June 2023

AERAS

NewsLetter #2

AERAS

A CybEr range tRaining platform for medicAl organisations and systems Security

AERAS Concept & Approach

AERAS aims to develop a realistic and rapidly adjustable cyber range platform for systems and organizations in the critical healthcare sector, to effectively prepare stakeholders with different types of responsibility and levels of expertise in defending high-risk, critical cyber-systems and organizations against advanced, known, and new cyberattacks, and reduce their security risks. The platform will be a virtual cyberwarfare solution enabling the simulation of the operation and effects of security controls and offering hands-on training on their development, assessment, use, and management.

PROJECT OBJECTIVES

Develop and deliver a highly adaptive and person-centric service to support older adults in work life by creating a positive work environment for employee wellbeing.

Develop smart environment technologies to improve occupational safety and health.

Enhance the perception and cognition of smart devices towards human-centered and intuitive human-computer interaction.

Develop and validate a solution in real-world environments, capitalizing on ICT innovations that will increase the competitiveness of EU industry by accommodating the ageing workforce.

Guarantee cost-effectiveness and create socio-economic benefits.

AERAS has received funding from the European Union's Horizon 2020 Research and Innovation program under Grant Agreement No 872735.

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Consortium

Universita Degli Studi Di Milano (UMIL)
Italy
The Coordinator

Hospital Environment Pilot (UPAT)
Greece

Cyprus University of Technology (CUT)
Cyprus

Panepistimiako Geniko Nosokomeio Irakleiou (PAGNI)
Greece

Aegis IT Research GMBH (AEGIS)
Germany

SPHYNX Analytics Limited (SPHYNX)
Cyprus

Erevnitiko Panepistimiako Instituto Tilepikoinoniakon Systimaton (TSI)
Greece

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MidTerm Review

The AERAS EU - H2020 Mid Term Review took place at Università degli Studi di Milano on the 31st of January 2023 and has been successfully completed! Our consortium met with the project officers Vasiliki Exarchou and Nathalie Riguelle, and presented the progress of the AERAS project along with the time plan for our next activities!

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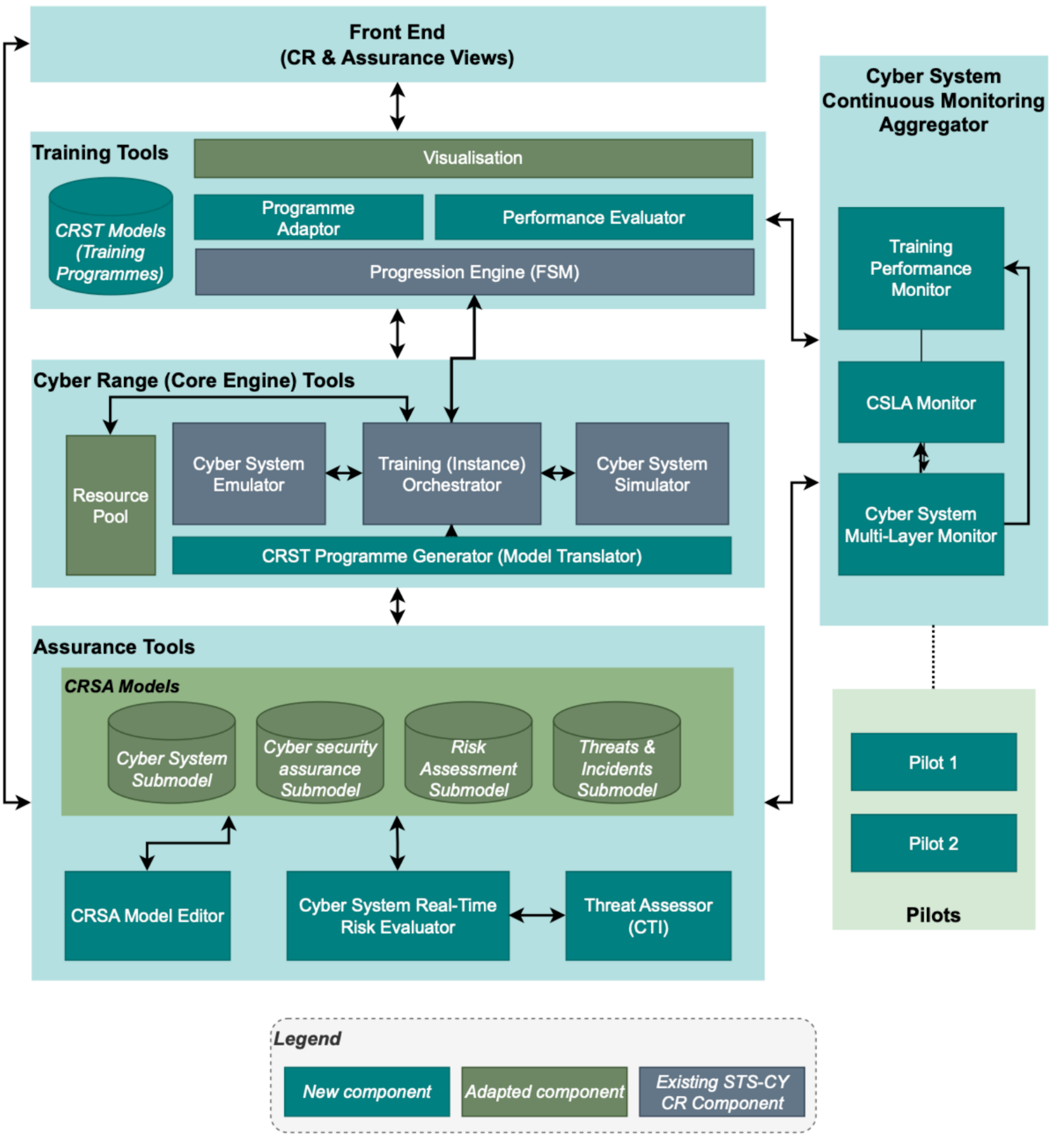
Implementation

