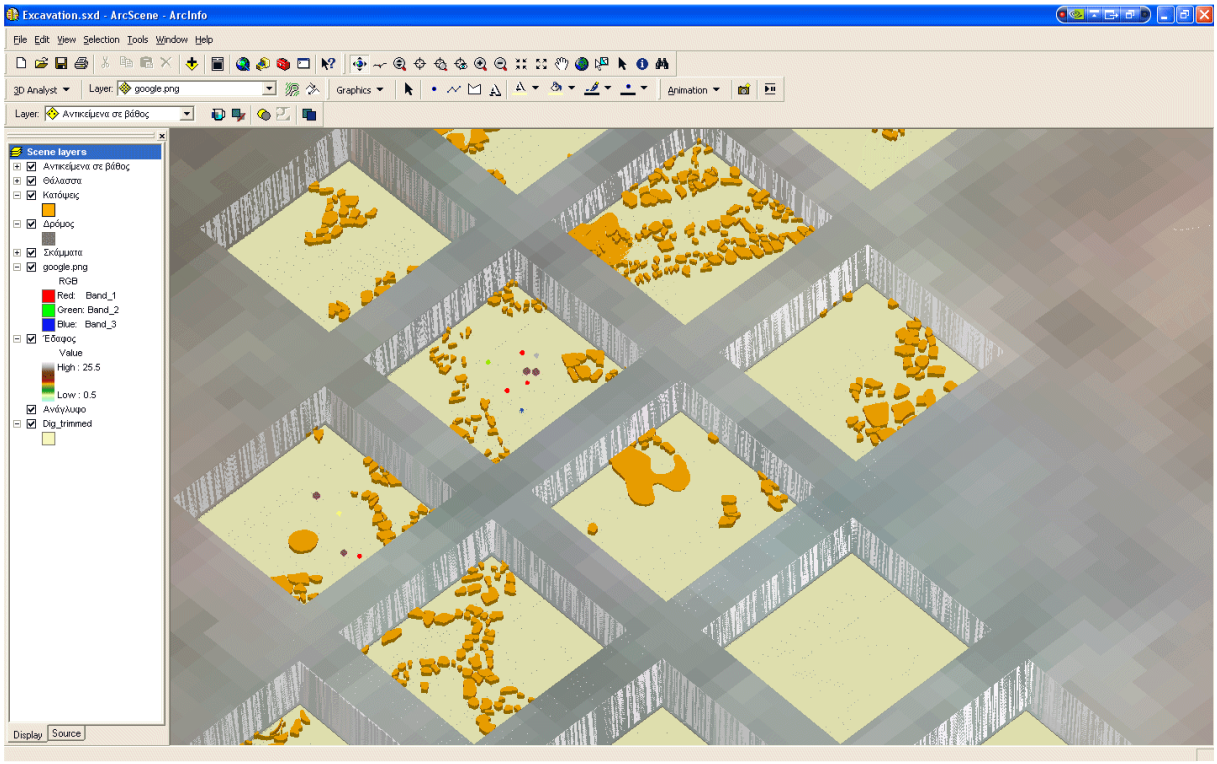

Figure 5. The 3D visualisation of the trenches along with the artifacts and the walls recovered

The trenches dug belong to a theoritical frame of trenches, not all of them yet dug. However the whole grid was digitised inside the GIS. Only the active trenches were "activated" inside the GIS and the rest remain "dormant" until the day they are dug. A simple change of the value of their depth, places them to the group of trenches dug. A zero value for field Z means that this trench is still intact. This simplifies the mainenance of the data for non experts. The 3D data are stored in GIS format and animated videos were created. In the future plans is included the creation of artifact-specific 3D symbols which will replace the standard 3D symbols of the software that were used for at first.

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