Στην παράθεση που ακολουθεί, οι εργασίες δίδονται ολόκληρες είτε πρόκειται για δημοσιεύσεις σε διεθνή περιοδικά και πρακτικά διεθνών συνεδρίων ή είναι περιλήψεις παρουσιάσεων σε διεθνή συνέδρια. Για λόγους οικονομίας χώρου αλλά και πρακτικότητας δεν παρατίθενται ολόκληροι οι τόμοι των περιοδικών ή των πρακτικών των συνεδρίων αλλά μόνο τα σχετικά αποσπάσματα. Όμως, αν πρόκειται για διεθνές συνέδριο παρατίθεται το πρόγραμμα του συνεδρίου. Στις περιπτώσεις όπου τα συνέδρια είναι πολύ μεγάλα και πολυθεματικά, με πολλές παράλληλες συνεδρίες, τότε παρατίθεται μόνο το πρόγραμμα των σχετικών συνεδριών (sessions).

Ακολουθείται χρονολογική παράθεση των εργασιών και των ανακοινώσεων.

Προκαταρκτικό Πρόγραμμα

Πέμπτη, 8 Οκτωβρίου

13:00 – 14:00 Εγγραφή, Γεύμα
14:00 – 16:00 Συνεδρία I
16:00 – 16:30 Καφές
16:30 – 18:30 Συνεδρία II

Παρασκευή, 9 Οκτωβρίου

9:00 – 11:00 Συνεδρία III
11:00 – 11:30 Καφές
11:30 – 13:30 Συνεδρία IV
13:30 – 14:30 Γεύμα
14:30 – 15:30 Συνεδρία Αφίσας
15:30 – 16:00 Καφές
16:00 – 18:00 Συνεδρία V
18:00 – 18:30 Κλείσιμο

Σάββατο, 10 Οκτωβρίου
11:00–13:00 Ξενάγηση στον Αρχαιολογικό χώρο Α. Μεσσήνης

Εγγραφή: 80 ευρώ (κανονική), 50 ευρώ (φοιτητική)
Περιλαμβάνει τον φάκελο συνέδρου, διαλείμματα καφέ, γεύματα, ξεναγήσεις, έκδοση πρακτικών.

Παρέχεται η δυνατότητα **εξ αποστάσεως παρουσίασης.**

Όποιος επιθυμεί να παρουσιάσει εργασία, πρέπει να υποβάλει ηλεκτρονικά περίληψη της εργασίας μέχρι τις **30 Αυγούστου**, χρησιμοποιώντας το σχετικό αρχείο το οποίο υπάρχει αναρτημένο στην ιστοσελίδα http://www.laboratoryarchaeometry.gr/symposia.html

Όλες οι περιλήψεις θα κριθούν από την Επιστημονική Επιτροπή. Κατόπιν αξιολόγησης και με βάση την ποιότητα και την πρωτοτυπία των εργασιών, θα παρουσιαστούν είτε ως προφορικές ανακοινώσεις, είτε με τη μορφή αφίσας. Όλες οι εργασίες μπορούν να υποβληθούν για να συμπεριληφθούν, κατόπιν κρίσης, σε Τόμο των **Εκδόσεων του Πανεπιστημίου Πελοποννήσου**.

Συνδιοργάνωση:
Περιφέρεια Πελοποννήσου
Δήμος Καλαμάτας

Με τη συνεργασία του
ΜΠΣ CultTech

CultTech MSc in Cultural Heritage Materials & Technologies

Εργαστήριο Αρχαιομετρίας
Πανεπιστήμιο Πελοποννήσου

6ο Συμπόσιο ARCH_RNT
Αρχαιολογική Έρευνα και Νέες Τεχνολογίες

8 – 9 Οκτωβρίου, 2020

Το Συμπόσιο εστιάζει στη χρήση των ***Νέων Τεχνολογιών*** στην ***Αρχαιολογική Έρευνα*** *(Αρχαιομετρία, Υπολογιστικά Συστήματα, Συντήρηση και Αποκατάσταση)* με έμφαση στην παρουσίαση ολοκληρωμένων διεπιστημονικών προσεγγίσεων, ειδικών εφαρμογών και πρωτότυπων μελετών σε αρχαιολογικά υλικά.

Ειδική Θεματική Συνεδρία:

ΤΕΧΝΗΤΗ ΝΟΗΜΟΣΥΝΗ ΣΤΗΝ ΠΟΛΙΤΙΣΤΙΚΗ ΚΛΗΡΟΝΟΜΙΑ

Καλωσορίζοντας τη συμμετοχή σας!

Επιστημονική Επιτροπή
Ν. Ζαχαριάς (Παν. Πελοποννήσου), Μ. Ξανθοπούλου (Παν. Πελοποννήσου), Β. Κυλίκογλου (ΕΚΕΦΕ Δημόκριτος), Α. Καρύδας (ΕΚΕΦΕ Δημόκριτος), Α. Αντωνίου (ΠΑΔΑ), Ε. Γερασόπουλος (ΕΑΑ), Ν. Μιχαλόπουλος (ΕΑΑ), Κ. Βασιλάκης (Παν. Πελοποννήσου)

Οργανωτική Επιτροπή
Ν. Ζαχαριάς, Ε. Παλαμάρα, Γ. Μαλαπέρδας, Ε. Κυριαζή, Β. Βαλάντου, Β. Παναγιωτίδη,Β. Μητσοπούλου, Ν. Κλαδούρη, Ε. Τριανταφυλλίδη, Β. Κατσίχτη

Laboratory of Archaeometry
University of the Peloponnese

6th ARCH_RNT Symposium
Archaeological Research and New Technologies

8 – 9 October, 2020

The Symposium focuses on the use of New Technologies in the Archaeological Research *(Archaeometry, Computing Technology, Conservation and Restoration)* notably with the presentation of interdisciplinary approaches, special case studies and research on archaeological material and assemblages.

Special Topic:

ARTIFICIAL INTELLIGENCE IN CULTURAL HERITAGE

Your participation and contribution are most welcome!

