

COMPUTER MODELING IN ARCHAEOLOGY: THE CASE OF BRONZE AND IRON AGE MONUMENTAL CONSTRUCTIONS OF ARMENIA*

*Hayk Avetisyan, Artak Gnuni, Levon Mkrtchyan,
Arsen Bobokhyan*

Abstract

The given contribution is devoted to the problem of computer modeling in archaeology. The territory of the Republic of Armenia is chosen as a target zone for investigations, which is considered in the context of historical and cultural developments of the neighboring countries. The chronological range of the given study is the Bronze and Iron Ages (3rd-1st millennia BC). The principles of computer modeling are applicable to the investigation of monumental architecture (fortifications, towers, cairns, kites, kurgans, dolmens), aiming at reconstructing both the complexes of the monuments and the historical landscape.

Keywords: *Archaeology, Computer, GIS system, Bronze Age, Iron Age, Armenia, “Cyclopean” constructions, Artsakh, Syunik.*

The statement of the issue and the perspectives of the investigation

This research is dedicated to the study of the traditions of the earliest monumental architecture in the territory of the Republic of Armenia, which is considered in the context of similar constructions in neighboring regions. In chronological sense the research focuses on the Bronze and Iron Ages (from 3rd to the beginning of the 1st millennia BC), which reflects the Kura-Araxes, Trialeti as well as the Lchashen-Metsamor cultural traditions.

The choice of the research topic is conditioned by the actuality of the scientific issue. Particularly, this study implies a theoretical, historical-archaeological and fieldwork investigation of the monumental architecture and

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then, as a result of it, a practical modeling and reconstruction of the relevant constructions and landscapes, which became a dominant direction in the current archaeological investigations. The actuality of the project specifically for Armenia is conditioned by the fact that Armenian archaeological heritage has never been systematically studied from the viewpoint of computer modeling. Thus, the supposed topic acquires both scientific-academic and practical significance in the context of publicizing archaeological knowledge and museification of the results.

The study of the monumental architecture is one of the important issues of modern archaeology, allowing to ascertain numerous problems connected to the social-economic and spiritual-cultural developments of ancient societies. Specifically in our case, the appearance of similar structures is considered in a contact zone of the ancient world, where the interactions between the farming civilizations of the Near East with the Eurasian steppe dwellers took place. The earliest monumental constructions of Armenia are mentioned in the travel notes of previous centuries alluding to their richness¹. In particular, Tavernier mentions a powerful fortress on the slopes of Ararat². Taghiadian and Parrot were the first who described the monumental cemeteries on the top of L. Ararat³. Haxthausen describes monumental structures (alignment, kurgans, and tower) not far from Yerevan: perhaps in Yeghvard. He was one of the first to use the term cyclopean architecture⁴. Berger mentions the importance of investigation of Syunik and Vayots Dzor alignments⁵. But the scientific study of monumental architecture began only at the end of the 19th century⁶. During the past century numerous papers appeared, where both the separate units⁷

¹ **Srvandzteants** 1862–1863: 88.

² **Tavernier** 1678: 16–20.

³ **Parrot** 1990: 97–99, **Taghiadian** 1846: 104.

⁴ **Haxthausen** 1857: 215–217.

⁵ **Berger** 1874: 43

⁶ **Ivanovski** 1911; **Atrpet** 1914; **Kalantar** 1925; **Barkhudaryan** 1935; **Piotrovski, Gyuzalyan** 1933; **Piotrovski** 1949.

⁷ **Khazadryan** 1969, 1973, 1979; **Khachatryan** 1975; **Sardaryan** 1967, 2004; **Simonyan** 2013.

and the subzones of their spreading⁸ were discussed. The present literature creates opportunities for syntheses⁹. At the same time, essential acquisitions were attested in the study of monumental constructions of the Caucasus¹⁰, and especially that of the fortification systems.

