



## Exploring digital horizons: Bulgarian contributions to the Annual conference of Computer Applications and Quantitative Methods in Archaeology (CAA 2025 in Athens, Greece)

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Computer Applications and Quantitative Methods in Archaeology (CAA) (<https://caa-international.org/>) is an international organisation that has been bringing together archaeologists, mathematicians and computer scientists since the 1970s. Its main aims are to encourage communication between these disciplines, to provide a survey of current work in the field, and to stimulate discussion and future progress. CAA International has been organising annual meetings of its members for more than fifty years. It has grown into a large community of over one thousand scholars from around the world. Its members have established a dozen national CAA chapters and several special interest groups.

This year's conference – the 52<sup>nd</sup> consecutive edition, entitled “Digital Horizons: Embracing Heritage in an Evolving World” – took place from 5 to 9 May 2025 and was hosted by the University of West Attica in Athens, Greece. The scientific programme (<https://2025.caaconference.org/program/>) included twelve workshops on 5 May, fifty-two sessions with 425 papers and twenty-one posters, and two round tables between 6 and 8 May, followed by an excursion on 9 May. Over four hundred researchers, PhD students, postdoctoral scholars and software developers from more than forty countries participated, representing a wide range of expertise in archaeology, geography and computer science.

Large international conferences are never easy to organise. CAA 2025 faced a few challenges even before the event began, such as website issues – missing detailed information for workshops and problems with the payment of registration fees – all of which were resolved, but only after the announced deadlines. The exact conference venue was also unclear: although it was held at the University of West Attica, Campus Two, the links on the conference website and mobile application initially pointed to Campus One (a distance of about three kilometres). This problem was eventually corrected, but the “price” paid was that many attendees missed the morning workshop sessions on 5 May. Once the main conference began on 6 May, divided into numerous engaging parallel sessions, the earlier organisational shortcomings were soon forgotten.

The major topics of CAA 2025 could be summarised as follows: spatial and statistical analyses (including modelling settlement systems with a focus on road networks and landscape archaeology),



*Fig. 1. A. Grigorov at CAA 2025 in Athens presenting research on GIS-based modelling of ancient road networks, highlighting how spatial data can help trace routes connecting Roman settlements in Bulgaria (photo J. Tzvetkova)*

chronological modelling, remote sensing (lidar and drones), 2D and 3D documentation and visualisation, agent-based modelling, artificial intelligence (AI) applications (including robotics), open science practices, and FAIR principles. The common practice for coordinators of EU-funded projects under different research infrastructures and networks (for example, Horizon Europe and COST Actions) to organise sessions at international conferences was also evident at CAA 2025 (for instance, the DARIAH and ARIADNE session 19, and COST Action CA22145 – Computational Techniques for Tabletop Games Heritage (GameTable) session 49).

Fifty-two sessions is quite a large number for two and a half days (excluding the welcome session). Many had similar focuses, which made attendees “run” from session to session in order to hear particular presentations of interest that were scheduled in different rooms. Preliminary preparation by exploring and bookmarking presentation topics in the mobile app was essential and extremely helpful. The keynote speaker of the welcome session addressed the topic of AI (particularly Large Language Models – LLMs) for cultural heritage purposes. The talk itself was somewhat technical and longer than necessary, but it nevertheless highlighted the direction in which archaeological research is heading – towards the use of AI in as many ways as possible, especially for summarising and extracting structured data from large bodies of historical narratives.

Bulgarian involvement in CAA 2025 was considerably greater than in previous years<sup>1</sup>. It included participation<sup>2</sup> in five sessions with three standard oral presentations (papers) and two posters. Projects from the National Archaeological Institute with Museum at the Bulgarian Academy of Sci-

1 N. Kecheva presented two co-authored papers at CAA 2019 in Kraków, Poland – Archaeological Map of Bulgaria in ARIADNE and ARIADNEplus and Enough paperforms – a web and a mobile app for GIS-based field surveys in Bulgaria (<https://2019.caaconference.org/program/>), where a test version of the GIS-based Archaeological Map of Bulgaria was demonstrated (<https://akb.naim.bg>).

2 Also present at the conference, in addition to the two authors of this paper, were Georgi Nekhrizov (NAIM-BAS), Julia Tzvetkova and Lily Grozdanova (Sofia University “St Kliment Ohridski”), and Miglena Raykovska (Institute of Information and Communication Technologies, Bulgarian Academy of Sciences).



*Fig. 2. N. Kecheva at CAA 2025 in Athens presenting a paper on spatial statistics and point process modelling of Early Iron Age sites in Southeastern Bulgaria, sharing new insights into landscape patterns and archaeological survey data (photo A. Grigorov)*

ences (NAIM–BAS), particularly from the Department of Interdisciplinary Research and Archaeological Map of Bulgaria, were primarily represented (for a detailed list of sessions and topics of the Bulgarian researchers, see below). The themes of the papers fell within the main topic of spatial and statistical analyses, with two focusing on historical GIS-based spatial modelling and modelling road networks between archaeological sites (A. Grigorov) (fig. 1), and one on spatial statistics and specifically point process modelling in a defined region (N. Kecheva) (fig. 2). The latter research was financed by Project no. KII-06-H80/6 (2023), “Gluhite Kamani Research Project: Interdisciplinary Research on the Early Iron Age in Thrace”, funded by the Bulgarian National Science Fund (BNSF). One of the posters presented another project funded by the BNSF (Project no. KII-06-H80/7, 2023), “Upgrading the Historical Narrative: From Deultum to DigiDeultum” (fig. 3).

All three papers, that fitted well into their sessions, were presented engagingly and generated interest among attendees. Fruitful discussions arose mainly during coffee breaks, while meeting colleagues with similar research interests from around the world. We were particularly concerned with discussing possibilities for improving road network analysis and addressing chronological uncertainty when dealing with archaeological data covering long time spans. Unfortunately, there is still no robust method for handling the latter issue, and the lack of sufficient data and consistency often forces researchers to work with archaeological time-span data simultaneously, without assigning probabilities of existence to individual sites.

Based on our research interests, we found many fascinating papers – from those on modelling road networks through spatial statistics and addressing uncertainty, to robotics and AI applications in archaeology. Some of the sessions we attended included:

- S6: Model-Driven Urban Archaeology;
- S8: Digital lifescapes: using multi-scalar approaches to map, model and reimagine urbanism, settlement and landscapes in archaeology;
- S14: Advances in modelling past human ecosystems;
- S20: “Scaling Heights”: Unveiling Mountainous Landscapes Through Interdisciplinary Survey Strategies, Quantitative Modelling and Computational Methods;



*Fig. 3. L. Grozdanova at CAA 2025 in Athens standing beside the poster “From Deultum to DigiDeultum: Upgrading the Historical Narrative by Connecting Diverse Sources”, part of a collaborative Bulgarian project showcased (photo A. Grigorov)*

S28: Follow Rivers: the application of advanced remote sensing, machine learning and modelling in the studies of water management of past societies;

S32: Connected Landscapes: Digital and Quantitative Methods for Landscape Archaeology;

S35: Mapping and modelling movement in archaeology: From least cost analysis to diffusion pathways;

S37: Computational and Landscape Archaeology in the renovation of surface survey methodologies;

S40: MuVAMoLa – Multivariate Approaches to Mortuary Landscapes;

S50: Exploring the Nexus of Robotics and Archaeology: Unveiling the Potential, contribution and Ethical Dimensions in different research fields.

In keeping with tradition, the final day of the conference was dedicated to an excursion. Participants were offered two alternative destinations: Marathon or Cape Sounion. This concluding activity provided an opportunity for cultural engagement and informal scholarly interaction, marking the unofficial closure of the conference.

As a concluding note on our pleasant stay in Athens, and as an addition to the Bulgarian participation in the forum, we would like to acknowledge our meeting with Dr Denitsa Nenova (CEO of Takin.solutions Ltd) – a fellow Bulgarian archaeologist and, above all, a good friend – who has been successfully working in the field of digital archaeology in Athens for many years.

The annual CAA conference remains one of the most significant and high-level scientific events in the field of archaeology and digital methodologies. Its interdisciplinary scope, international participation, and emphasis on innovation make it a key event for researchers working at the inter-

section of archaeology, computing, and data science. CAA continues to be an important platform for exchanging knowledge, presenting new work, and staying connected with current developments in archaeological research. Direct person-to-person communication remains vital for future opportunities in knowledge and know-how exchange.

The 52<sup>nd</sup> edition in Athens demonstrated both the strengths and the challenges of organising such a large-scale academic gathering. While the scientific content and networking opportunities were of a high standard, certain logistical issues reminded us that clarity and appropriate organisation are essential, especially for events of this scale.

Nevertheless, the benefits far outweighed the shortcomings. For the Bulgarian participants, this year's conference marked a stronger presence, reflecting a growing interest in digital approaches within our academic circles. We hope that at future CAA conferences, more and more Bulgarian archaeologists, cultural heritage researchers, and computer science specialists will take an active role, helping to lay the foundations for the possible establishment of a CAA National Chapter Bulgaria.

See you at CAA 2026 in Vienna, Austria!

### Bulgarian contributors to CAA 2025 (3 papers and 2 posters in 5 sessions):

#### **Papers:**

Session 32: Connected Landscapes: Digital and Quantitative Methods for Landscape Archaeology

Angel Grigorov: Mapping the Lost City: Using Historical Texts and GIS to Rediscover Aqr-nus.

Session 08: Digital Lifescapes: Using Multi-Scalar Approaches to Map, Model, and Reimagine Urbanism, Settlement, and Landscapes in Archaeology

Ivo Cholakov, Angel Grigorov, Plamena Dakasheva: All Roads Lead to... Deultum! Case Study of the Ancient Road Network in the Area of the Roman Colony of Deultum.

Session 20: "Scaling Heights": Unveiling Mountainous Landscapes Through Interdisciplinary Survey Strategies, Quantitative Modelling and Computational Methods

Georgi Nekhrizov, Julia Tzvetkova, Veronika Gencheva, Nadezhda Kecheva: Mountains in Scales: Point Process Models of Early Iron Age Sites in Southeastern Bulgaria.

#### **Posters:**

Session 17: Comparing the Incomparable: Managing and Analyzing Data from Heterogeneous Sources in Archaeological Research

Lily Grozdanova, Dilyana Boteva-Boyanova, Nikolay Dimitrov, Hristina Ivanova-Anaplioti, Krasimira Kostova, Emil Dakashev: From Deultum to DigiDeultum: Upgrading the Historical Narrative by Connecting Diverse Sources.

Session 53: Not Just Pretty Pictures: Utilizing 3D Scans for Precise Data Collection in Archaeology

Mirvana Raykovska, Miglena Stamberova, Nikolay Petkov, Miglena Raykovska, Kristen Jones, Slava Vasileva: Digital Insights into Ancient Artefacts: Investigating Ceramic Vessels for Perfumed Oil from Ancient Thrace.