Scientific Committee

N. Zacharias (Univ. Peloponnese), M. Xanthopoulou (Univ. Peloponnese), V. Kilikoglou (NCSR Demokritos), A. Karydas (NCSR Demokritos), A. Antoniou (Univ. West Attica), E. Gerasopoulos (NOA), N. Michalopoulos (NOA), C. Vasilakis (Univ. Peloponnese)

Organizing Committee

N. Zacharias, E. Palamara, G. Malaperdas, E. Kyriazi, V. Valantou, V. Panagiotidis, V. Miitsopoulou, N. Kladouri, E. Triantafyllidi, V. Katsichti

Preliminary Programme

Thursday, 8 October

13:00 – 14:00 Registration, Lunch break
14:00 – 16:00 Session I
16:00 – 16:30 Coffee break
16:30 – 18:30 Session II

Friday, 9 October

9:00 – 11:00 Session III
11:00 – 11:30 Coffee break
11:30 – 13:30 Session IV
13:30 – 14:30 Lunch break
14:30 – 15:30 Poster session
15:30 – 16:00 Coffee break
16:00 – 18:00 Session V
18:00 – 18:30 Closing remarks

Saturday, 10 October

11:00–13:00 Ancient Messene Guided Tour

Registration: 80 euro (regular), 50 euro (student)
Includes participant bag, coffee and lunch breaks, guided tours, proceedings publication.

Online presentation options are available.

Abstracts must be submitted electronically by **August 30**, using the template given on the web page
http://www.laboratoryarchaeometry.gr/symposia.html

All submissions will be reviewed by the members of the Scientific Committee. Presentations will be given either as oral or poster communications depending on the reviewers' decision, based on quality and originality. All presentations will be eligible for publication in the Symposium Proceedings (University of the Peloponnese Press) after peer-review.

Co-Organization:
Prefecture of Peloponnese
Kalamata Municipality

In collaboration with
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CultTech
MSc in Cultural Heritage Materials & Technologies

6th ARCH_RNT
Archaeological Research & New Technologies

8-9 OCTOBER 2020, KALAMATA

SYMPOSIUM PROGRAMME

	Thursday, October 8
15:00 - 15:45	Registration
15:45 - 16:00	Welcoming Remarks and Opening Ceremony
16:00 - 17:40	***SESSION 1***
16:00 - 16.20	(O-1) Cosmos. Cultural Osmosis - mythology & art. Cultural heritage data correlations with AI (S.C.A. Thomopoulos, P. Tsimpiridis, I. Theodorou, C. Maroglou, S. Georgiou and C. Christopoulou)
16:20 - 16:40	(O-2) The pre-emerging technologies of byzantine monumental art (K. Karoussos)
16:40 - 17:00	(O-3) Digital Mapping and 3D Geovisualization in Cultural Heritage. The Ancient Pylos case study (G. Malaperdas and N. Zacharias)
17:00 - 17:20	(O-4) The Byzantine city of Mystras: The Monastery of Pantanassa (V. Panagiotidis, V. Valantou and N. Zacharias)
17:20 - 17:40	(O-5) Integrated scientific approach for the diagnosis and restoration of the catholicon and cell quarters of the Varnakova Monastery in Fokida (V. Keramidas, E.T. Delegou, M. Apostolopoulou, I. Ntoutsi, M. Thoma, C. Michalaros, C. Papatrechas, C. Mouzakis and A. Moropoulou)
17:40 - 18:10	Coffee Break
18:10 - 19:50	***SESSION 2***
18:10 - 18:30	(O-6) Combined geochemical and luminescence analysis for reconstructing the use history of agricultural terraces (D. Fallu, A. Brown, S. Cucchiaro, P. Tarolli, L. Snape and A. Lang)
18:30 - 18:50	(O-7) ^{18}O & ^{16}O in archaeological obsidian: Preliminary results and a case study from Delphi (N. Laskaris and I. Liritzis)
18:50 - 19:10	(O-8) The Hiera Eruption (197 BC) of Santorini: First evidence in speleothem archives (K. Theodorakopoulou, K. Kyriakopoulos and E. Galanopoulos)
19:10 - 19:30	(O-9) Old stories and new technologies in Yellow River and Aegean disaster archaeology (A. Westra)
19:30 - 19:50	(O-10) TA-OSL, a tool for extending the luminescence age limits beyond 1 million years; preliminary results from a number of sites (G.S. Polymeris)
20:00	Welcome Cocktail at the Campus of the University of the Peloponnese

	Friday, October 9
9:30 - 11:10	***SESSION 3***
09:30 - 09:50	(O-11) Exploring biological affinities in Bronze Age Pylos (C. Papadopoulos and J.D. Irish)
09:50 - 10:10	(O-12) Η επίδραση της UV ακτινοβολίας σε μεταξωτά υφάσματα βαμμένα με φυσικές βαφές (Α. Βασιλειάδου, Ι. Καραπαναγιώτης και Α.-Σ. Ζώτου)
10:10 - 10:30	(O-13) Waterlogged archaeological charred wood: Implications for its condition assessment and future conservation (E. Mitsi and A. Pournou)
10:30 - 10:50	(O-14) Data fusion: The art of putting all data sets together (A. Karamitrou, G.N. Tsokas and G. Didaskalou)
10:50 - 11:10	(O-15) Image fusion of the geophysical and other data at the site bearing the ruins of ancient Europos (G. Tsokas, A. Stampolidis, A. Karamitrou, G. Stratouli, K. Chavanidis, P. Tsourlos, G. Vargemezis, P. Louvaris, K. Polydoropoulos and N. Kordatos)
11:10 -11:30	***TECHNICAL SESSION*** "Modelling Reality", Tree Company Corporation
11:30 - 12:00	Coffee Break
12:00 - 13:00	***SESSION 4***
12:00 - 12:20	(O-16) The painting materials & techniques of a post-byzantine icon: A Scanning XRF investigation (A. Asvestas, I. Liougos, G.P. Mastrotheodoros, A. Tzima, K.G. Beltsios and D.F. Anagnostopoulos)
12:20 - 12:40	(O-17) Preliminary results of an integrated study on a western religious canvas painting from the series of the station of the cross (S. Kesidis, A.G. Karydas, N. Zacharias and E. Kouloumpi)
12:40 - 13:00	(O-18) Applying SEM-Cathodoluminescence in paintings: Building a database for the characterization of organic and inorganic pigments (E. Palamara, P.P. Das, S. Nicolopoulos, L. Tormo Cifuente, E. Kouloumpi and N. Zacharias)
13:00 - 14:00	***CULTTECH MSc PRESENTATION***
14:00 - 14:30	Lunch Break
14:30 - 15:30	***POSTER SESSION***
15:30 - 16:40	***SESSION 5***
15:30 - 15:50	(O-19) Development of multi-functional restoration mortars for safeguarding architectural monuments – The "AKEISTHAI" approach (I. Karatasios, M. Amenta, A. Michalopoulou, N.D. Alexopoulos, S. Papaioannou, G. Asimakopoulos, D. Gournis and V. Kilikoglou)
15:50 - 16:10	(O-20) Glass technology from the Mycenaeans to the 1st millennium BC: Continuity or change? (M. Kaparou and A. Oikonomou)
16:10 - 16:30	(O-21) Preliminary investigation of an archaic bronze double axe from the cemetery of Paleron Delta, Attica (A. Panagopoulou, S. Chryssoulaki, A.G. Karydas and N. Zacharias)
16:30 - 16:50	(O-22) Η εφαρμογή της φασματοσκοπίας φθορισμού με μικροδέσμη ακτίνων Χ (micro-XRF) στη μελέτη των μεταλλικών τέχνεργων τεσσάρων ιερών της Τεγεάτιδας ($10^{ος}$-$7^{ος}$ αιώνας π.Χ.) (Ν.Κ. Κλαδούρη, Α.Γ. Καρύδας, Β. Ορφανού, Β. Κανταρέλου και Ν. Ζαχαριάς)
16:50 - 17:00	***Closing remarks***