During the last years, an attempt was made to summarize the available material on the one hand, and on the other hand, to put new materials into circulation. Significantly, since 1996 several dozens of monumental constructions (fortresses, towers, kites, cairns, alignments, cromlechs) were investigated in the territory of Armenia and Artsakh, particularly in the provinces of Aragatsotn, Shirak, Armavir, Vayots Dzor, Syunik, as well as Karvachar and Kashatagh regions. Separate cells of these constructions have been distinguished in different regions of Armenia: investigations allow us to consider several local-chronological versions. Aerial photographs of some monuments were realized, particularly in the southern regions of the Republic of Armenia and Artsakh. Preliminary mapping of the corresponding monuments of Armenia was realized by GIS system. The results of the mentioned investigations were partially published¹¹.

In spite of all this, numerous issues connected to the history of development of monumental structures still remain unsolved. Among them are:

The issue of origin of monumental constructions.

The issue of appearance, as well as socio-economic and political significance of the so-called “Cyclopean” constructions.

The issue of using various construction methods and techniques in different regions.

The extravert and intravert building of settlement cells, formation of separate fortified cells and their possible connections.

⁸ **Mikaelyan** 1968; **Khachatryan** 1975; **Esayan** 1976; **Biscione et al.** 2002; **Badalyan, Avetisyan** 2007; **Smith et al.** 2009; **Sanamyan** 2010.

⁹ **Areshyan et al.** 1996; **Kushnareva** 1996.

¹⁰ **Rasulogli** 1993; **Narimanashvili** 2009, **Reinhold** 2009.

¹¹ **Avetisyan et al.** 2014; **Avetisyan et al.** 2015a,b; **Avetisyan et al.** 2016; **Gnuni** 2010; **Gnuni, Khachatryan** 2010; **Gnuni et al.** 2011; **Gharibyan et al.** 2011; **Sargsyan et al.** 2014; **Avetisyan** 2012.

The issue of relations of monumental structures with the socio-economic and spiritual-cultic parts.

Ancient routes.

The issue of the relations of monumental constructions in different regions and their historical-cultural subtext.

Based on the above mentioned points the purposes of this investigation are:

To introduce the peculiarities of the monumental architecture of the Bronze and Iron Age Armenia in the context of synchronous Near Eastern and Caucasian regions, and to explain the paradigms of the existence or the absence of monumentalism in mountainous zones.

To separate and describe the types of monumental constructions in spatial and chronological context.

To consider the sphere of spreading of “Cyclopean” constructions, finding out the reasons of the origin of monumental way of thinking¹².

To describe the landscapes typical to the “Cyclopean” constructions, their natural and anthropogenic elements, comparing them with the examples of other regions, as well as, in accordance with this, and to map the fortresses and fortified settlements by using the GIS system.

To consider the monumental way of thinking in the context of historical and cultural relations and to visualize all this by the means of modern computer technologies.

The main purpose of such investigation is the modeling of the materials obtained by the archaeological research through three-dimensional images and videos. The need for modeling arises when the study of the object itself is difficult¹³. The graphic modeling of the archaeological objects aims at presenting to the public the history and the “trajectory” of development of the studied area and its features in a visible way¹⁴. Reconstruction and visualization of the historical units are perspective in the museum work, for

¹² For theoretical questions cf. **Trigger** 1990.

¹³ **Chernosvitov** 1989: 23.

¹⁴ **Chernosvitov** 1989: 23.

the development of tourism has a practical significance in the didactic-enlightenment field from the point of view of preservation of historical values and their dissemination. Important are in this context the graphic presentation of archaeological information facilitates, the process of getting acquainted with cultural values, giving a person the opportunity to acquire knowledge through bright. This is a modern method of being present in a virtual information system. Within this framework works are carried out in different regions of Armenia: Armavir (Haytagh, Arshaluys, Shresh Blur-Norakert), Aragatsotn (Ujan, Avan, Kosh, Voskehat, Shamiram, Parpi, Mughni, Lazaravan, Aragatsavan, Arteni), Kotayk (Kaputan, Oshakan, Aramus, Kamaris), Vayots Dzor (Spitak Kar, Kapuyt, Gomk), Syunik (Harzhis, Khoznavar) and Gegharkunik (Sotk, Artanish). The modeling of monumental architecture is a promising field of work, as it implies the possibility of large-scale reconstructions.