Have a look at

the AERAS cyber range training platform architecture



The platform will include tools organized in three layers.

The first layer includes the Training Tools.

The second layer includes the Cyber Range Tools.

Finally, the third and last layer includes the Assurance Tools.

In addition, a vertical set of tools, named, Cyber-System Continuous Monitoring Aggregator is responsible for interfacing with all three layers of the deployed environment (actual cyber system).

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Deliverables

AERAS partners submitted the following deliverables that are currently under review:

Deliverable 2.1. Healthcare Pilots & Cyber Range Training Requirements Analysis Report

Deliverable 2.2. Platform requirements and Technology Analysis Report

The deliverables will appear on the AERAS website as soon as they are accepted at the following link:
https://www.aeras-project.eu/deliverables/

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News

Research Updates

Standardization and Validation of Brachytherapy Seeds' Modelling Using GATE and GGEMS Monte Carlo Toolkits

This study used GATE and GGEMS simulation toolkits, to estimate dose distribution on Brachytherapy procedures. Specific guidelines were followed as defined by the American Association of Physicists in Medicine (AAPM) as well as by the European SocieTy for Radiotherapy and Oncology (ESTRO). Several types of brachytherapy seeds were modelled and simulated, namely Low-Dose-Rate (LDR), High-Dose-Rate (HDR), and Pulsed-Dose-Rate (PDR). The basic difference between GATE and GGEMS is that GGEMS incorporates GPU capabilities, which makes the use of Monte Carlo (MC) simulations more accessible in clinical routine, by minimizing the computational time to obtain a dose map. During the validation procedure of both codes with protocol data, differences as well as uncertainties were measured within the margins defined by the guidelines. The study concluded that MC simulations may be utilized in clinical practice, to optimize dose distribution in real time, as well as to evaluate therapeutic plans.