POSTER SESSION

P-1. The use of earth observation in adressing cultural heritage issues
(G. Vlachos and E. Gerasopoulos)

P-2. Thermoluminescence dating of limestone walls from Ithaca (School of Homer)
(A.Vafiadou, G.S. Polymeris, G. Kitis and I. Liritzis)

P-3. Technological and chronological study of mortar samples from Varnakova Monastery in Fokida
(N. Zacharias, P. Moska, K. Triantafyllopoulos, E.T. Delegou, M. Apostolopoulou, A. Karydas and A. Moropoulou)

P-4. Non-destructive analysis in paintings of the Church Agia Trida Volos
(K. Romantzi, Th. Ganetsos , D. Giakoumi and St. Mouzakiotou)

P-5. Non-destructive investigation of inks & pigments of manuscripts from Zakynthos Island, Greece
(G.P. Mastrotheodoros, M. Theodosis, K.G. Beltsios and E. Filippaki)

P-6. Varnish recipes in post-Byzantine painting manuals
(G.P. Mastrotheodoros and K.G. Beltsios)

P-7. Petrographic analysis of pottery samples from Mycenaean Thebes
(V. Valantou, N. Zacharias, V. Aravantinos and I. Fappas)

P-8. Scientific enquiry of pottery provenancing and production in Zimbabwean archaeology: A critical review
(T. Tavingeyi)

P-9. XRF Analysis of 16 Messenean coins: An archaeometric approach of the Messenean Hellenistic and Roman bronze alloy
(A. Kampa, E. Palamara and N. Zacharias)

(P-10) EDXRF analysis of Rare Earth Elements in archaeological ceramics: Development and validation of the method
(A.P. Panagopoulou, K. Tsampa, St. Papagiannis, K. Eleftheriadis, A. Hein and A. Karydas)

DATA FUSION: THE ART OF PUTTING ALL DATA SETS TOGETHER

A. KARAMITROU[1], G.N.TSOKAS[1] and G. DIDASKALOU[3]

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[3]Department of Dynamic, Tectonic and Applied Geology, Faculty of Geology and Geoenvironment ,
National & Kapodistrian University of Athens

Introduction: It is common practice nowadays that various geophysical or other type data may have been produced during the investigations at an archaeological site. It is also commonly admitted on the other hand that joint interpretation of them comprises a difficult task requiring not only experience and expertise, but also special protocols and mathematical algorithms. In any case, this task of extracting the useful information from each separate data set and put it all together is called "data fusion" or "data integration".
Protocols and algorithms for integration (fusion) of data sets have been developed and implemented by the exploration Geophysics Laboratory of the Aristotle University of Thessaloniki and they are presented here. Further, an ambitious schedule of introducing new more effective and reliable ones is currently implemented. The outlines of this effort are also presented here.
The merits and drawbacks of data fusion are demonstrated by some examples.

Data sets from archaeological sites and fusion: Data integration (fusion) can be viewed in various ways: "It could be done between attributes of the same data set; between geophysical data acquired by various sensors; between one or more kinds of geophysical data and aerial and/or satellite imagery; and so on (Kvamme et al, 2018). Perhaps other data sets may be available like Lidar, drawings of the ground view of visible antiquities, archaeological surface collections of sherds or other items, archaeological notes, geochemical analyses and PXRF data.
The aim is to extract the useful information provided by each separate data set. Thus, finally to produce images resembling the ground view that could be possibly drawn if excavation is carried out in the future.

Data fusion algorithms and protocols: Some of the existing image fusion algorithms that were custom built by the Exploration Lab of the Aristotle University of Thessaloniki (Karamitrou, 2013; Karamitrou et al., 2011; 2013, 2014, 2017, 2019), are currently under improvement. New ones will be developed to cope with various kinds of data obtained using modern instrumentation and imagery. Initially, curvelet-based fusion algorithms that have been developed will be used to explore the available remote sensing and geophysical data and will help obtaining better interpretations about possible archaeological structures. This will also serve as a comparison base for performing quantitative assessment of the performance of newer fusion techniques that will be developed at the subsequent stage of the project. More specifically, we plan to investigate novel region-based fusion rules and furthermore to implement newly available powerful machinery based upon the sparse representation theory and the joint sparsity model which represents fused images as the sum of common and complementary components, and provides significant advantages in fusing multimodal images in the presence of noise.

Fusing data in Maronia: In this case study from the archaeological site of Maronia, the pixel-level image fusion technique was applied, based on the curvelet transform of the two initial images, a magnetic image (Figure1A) and an apparent resistivity image (Figure1B). The final fused image (Figure1C) derived from in the curvelet domain using the maximum frequency rule i.e., by comparing the amplitude of the corresponding coefficients of the starting images and selecting the one with the maximum amplitude. Moreover, prior information about the general orientation and size of the targets was also exploited by selectively amplifying features along these orientations and scales. Features that were elusive or indistinguishable in the initial images, became apparent at the fused image, significantly improving the interpretation (Karamitrou 2013; Karamitrou & Tsokas, 2014; Karamitrou et al., 2019).