Working methods

In order to realize the mentioned steps the following methods are used:

The first stage of the study is the formulation of the problem and the study of the sources¹⁵, primarily cartographic ones. In this context, the method of studying the “Google earth” system with three-dimensional space photos is applicable. Suspicious points are compared with 1:25 000 and 1:50 000 topographic maps, supplemented by the information contained in them. The opposite process also takes place: the separate cemeteries, ruins, which are mostly abandoned villages or castles, are combined with space photos¹⁶.

Field surveys, documentation of monuments, if necessary, test trenchings, on the basis of which the constructive features of the structures and their components are to be theoretically defined.

Aerial photography of the monuments and their measurement. This method allows not only fixing the modern landscape and outlining the

¹⁵ Cf. **Kvirkveliya, Radilovski** 1994: 10.

¹⁶ **Sargsyan et al.** 2014: 150.

boundaries of large archaeological sites, but also it allows noticing the ancient riverbeds and irrigation systems¹⁷.

Classification, dating, drawing of the investigated objects.

Mapping of monuments by using GIS system with definition of landscape peculiarities¹⁸. A map is a mean of establishing patterns of distribution and relationship of archaeological complexes. In addition, archaeological maps are pivotal in solving issues of paleoecology and the relationship between humans and the environment¹⁹.

Preparing of available data for modeling.

As a result of working with the materials, renderings of models of constructions is created with different angles, from outside to inside: For getting 3D models Agisoft PhotoScan and Pix4Dmapper is applied, maps of altitudes are realized through Global Mapper, mapping and data base – through QGIS.

Based on the final processing of materials, appropriate three-dimensional models and videos are created.

Existing revisions are used in the final publications, enriching the scientific text, as well as in popularization of the material acquired.

Conclusion

Digital archaeology is a popular direction in today's world and such studies are being done in Armenia as well. However, these researches have never been systematic. The mentioned cooperation and the combination of the joint results increases the efficiency of research and representation, as well as creates a basis for applying the obtained images not only for scientific, but also for educational purposes. The results can be used to arouse interest among the public.

The result of the digital modeling of the archaeological monuments of Armenia will be composed of the catalogue of the monumental constructions of Armenia and a corresponding distribution map, modeling of the target

¹⁷ Doyel 1979: 15-17, 47-63; Avetisyan et al. 2019: 97.

¹⁸ Conolly, Lake 2006; Avetisyan et al. 2019: 97-98.

¹⁹ Lbova 1989: 181.

monuments and their landscapes and reconstruction of ancient routes. A work which aims at reconstructing the features of monumental constructions and introducing them in their landscape, historical and cultural context, while making the data available for the public by computer modeling has a great innovative potential.

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Hayk Avetisyan

Yerevan State University, Republic of Armenia

hykavetisyan@yahoo.com

Artak Gnuni

Yerevan State University, Republic of Armenia

uruatry@rambler.ru

Levon Mkrtyan

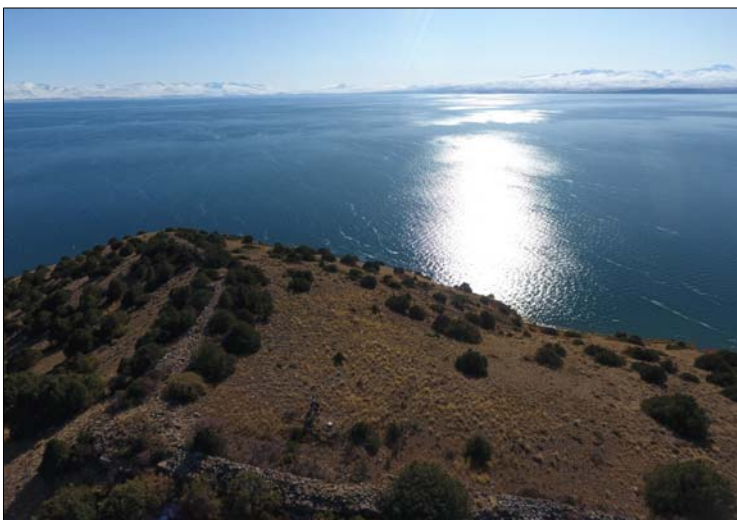
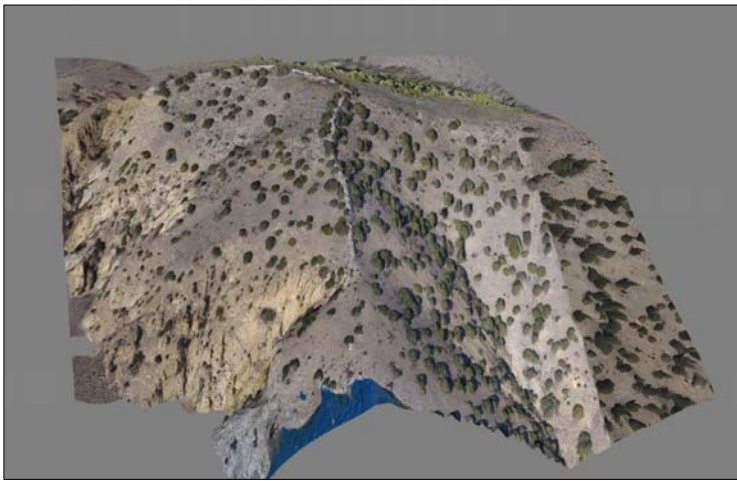
Yerevan State University, Republic of Armenia
levoncultur@gmail.com