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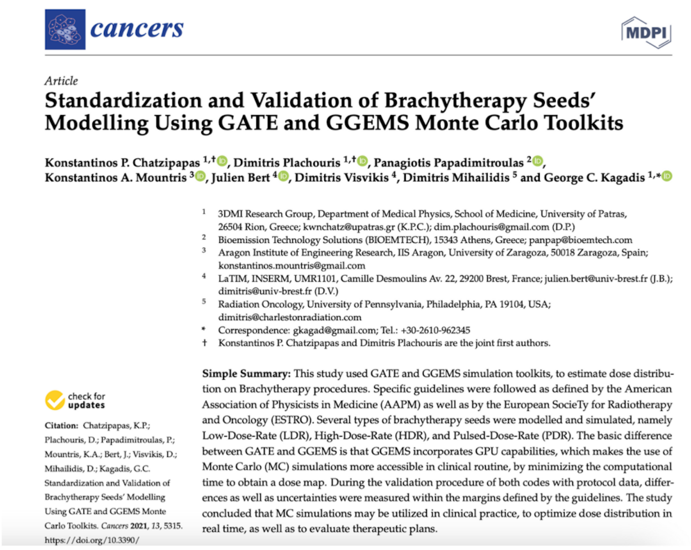
UNIVERSITY OF PATRAS



cancers

MDPI

Article

Standardization and Validation of Brachytherapy Seeds' Modelling Using GATE and GGEMS Monte Carlo Toolkits

Konstantinos P. Chatzipapas [1,†], Dimitris Plachouris [1,†], Panagiotis Papadimitroulas [2], Konstantinos A. Mountris [3], Julien Bert [4], Dimitris Visvikis [4], Dimitris Mihailidis [5] and George C. Kagadis [1,*]

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2 Bioemission Technology Solutions (BIOEMTECH), 15343 Athens, Greece; panpap@bioemtech.com
3 Aragon Institute of Engineering Research, IIS Aragon, University of Zaragoza, 50018 Zaragoza, Spain; konstantinos.mountris@gmail.com
4 LaTIM, INSERM, UMR1101, Camille Desmoulins Av. 22, 29200 Brest, France; julien.bert@univ-brest.fr (J.B.); dimitris@univ-brest.fr (D.V.)
5 Radiation Oncology, University of Pennsylvania, Philadelphia, PA 19104, USA; dimitris@charlestonradiation.com
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† Konstantinos P. Chatzipapas and Dimitris Plachouris are the joint first authors.

check for updates

Citation: Chatzipapas, K.P.; Plachouris, D.; Papadimitroulas, P.; Mountris, K.A.; Bert, J.; Visvikis, D.; Mihailidis, D.; Kagadis, G.C. Standardization and Validation of Brachytherapy Seeds' Modelling Using GATE and GGEMS Monte Carlo Toolkits. *Cancers* **2021**, *13*, 5315. https://doi.org/10.3390/

Simple Summary: This study used GATE and GGEMS simulation toolkits, to estimate dose distribution on Brachytherapy procedures. Specific guidelines were followed as defined by the American Association of Physicists in Medicine (AAPM) as well as by the European SocieTy for Radiotherapy and Oncology (ESTRO). Several types of brachytherapy seeds were modelled and simulated, namely Low-Dose-Rate (LDR), High-Dose-Rate (HDR), and Pulsed-Dose-Rate (PDR). The basic difference between GATE and GGEMS is that GGEMS incorporates GPU capabilities, which makes the use of Monte Carlo (MC) simulations more accessible in clinical routine, by minimizing the computational time to obtain a dose map. During the validation procedure of both codes with protocol data, differences as well as uncertainties were measured within the margins defined by the guidelines. The study concluded that MC simulations may be utilized in clinical practice, to optimize dose distribution in real time, as well as to evaluate therapeutic plans.

https://www.mdpi.com/2072-6694/13/21/5315

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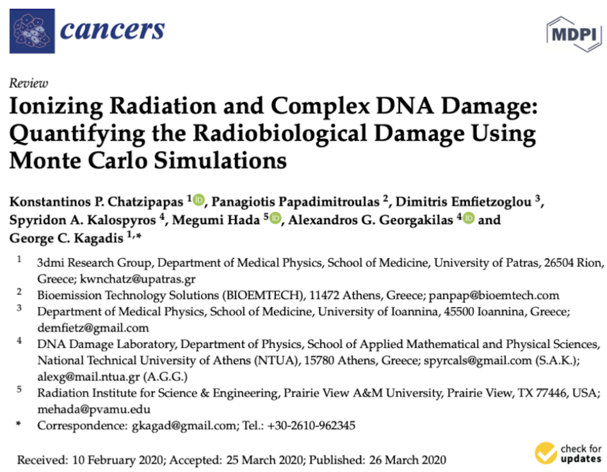
News

Research Updates

Ionizing Radiation and Complex DNA Damage: Quantifying the Radiobiological Damage Using Monte Carlo Simulations

ΠΑΝΕΠΙΣΤΗΜΙΟ ΠΑΤΡΩΝ UNIVERSITY OF PATRAS

Ionizing radiation is a common tool in medical procedures. Monte Carlo (MC) techniques are widely used when dosimetry is the matter of investigation. The scientific community has invested, over the last 20 years, a lot of effort into improving the knowledge of radiation biology. The present article aims to summarize the understanding of the field of DNA damage response (DDR) to ionizing radiation by providing an overview on MC simulation studies that try to explain several aspects of radiation biology. The need for accurate techniques for the quantification of DNA damage is crucial, as it becomes a clinical need to evaluate the outcome of various applications including both low- and high-energy radiation medical procedures. Understanding DNA Repair processes would improve radiation therapy procedures. Monte Carlo simulations are a promising tool in radiobiology studies, as there are clear prospects for more advanced tools that could be used in multidisciplinary studies, in the fields of physics, medicine, biology and chemistry. Still, lot of effort is needed to evolve MC simulation tools and apply them in multiscale studies starting from small DNA segments and reaching a population of cells.


cancers MDPI

Review

Ionizing Radiation and Complex DNA Damage: Quantifying the Radiobiological Damage Using Monte Carlo Simulations

Konstantinos P. Chatzipapas [1], Panagiotis Papadimitroulas [2], Dimitris Emfietzoglou [3], Spyridon A. Kalospyros [4], Megumi Hada [5], Alexandros G. Georgakilas [4] and George C. Kagadis [1,*]

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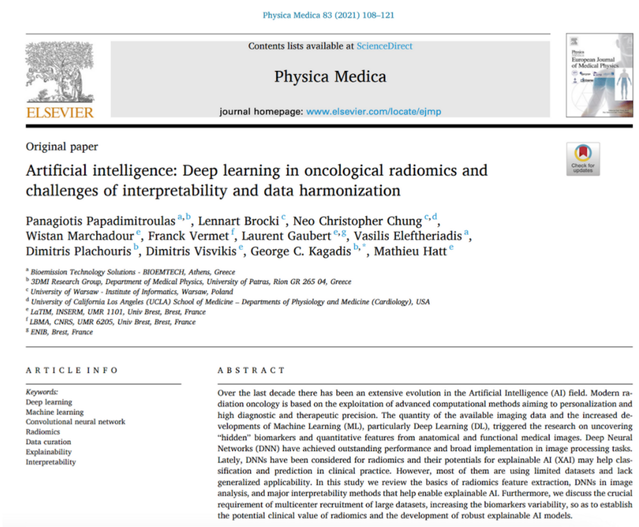
Research Updates

Artificial intelligence: Deep learning in oncological radiomics and challenges of interpretability and data harmonization

Over the last decade there has been an extensive evolution in the Artificial Intelligence (AI) field. Modern radiation oncology is based on the exploitation of advanced computational methods aiming to personalization and high diagnostic and therapeutic precision. The quantity of the available imaging data and the increased developments of Machine Learning (ML), particularly Deep Learning (DL), triggered the research on uncovering "hidden" biomarkers and quantitative features from anatomical and functional medical images. Deep Neural Networks (DNN) have achieved outstanding performance and broad implementation in image processing tasks.

Lately, DNNs have been considered for radiomics and their potentials for explainable AI (XAI) may help classification and prediction in clinical practice. However, most of them are using limited datasets and lack generalized applicability. In this study we review the basics of radiomics feature extraction, DNNs in image analysis, and major interpretability methods that help enable explainable AI. Furthermore, we discuss the crucial requirement of multicenter recruitment of large datasets, increasing the biomarkers variability, so as to establish the potential clinical value of radiomics and the development of robust explainable AI models.



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Original paper

Artificial intelligence: Deep learning in oncological radiomics and challenges of interpretability and data harmonization

Panagiotis Papadimitroulas [a,b], Lennart Brocki [c], Neo Christopher Chung [c,d], Wistan Marchadour [e], Franck Vermet [f], Laurent Gaubert [e,g], Vasilis Eleftheriadis [a], Dimitris Plachouris [b], Dimitris Visvikis [e], George C. Kagadis [b,*], Mathieu Hatt [e]

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ARTICLE INFO

Keywords:
Deep learning
Machine learning
Convolutional neural network
Radiomics
Data curation
Explainability
Interpretability

ABSTRACT

Over the last decade there has been an extensive evolution in the Artificial Intelligence (AI) field. Modern radiation oncology is based on the exploitation of advanced computational methods aiming to personalization and high diagnostic and therapeutic precision. The quantity of the available imaging data and the increased developments of Machine Learning (ML), particularly Deep Learning (DL), triggered the research on uncovering "hidden" biomarkers and quantitative features from anatomical and functional medical images. Deep Neural Networks (DNN) have achieved outstanding performance and broad implementation in image processing tasks. Lately, DNNs have been considered for radiomics and their potentials for explainable AI (XAI) may help classification and prediction in clinical practice. However, most of them are using limited datasets and lack generalized applicability. In this study we review the basics of radiomics feature extraction, DNNs in image analysis, and major interpretability methods that help enable explainable AI. Furthermore, we discuss the crucial requirement of multicenter recruitment of large datasets, increasing the biomarkers variability, so as to establish the potential clinical value of radiomics and the development of robust explainable AI models.

https://www.sciencedirect.com/science/article/pii/S1120179721001253?via%3Dihub

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News

Research Updates

Using kinetic Monte Carlo simulations to design efficient magnetic nanoparticles for clinical hyperthermia

The purpose of this study was to identify the properties of magnetite nanoparticles that deliver optimal heating efficiency, predict the geometrical characteristics to get these target properties, and determine the concentrations of nanoparticles required to optimize thermotherapy.

Kinetic Monte Carlo simulations were employed to identify the properties of magnetic nanoparticles that deliver high Specific Absorption Rate (SAR) values. Optimal volumes were determined for anisotropies ranging between 11 and 40 kJ/m3 under clinically relevant magnetic field conditions. Atomistic spin simulations were employed to determine the aspect ratios of ellipsoidal magnetite nanoparticles that deliver the target properties. A numerical model was developed using the extended cardiac-torso (XCAT) phantom to simulate low-field (4 kA/m) and high-field (18 kA/m) prostate cancer thermotherapy. A stationary optimization study exploiting the Method of Moving Asymptotes (MMA) was carried out to calculate the concentration fields that deliver homogenous temperature distributions within target thermotherapy range constrained by the optimization objective function. A time-dependent study was used to compute the thermal dose of a 30-min session.

The optimal properties and design specifications of magnetite nanoparticles vary with magnetic field properties. Application-specific magnetic nanoparticles or nanoparticles that are optimized at low fields are indicated for optimal thermal dose delivery at low concentrations.

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RESEARCH ARTICLE

MEDICAL PHYSICS

Using kinetic Monte Carlo simulations to design efficient magnetic nanoparticles for clinical hyperthermia

Costas Papadopoulos[1] | Argiris Kolokithas-Ntoukas[2,3] | Roberto Moreno[4] | David Fuentes[5] | George Loudos[6] | Vassilios C. Loukopoulos[7] | George C. Kagadis[1,5]

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[2] Department of Materials Science, School of Natural Sciences, University of Patras, Rion, GR, Greece

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[4] Earth and Planetary Science, School of Geosciences, University of Edinburgh, Edinburgh, UK

[5] Department of Imaging Physics, University

Abstract

Purpose: The purpose of this study was to identify the properties of magnetite nanoparticles that deliver optimal heating efficiency, predict the geometrical characteristics to get these target properties, and determine the concentrations of nanoparticles required to optimize thermotherapy.

Methods: Kinetic Monte Carlo simulations were employed to identify the properties of magnetic nanoparticles that deliver high Specific Absorption Rate (SAR) values. Optimal volumes were determined for anisotropies ranging between 11 and 40 kJ/m^3 under clinically relevant magnetic field conditions. Atomistic spin simulations were employed to determine the aspect ratios of ellipsoidal magnetite nanoparticles that deliver the target properties. A numerical model was developed using the extended cardiac-torso (XCAT) phantom to simulate low-

https://aapm.onlinelibrary.wiley.com/doi/epdf/10.1002/mp.15317

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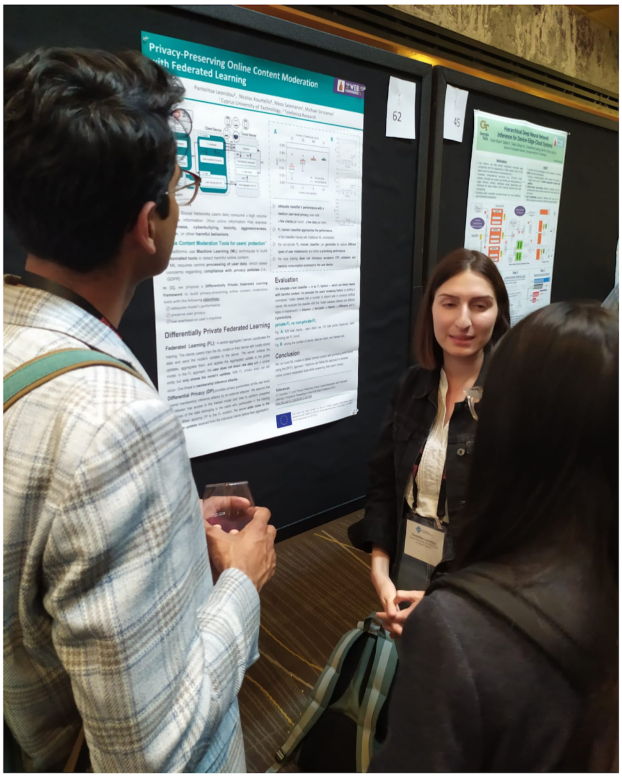
News

Research Updates

Privacy-Preserving Online Content Moderation: A Federated Learning Use Case

Cyprus University of Technology

Pantelitsa Leonidou presented the collaborative work of the Cyprus University of Technology and Telefonica Spain titled “Privacy-preserving online content moderation with Federated Learning” at the CySoc workshop and the poster session of the ACM Web Conference 2023.
This work received funding from the AERAS project.



Find more details about this work at the following links:

- https://dl.acm.org/doi/abs/10.1145/3543873.3587366
- https://dl.acm.org/doi/abs/10.1145/3543873.3587604.

@ACM Web Conference 2023, Austin, Texas 30/04-04/05/2023

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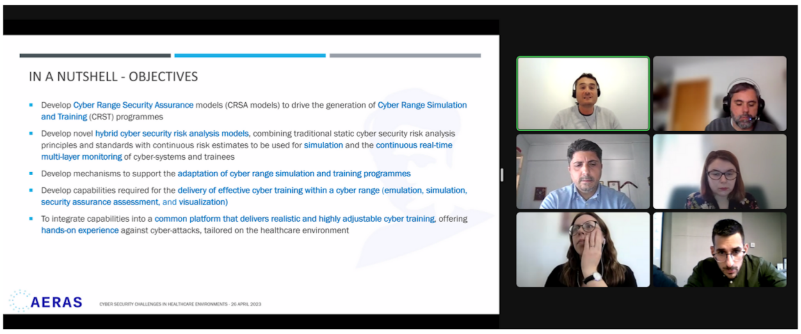
Events

AERAS @Webinar: Cyber Security challenges in healthcare environments

AERAS participated in the Cyber Security challenges in healthcare environments webinar on the 26th of April 2023.
Fulvio Frati (UMIL) presented the AERAS objectives, and project outlined the capabilities of the AERAS cyber range training platform.
Georgiana Darau (AEGIS) presented the AERAS WP2 survey results 'Cybersecurity challenges and training expectations for the medical domain'.

Watch the webinar at the following link:
https://www.youtube.com/watch?v=PkhQNPVkxhQ&ab_channel=HEIRH2020



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