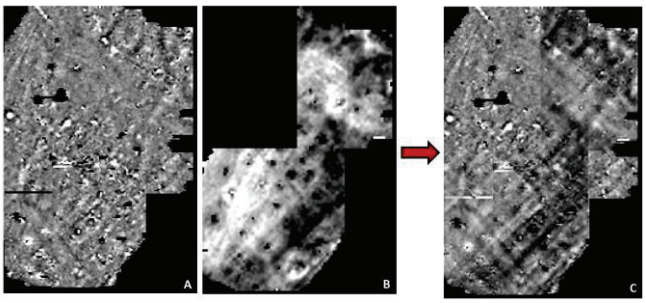

Figure 1: *(A) Magnetic image (vertical gradient of the local magnetic field) (B) apparent resistivity image and (C) fused image with the use of the curvelet transformation method giving emphasis at north-east to north-west orientation.(Karamitrou 2013;Karamitrou & Tsokas, 2014;Karamitrou et al., 2019).*

Conclusions: Data fusion offers a high potential for the multimethod approach in maximizing the obtained information and increasing the reliability of the interpretation.

Acknowledgement:
This work was carried out in the framework of the research project EKATY (Innovative imaging of the subsurface of archaeological sites and the interior of structural elements of monuments in 3 and 4 Dimensions). The project is under the code T6YBΠ-00211 in the framework of the Operational Program "Competitiveness, Entrepreneurship & Innovation" (EPAnEK)Operational Programme Competitiveness, Entrepreneurship and Innovation 2014-2020 (EPAnEK) funded after the decision 97476/I2/18-06-2019 (ΑΔΑ: ΩΕ1Ω4653ΠΣ-ΒΑΓ) of the Greek General Secretariat for Research and Technology.

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UNIVERSITY OF THE PELOPONNESE

6th ARCH_RNT
Archaeological Research and New Technologies

IMAGE FUSION OF THE GEOPHYSICAL AND OTHER DATA AT THE SITE BEARING THE RUINS OF ANCIENT EUROPOS

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[1]Laboratory of Exploration Geophysics, Aristotle University of Thessaloniki, Greece ,
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Introduction: The city of Europos was located in ancient Macedonia, in an area of Northern Greece, at a distance of 1-kilometer NW of the modern Europos village. The city was the birthplace of Seleucus I Nikator, the founder of the Seleucid Empire of the Hellenistic period. Nowadays, ruins of this ancient city can be observed in place, since archaeological excavations have brought to light a part of its Acropolis, a graveyard and workshops, where several pottery kilns can be, also, spotted. At the age of its former glory, Europos was located closer to the sea than today, but the ongoing propagation of Axios and Aliakmon deltas during the Holocene period, in combination with epeinogenic movements, caused the gradual sea regression and the alteration of the city from a trade center to an agricultural community.

The contribution of Europos on the development of the civilization of the Hellenistic period and its significance as a trade center in ancient Macedonia can be inferred from a number of historical sources and references. Hence, knowledge that might arise from new archaeological and geophysical explorations can be proved of crucial importance on our understanding of the city's historical role.

Geophysical and other Investigations in ancient Europos: The aim of the research is to image the subsurface vestiges and other antique structures in order to understand the urban organization of ancient Europos. Also, to detect bits of land concealing antiquities that have not been located until now. To accomplish these tasks, firstly the geophysical data that have been acquired during previous surveys (Sarris, 1992; Tsokas et al., 1994; Tsokas et al., 1994; Diamanti et al., 2005) were revisited. This approach was followed for the areas of the Acropolis and the workshops. These data include measurements of the total magnetic field and of the vertical gradient from gradiometers, and measurements of electric resistivity, which were used for resistivity mapping. Further, new surveys were carried out at the foothills of the topographic table where Europos stood once upon a time. Finally, the geophysical data were implemented by satellite images.

Data integration: At first, the different data sets were processed and interpreted independently. Next, increase of the information content was attempted, using data integration (fusion) techniques (Karamitrou et al. 2020). The newly created fused images provided a good insight on the distribution of buried antiquities in Europos area giving a more complete presentation of the archaeological structures.

Acknowledgement:
This work was carried out in the framework of the research project EKATY (Innovative imaging of the subsurface of archaeological sites and the interior of structural elements of monuments in 3 and 4 Dimensions). The project is under the code Τ6ΥΒΠ-00211 in the framework of the Operational Program "Competitiveness, Entrepreneurship & Innovation" (EPAnEK)Operational Programme Competitiveness, Entrepreneurship and Innovation 2014-2020 (EPAnEK) funded after the decision 97476/Ι2/18-06-2019 (ΑΔΑ: ΩΕ1Ω4653ΠΣ-ΒΑΓ) of the Greek General Secretariat for Research and Technology.

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GENERAL INFO > SCOPE OF THE CONFERENCE

The conference aims to provide a forum for the presentation and discussion of latest developments and cutting-edge research in the field of archaeological prospection. It shall cover the entire spectrum of methodology and technology applied to the detection, localization and investigation of buried cultural heritage (aerial photography, airborne laser scanning, hyperspectral imaging, near-surface geophysics, data processing, visualization and archaeological interpretation).

Five sessions will be held:

- Case studies and archaeological feedback
- Methods and innovations
- Environmental studies and landscape evolution
- Processing and visualisation of data
- **Special session**: Spatial analysis and aerial remote sensing

The special session will be devoted to experimental, innovative or original approaches of spatial analysis and modeling in archeology or geo-archeology, in the diversity of scales, data or methods used. The objective is the dissemination of these approaches, their potential reuse or their adaptation to different topics or contexts.

Wednesday, September 8, 2021

TIME	EVENT
09:00 - 09:15	Conference introduction
09:15 - 10:15	Archaeology in Lyon and its neighborhood
10:15 - 11:45	Poster session
11:45 - 13:00	Case Studies and archaeological feedback
11:45 - 12:00	› Geophysical survey at Mount Pleasant Henge - *Neil Linfor, Paul Linford, Andrew Payne*
12:00 - 12:15	› Magnetic and EMI prospection in a disturbed environment: the case of the Saint Brice/ Ecouen (Val d'Oise, France) pottery workshop. - *Michel Dabas, Rémy Guadagnin, Lambert Danièle, Alain Tabbagh, Julien Thiesson*
12:15 - 12:30	› Multidisciplinary investigation of the pit circuit at Durrington Walls, UK - *Chris Gaffney, Vincent Gaffney, Eamonn Baldwin, Martin Bates*
12:30 - 12:45	› Geophysical and archaeological survey of the Alanic barrow cemeteries in the Northern Caucasus (Russia) - *Dmitry Korobov, Vladimir Malashev, Jörg Fassbinder*
12:45 - 13:00	› Recent geophysical data regarding the broad planimetric diversity of Cucuteni Aarchaeological sites from Ne Romania - *Andrei Asăndulesei, Felix-Adrian Tencariu, Radu-Stefan Balaur, Mihaela Asăndulesei*
13:00 - 14:00	Lunch Time
14:00 - 15:00	Case Studies and archaeological feedback
14:00 - 14:15	› The western suburbium in Roman Carnuntum – An integrated spatio-temporal analysis of different archaeological prospection datasets - *Mario Wallner, Christian Gugl, Silvia Radbauer, Wolfgang Neubauer*
14:15 - 14:30	› New insights into a Romanesque basilica church in the deserted town of Corvey, Germany, based on a high-resolution GPR survey - *Joris Coolen, Mario Wallner, Tanja Trausmuth, Andreas König*
14:30 - 14:45	› An experimental use of ground-penetrating radar to identify human footprints - *Adam Wiewel, Lawrence B. Conyers, Luca Piroddi, Nikos Papadopoulos*
14:45 - 15:00	› Using ground-penetrating radar to analyze interior details of a Hohokam dwelling to test ideas about cultural change and community dynamics in 10th century southern Arizona, USA - *Lawrence Conyers*
15:00 - 16:15	Poster session
16:15 - 17:30	Methods and innovations
16:15 - 16:30	› Three-dimension (3D) presentation of a hominid caveusing ground-penetrating radar - *Huthaifa Qawasmeh, Mohammed M. AL-Hameedawi, Lawrence Conyers*
16:30 - 16:45	› Direct push video imaging: an innovation in prehistoric paleolandscape survey - *Jeroen Verhegge, Simon Delvoie, Hiep Luong*
16:45 - 17:00	› Can magnetic directions of kilns help us distinguish settlement phases? A case study from the Shahrizor Plain, Iraqi Kurdistan - *Marion Scheiblecker*
17:00 - 17:15	› Magnetization patterns as indicator of settlement structures - *Natalie Pickartz, Robert Hofmann, Tina Wunderlich, Knut Rassmann, Johannes Müller, René Ohlrau, Dennis Wilken, Wolfgang Rabbel*
17:15 - 17:30	› Mineral-magnetic characterization as a key to explain differences in magnetic contrast and improve archaeological interpretation. An example of the Roman site at Auritz/Aurizberri, Navarre. - *Ekhine Garcia-Garcia, Hana Grison, Neli Jordanova, Philippe De Smedt and Eneko Iriarte*

Thursday, September 9, 2021

TIME	EVENT
09:00 - 10:00	Case Studies and archaeological feedback
09:00 - 09:15	› A geophysical survey in Notre-Dame de Paris cathedral: revealing the buried past after the disaster - *Guillaume Hulin, Christophe Besnier, Dorothée Chaoui-Derieux, Sébastien Flageul, Christophe Norgeot, Cyril Schamper, Francois-Xavier SIMON, Alain Tabbagh*
09:15 - 09:30	› How geophysics can help evaluating the archaeological potential of urban soil: an example in the 'Archdiocese gardens' in Bourges - *Julien Thiesson, Mélanie Fondrillon, Ludovic Bodet, Audrey Burzawa, Camille Lanéelle and Amélie Laurent*
09:30 - 09:45	› Urban investigations in the heart of Rome: The Rome Transformed Project - *Stephen Kay, Ian Haynes, Paolo Liverani, Salvatore Piro, Elena Pomar, Gianfranco Morelli*
09:45 - 10:00	› GPR mural study of the commandery of Jalès (France) - *Christophe Benech, Quentin Vitale, Laurent d'Agostino, Côme Parfant*
10:00 - 11:30	Poster session
11:30 - 12:15	Environmental studies and landscape evolution
11:30 - 11:45	› Identifying elusive prehistoric land-use by integrating electromagnetic and invasive survey approaches - *Philippe De Smedt, Paul Garwood, Henry Chapman, Koen Deforce, Johan De Grave, Daan Hanssens, Dimitri Vandenberghe*
11:45 - 12:00	› Magnetic and electrical resistivity methods in locating ancient waterways and riverine harbours in Egypt - *Tomasz Herbich*
12:00 - 12:15	› Studying the ancient settlement of Hacilar Büyük Höyük with integrated methods - *Inci Nurgül Özdoğru, Melda Küçükdemirci, Tolga Görüm, Orkan Özcan*
12:15 - 12:45	Spatial analysis and aerial remote sensing
12:15 - 12:30	› Mapping archaeological signs from airbone Lidar data using deep neural networks: Preliminary results - *Melda Küçükdemirci, Giacomo Landeschi, Nicolo Dell'Unto and Mattias Ohlsson*
12:30 - 12:45	› What Lies Beneath The Surface? Using Airborne Hyperspectral Imagery To Map Submerged Archaeological Landscapes. A Case Study In The Molène Archipelago, Brittany - *Alexandre Guyot, Marc Lennon, Pierre Stéphan, Thibaut Péres, Marie Hascoët, Marie-Yvane Daire and Laurence Hubert-Moy*
12:45 - 14:00	Lunch Time
14:00 - 15:00	Methods and innovations
14:00 - 14:15	› An integrated approach for ground and drone-borne magnetic surveys and their interpretation in archaeological prospection - *Bruno Gavazzi, Hugo Reiller and Marc Munschy*
14:15 - 14:30	› Chances of Airborne SAR in the Investigation of Buried Archaeological Sites in Moist Soil in Bavaria - *Roland Linck, Jens Fischer, Rebecca Casement*
14:30 - 14:45	› ArchGeoRobot: automated archaeo-geophysical data acquisition using an unmanned ground vehicle - *Lieven Verdonck*
14:45 - 15:00	› Potential and challenges of UAV-borne magnetic measurements for archaeological prospection - *Volkmar Schmidt, Joris Coolen*
15:00 - 16:30	Poster session
16:30 - 17:30	Case Studies and archaeological feedback
16:30 - 16:45	› Electromagnetic mapping of Pasargadae (Fars Province, Iran): feedback from the 2017-2018 fieldwork - *Christelle Sanchez, Sébastien Gondet, Kourosh Mohammadkhani, Julien Thiesson*
16:45 - 17:00	› Persian residences in the Southern Caucasus: latest discoveries in the periphery of the Achaemenid Empire - *Jörg W.E. Fassbinder, Sandra Hahn, Mandana Parsi, Florian Becker, Wolf Marco, Kai Kaniuth, Iulon Gagoshidze*
17:00 - 17:15	› Magnetic signatures of urban structures: The Case study of Larsa (Iraq, 6th – 1st millennium BC) - *Lionel Darras, Régis Vallet*
17:15 - 17:30	› Survey of Soba (Sudan). Non-invasive approach to study the urban landscape of medieval capital of the Kingdom of Alwa. - *Robert Ryndziewicz, Mariusz Drzewiecki, Łukasz Banaszek, Tomasz Herbich, Krzysztof Kiersnowski*

Friday, September 10, 2021

TIME	EVENT
09:00 - 10:00	Case Studies and archaeological feedback
09:00 - 09:15	› Claus Colani's pulsed electromagnetic induction principle: documents and data of the first archaeo-geophysical prospecting in Bavaria - *Andreas Stele, Roland Linck and Jörg W. E. Fassbinder*
09:15 - 09:30	› Large-scale Ground-Penetrating Radar Survey of the Iron Age site of Bodøsjøen, Northern Norway. - *Arne Anderson Stamnes, Krzystof Kiersnowski*
09:30 - 09:45	› Reconstruction of the mine plan in Szklary (Poland) using ERT - *Mikołaj Zawadzki, Helena Ciechowska, Radosław Mieszkowski, Franciszek Pęski*
09:45 - 10:00	› The ancient rural settlement of Plantades in Salviac (Lot, France): comparison of previous data with two geophysical surveys. - *Michel Dabas and Julien Ollivier*
10:00 - 11:15	Poster session
11:15 - 12:45	Processing and visualisation of data
11:15 - 11:30	› Characterising Noise in Archaeo-Geophysical Measurements - *Armin Schmidt, Michel Dabas, Apostolos Sarris*
11:30 - 11:45	› Curvelet-Transform-Based Fusion: Application to Europos and Doriskos, N. Greece - *Alexandra Karamitrou, Gregory Tsokas, Alexandros Stampolidis*
11:45 - 12:00	› Joint interpretation of various geophysical data by means of image fusion in Philippi in N. Greece - *Alexandra Karamitrou, Gregory Tsokas, Dimitrios Kaimaris, Stavroula Dadaki, Alexandros Stampolidis, George Vargemezis, Panagiotis Tsourlos, Elias Fikos*
12:00 - 12:15	› Multi-trace coherence mapping and data fusion for improved GPR imaging - *Immo Trinks, Alois Hinterleitner, Petra Schneidhofer, Erich Nau, Christer Tonning, Alexander Bornik, Geert Verhoeven, Wolfgang Neubauer*
12:15 - 12:30	› A vector based approach to assessing the results from constant velocity migration of GPR data - *Neil Linford*
12:30 - 12:45	› GPR coherence imaging examples: The good, the bad, and the ugly - *Alois Hinterleitner, Immo Trinks, Erich Nau, Lars Gustavsen, Mario Wallner, Klaus Löcker*
12:45 - 14:00	Lunch Time
14:00 - 15:15	Methods and innovations
14:00 - 14:15	› A geophysical multi-method approach to investigate the archaeological landscape of Lanakerveld (NL) - *Lena Lambers, Walter Laan, Philippe De Smedt, Burkart Ullrich, Sandra Kniess, Henning Zoellner, Rudolf Kniess, Ivo van Wijk*
14:15 - 14:30	› Application of two dimensional electrical resistivity tomography (ERT) for moisture detection in Thessaloniki's rotunda pillars and three-dimensional ERT modeling using optimized electrode arrays - *Prodromos Louvaris, Panagiotis Tsourlos, Gregory Tsokas, George Vargemezis, Nectaria Diamanti, Konstantinos Polydoropoulos, Georgia Zacharopoulou*
14:30 - 14:45	› Highlighting the potential of 3D ERT by comparing its results with GPR and the excavation map of a Roman building - *Mandana Parsi, Roland Linck, Jörg W.E. Fassbinder, Michael Eitel, Fusena Issifu*
14:45 - 15:00	› Mapping archaeological features and/or removing disturbances: Tricky behaviors of electromagnetic multi-frequency signal in the vicinity of metallic objects - *Francois-Xavier SIMON, Julien THIESSON, Alexandre Beylier, Carole Fossurier, Alain Tabbagh*
15:00 - 15:15	› Magnetization patterns as indicator of settlement structures - *Natalie Pickartz, Robert Hofmann, Tina Wunderlich, Knut Rassmann, Johannes Müller, René Ohlrau, Dennis Wilken, Wolfgang Rabbel*
15:15 - 15:30	Virtual Coffee break
15:30 - 16:45	Case Studies and archaeological feedback
15:30 - 15:45	› All round: Workflow for the identification of Neolithic enclosure sites of the Sopot culture in Eastern Slavonia (Croatia) - *Cornelius Meyer, Rajna Šošić-Klindžić, Peter Milo, Tomas Tencer, Hrvoje Kalafatić, Bartul Šiljeg*

TIME	EVENT
15:45 - 16:00	› The effect of remanence in magnetometer prospection - *Sandra Hahn - Department of Earth- and Environmental Sciences [München]*
16:00 - 16:15	› Vanishing ancient landscape: challenges of surveying Roman remains in Teskera & Hardomilje (Ljubuški, Bosnia&Herzegovina) - *Michał Pisz - Faculty of Geology, University of Warsaw*
16:15 - 16:30	Virtual Coffee break
16:30 - 18:30	Annual Meeting of the International Society for Archaeological Prospection (ISAP) - Free for all ISAP members

APPLICATION OF TWO DIMENSIONAL ELECTRICAL RESISTIVITY TOMOGRAPHY (ERT) FOR MOISTURE DETECTION IN THESSALONIKI'S ROTUNDA PILLARS AND THREE-DIMENSIONAL ERT MODELING USING OPTIMIZED ELECTRODE ARRAYS

Prodromos Louvaris, Panagiotis Tsourlos, Gregory N. Tsokas, George Vargemezis, Nectaria Diamanti, Konstantinos Polydoropoulos, Georgia Zacharopoulou

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Application of Two Dimensional Electrical Resistivity Tomography (ERT) For Moisture Detection in Thessaloniki's Rotunda Pillars and Three-Dimensional ERT Modeling Using Optimized Electrode Arrays

Prodromos Louvaris [a], Panagiotis Tsourlos [b], Gregory Tsokas [b], George Vargemezis [b], Nectaria Diamanti [b], Konstantinos Polydoropoulos [b] and Georgia Zacharopoulou [c]

Highlights:

- *Moisture detection inside pillars using electrical resistivity tomography (ERT).*
- *Three-dimensional ERT modeling using non-conventional arrays.*
- *Jacobian matrix optimization method.*

Keywords: ERT, optimized, pillar, Thessaloniki, urban.

Electrical Resistivity Tomography (ERT) is widely known for providing valuable information for numerous archaeological prospection problems in two and three dimensions. The purpose of this work was to detect possible moisture inside one of the main pillars of Thessaloniki's Rotunda (Region of Macedonia, Greece), a Unesco heritage monument using various geophysical methods, including two and three dimensional (2D & 3D) ERTs, as well as the Ground Penetrating Radar method (GPR).

2D ERT lines were initially performed directly on the wall, in order to show the pillar's current state using 23 electrodes with conventional arrays such as the dipole–dipole and multi-gradient (Fig. 1). Holes for fixing the electrodes, approximately 6 mm wide, had to be drilled in the mortar of the wall. The electrodes were placed along a single line with inter-electrode spacing set to 0.6 m, encircling a large part of the pillar to obtain the maximum possible coverage. To minimize contact resistance, a small amount of bentonite clay was injected into each hole. The inverted results presented here delineate internal areas of low resistivity (Fig. 2), which are interpreted as regions of increased moisture; the GPR sections obtained over the same line have confirmed these findings.

Besides, synthetic ERT models simulating a 3D grid of electrodes covering the pillar were generated prior to the on-site installation in order to optimize the measuring and installation scheme. The synthetic data were calculated using conventional and non-conventional arrays involving comprehensive and optimized protocols, following the circled pillar involving four lines of 12 electrodes each. The specific setup of electrodes in the presence of extreme topographical variation demands a stringent filtering process (Loke *et al.*,

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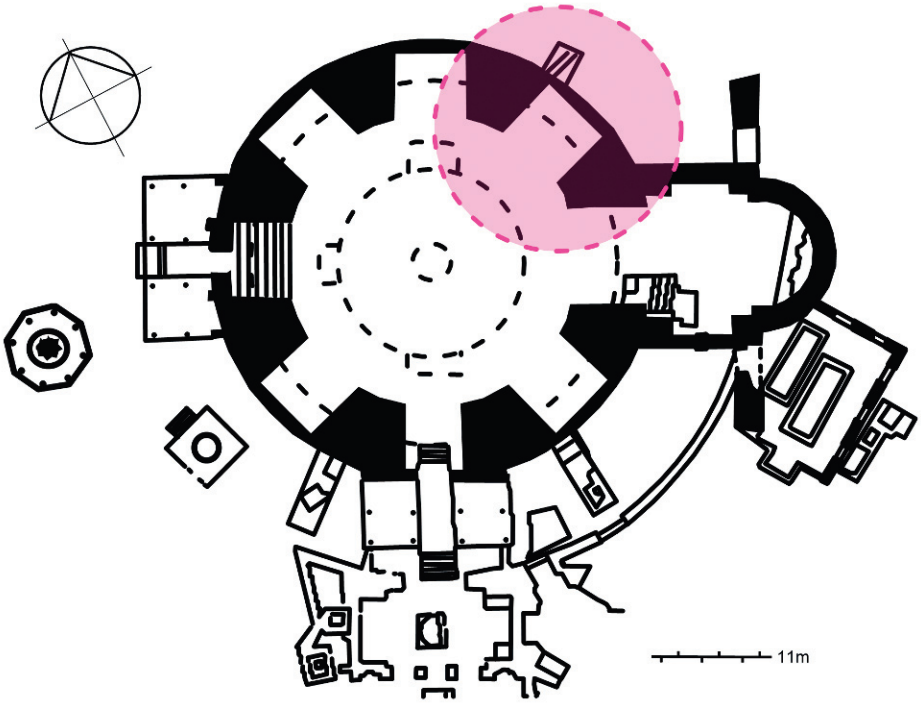

Figure 1. Archaeological site plan (rotunda, Thessaloniki). ERT and GPR measurements were conducted by the eastern and northeastern structural pillars.

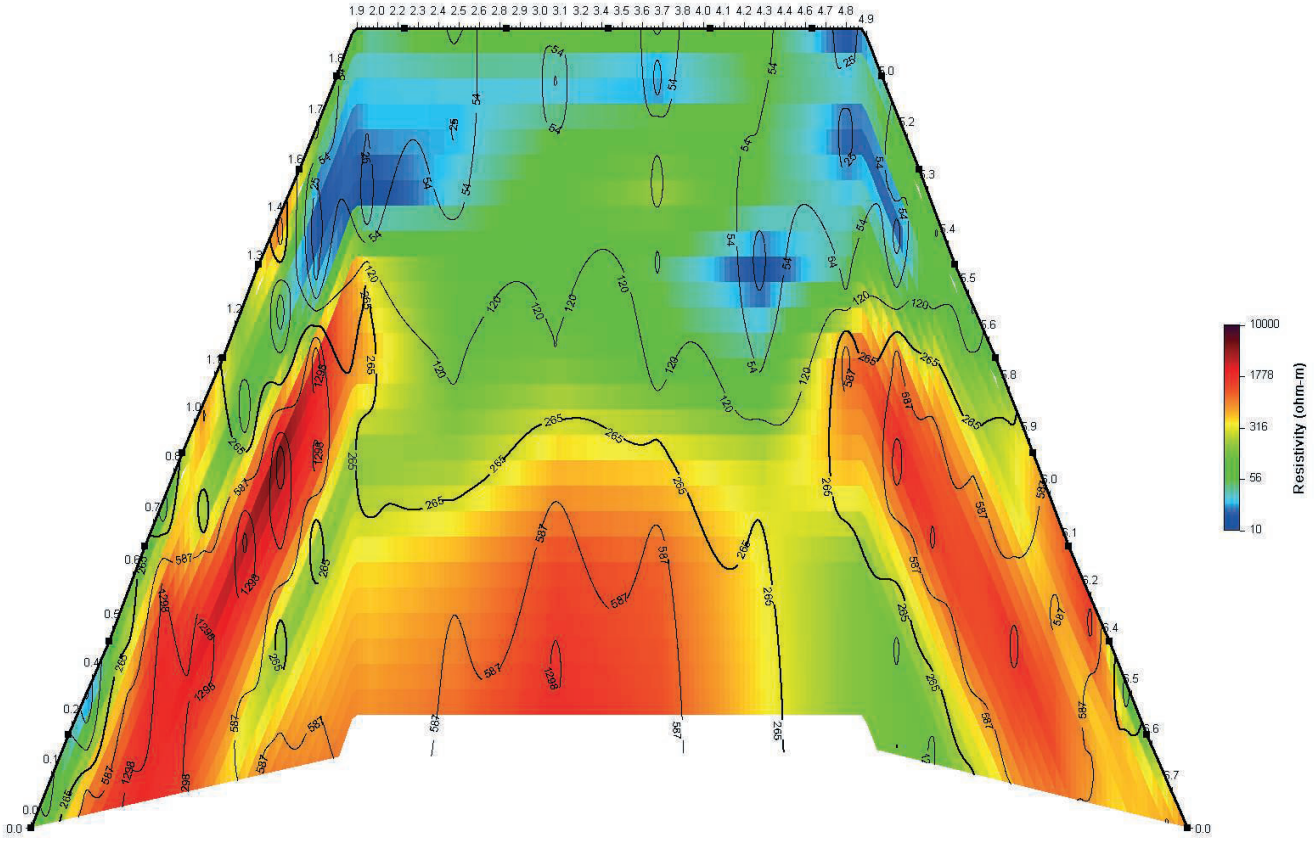

Figure 2. Inverted results of 2D ERT located by the northeastern pillar, obtained using the multi-gradient array.

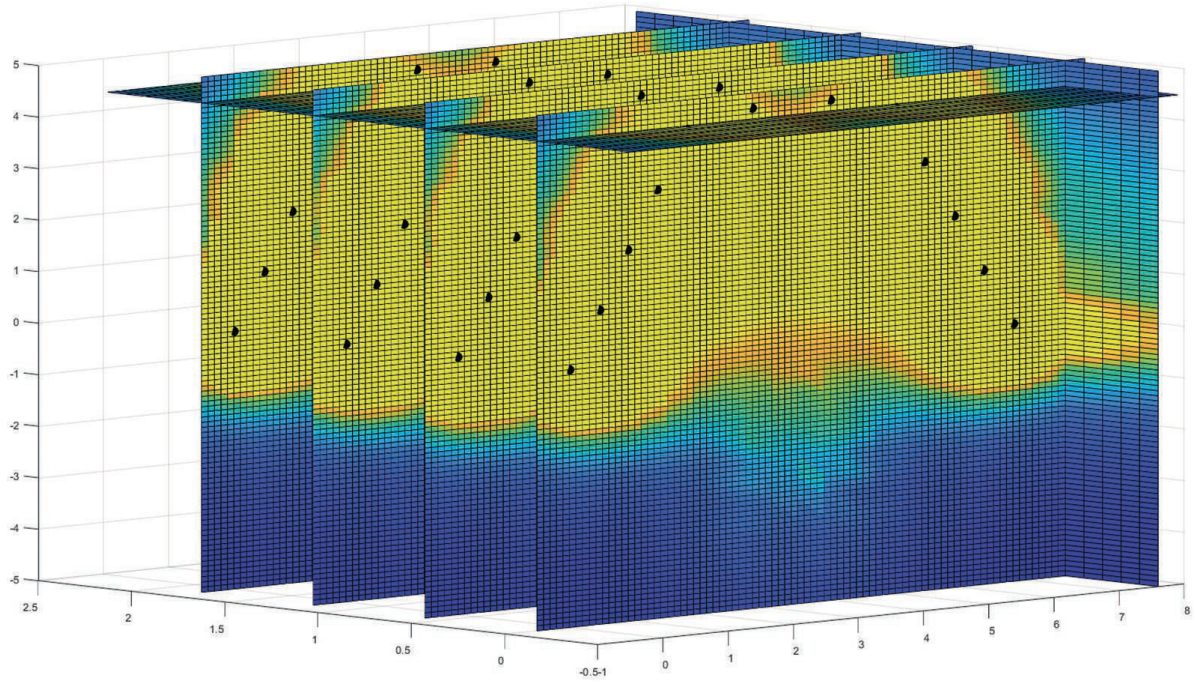

Figure 3. Cumulative Jacobian for calculated optimized 3D arrays, involving four lines with 12 electrodes each.

2014; Wilkinson *et al*., 2008) to calculate the optimized protocols. For this reason, an algorithm was developed to compute optimum measurements using already known techniques (Fig. 3). Some of the existing optimization techniques require the calculation of the Jacobian and Resolution matrices in order to compute the optimized protocol (Stummer *et al*., 2004; Wilkinson *et al*., 2006), which can be a time-consuming process. The method that was preferred among others due to its rapid protocol computation depends only on the Jacobian matrix (Athanasiou *et al*., 2009). This optimization technique does not require the calculation of the Resolution matrix and consequently makes it a time-saving method, giving the opportunity to rapidly recalculate or alter the existing optimum measurements. Synthetic data inversions are very promising and helpful in deciding the measurement geometry, which will be implemented in the field to operate in a time-lapse monitoring framework.

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