Arsen Bobokhyan

arsenbobokhyan@yahoo.com
Yerevan State University, Republic of Armenia

Fig. 1. Preliminary example of computer modeling.

Air photo of Artanish peninsula fortress and its 3D/computer animation reconstruction



**ՀԱՄԱԿԱՐԳՉԱՅԻՆ ՄՈԴԵԼԱՎՈՐՈՒՄԸ ՀՆԱԳԻՏՈՒԹՅԱՆ ՄԵՋ.
ՀԱՅԱՍՏԱՆԻ ԲՐՈՆԶ-ԵՐԿԱԹԵԴԱՐՅԱՆ ԿՈԹՈՂԱՅԻՆ
ԿԱՌՈՒՅՑՆԵՐԻ ՕՐԻՆԱԿՈՎ**

*Հայկ Ավետիսյան, Արտակ Գնունի, Լևոն Մկրտչյան,
Արսեն Բոբոխյան*

Բանալի բառեր՝ Հնագիտություն, համակարգիչ, GIS համակարգ, Բրոնզի դար, Երկաթի դար, Հայաստան, «կիկլոպյան» կառույցներ, Արցախ, Սյունիք:

Ներկայացվող հոդվածը նվիրված է հնագիտության մեջ համակարգչային մոդելավորմանը: Որպես հետազոտության թիրախային գոտի է ընտրված Հայաստանի Հանրապետության տարածքը, որը դիտարկվում է հարակից երկրների պատմամշակութային զարգացումների համատեքստում: Հետազոտության ժամանակագրական սահմաններն ընդգրկում են բրոնզի և երկաթի դարաշրջանները (մ.թ.ա. III հազ. - I հազ. կես): Սույն հոդվածի շրջանակներում ներկայացվում են կոթողային ճարտարապետության հուշարձանների (ամրոցներ, աշտարակներ, դամբարանաթմբեր, դոլմեններ) համակարգչային մոդելավորման ու վերակազմության նպատակները և կարևորությունը: Աշխատանքի հիմնական խնդիրներն են.

1. ներկայացնել կոթողային ճարտարապետության առանձնահատկությունները,
2. բացատրել կոթողայնության առկայության և բացակայության պարադիգմները՝ լեռնային գոտիներում,
3. գատել և նկարագրել կոթողային կառույցների տիպերը՝ տարածական և ժամանակագրական կտրվածքով,
4. դիտարկել «կիկլոպյան» շինարարության տարածման տիրույթը՝ պարզելով կոթողային մտածելակերպի առաջացման պատճառները,
5. բնորոշել «կիկլոպյան» շինարարությանը բնորոշ լանդշաֆտը, դրա բնական և մարդածին բաղադրատարրերը՝ դրանք համադրելով այլ տարածքների օրինակների հետ,
6. ըստ այդմ՝ GIS համակարգի օգնությամբ քարտեզագրել համապատասխան հուշարձանները,

7. կոթողային մտածելակերպը դիտարկել պատմամշակութային փոխառնչությունների համատեքստում, և այս ամենը վերարտադրել թվային միջավայրում: