Funded by
the European Union

HORIZON EUROPE

ERA Chair Project

**“Regional Center of Excellence at
the Orbeli Institute of Physiology”**

Funding: 5 years (2023-27), €2.4mln

By Narine Sarvazyan, PhD

L. A. Orbeli Institute of Physiology NAS RA

Horizon Europe ERA Chair, L.A.Orbeli Institute of Physiology

William Frazer Endowed Chair, American University of Armenia

THE GEORGE WASHINGTON UNIVERSITY WASHINGTON, DC

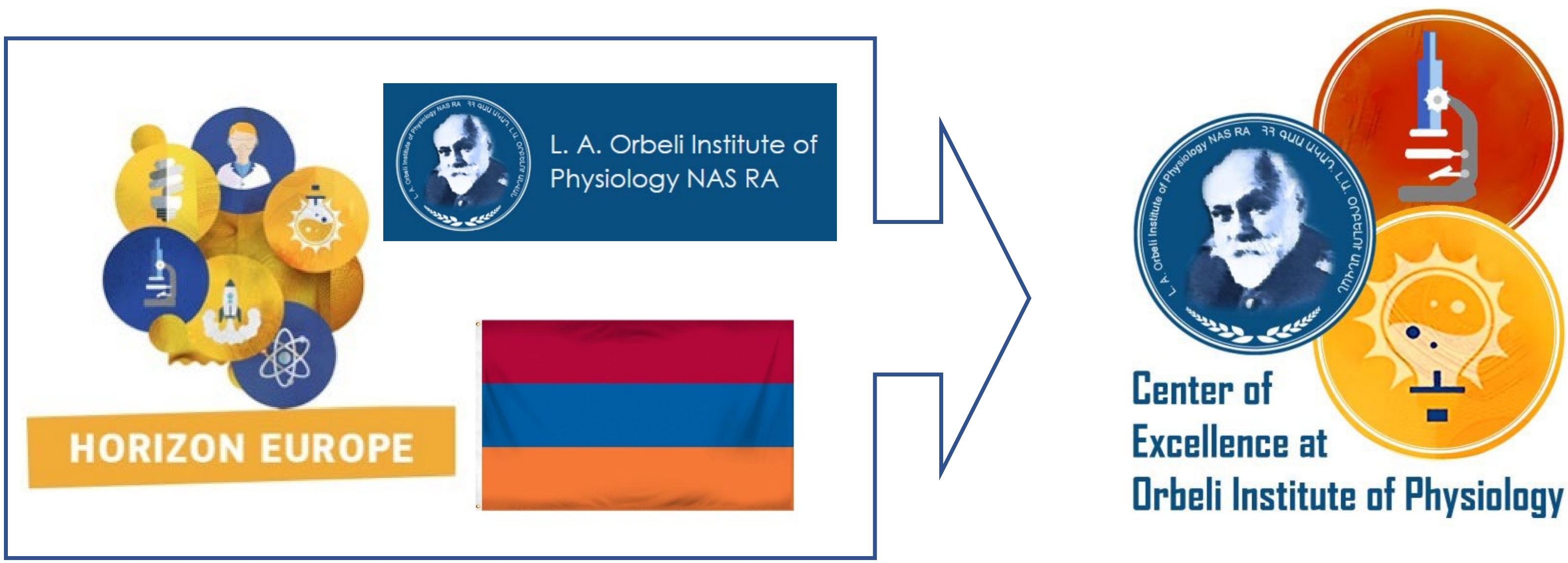
Professor, The George Washington University School of Medicine

“Regional Center of Excellence at the Orbeli Institute of Physiology”

Funding: 5 years (2023-27), €2.4mln

RESEARCH	EDUCATION	COMPLIANCE	INFRASTRUCTURE

The Project aims to enhance the research environment in the Orbeli Institute of Physiology, one of the first institutions of the Armenian Academy of Sciences



Key objectives

Center of
Excellence at
Orbeli Institute of Physiology

- ***Establishment of a new research group focused on hyperspectral imaging of biological targets***

- ***Improvements in institutional infrastructure, including the vivarium***

- ***Compliance with EU standards in animal use, biosafety, and human subjects research***

- ***Trainings in bioimaging, data analysis, poster and oral presentations***

https://era-chair.am

Center of
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Search

HOME OUR TEAM COMPLIANCE RESOURCES NEWS GALLERY CONTACT

ERA Chair Science Team:

Narine Sarvazyan

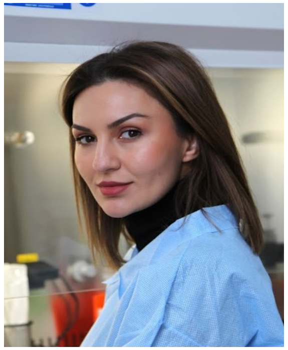
Narek Meloyan

Kristina Ghahramanyan

Fernando Villarruel, PhD

Katya Baydiuk, PhD

Tigran Soghomonyan



Ani Avetisyan

Narek Chilingarian

ERA Chair Admin Team

Mariam Sianozova

Managing Director

Evelina Harutunyan

Admin Assistant

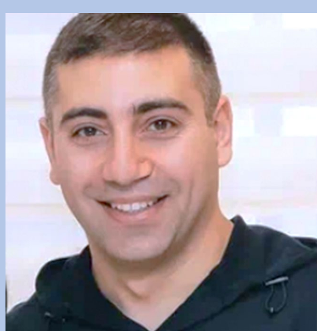
Garegin Muradyan

Webmaster

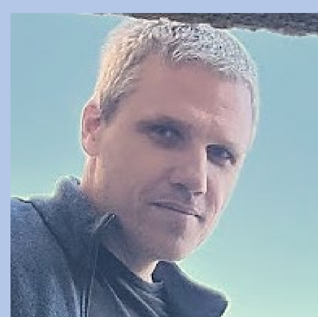
Host & Coordinator

Naira Ayvazyan, D.Sc

Bioimaging Instructors



Gevorg Gukasyan



Sergei Fedotov

Daniel Polianczyk

Institutional IT support

Members of different committees

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Search

HOME OUR TEAM COMPLIANCE RESOURCES NEWS GALLERY CONTACT

- Ethics and Compliance Committee
- Laboratory Safety
- Animal Care & Use
- Animal Care and Use Trainings
- Biosafety
- Research Involving Human Participants

Home » Compliance

COMPLIANCE

ANIMAL CARE & USE | BIOSAFETY | HUMAN SUBJECTS RESEARCH

Ethics and compliance in research cover a broad range of activity from general principles for conducting research responsibly to specific regulations governing particular type of research. These principles are essential for ensuring that research is conducted in a manner that is both responsible and credible, while also safeguarding the rights and well-being of participants and maintaining the trust of stakeholders

Compliance refers to the adherence to established guidelines or specifications, or the process of achieving such adherence.

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Center of Excellence at Orbeli Institute of Physiology

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ANIMAL CARE & USE

ANIMAL CARE & USE

Institutional Animal Care and Use Committee

Occupational Health and Safety

PROTOCOL SUBMISSION

POLICIES AND INFOMATION MATERIALS

RESOURCES

SOP

The L.A.Orbeli Institute of Physiology conducts research involving animals to better understand health and diseases in humans and animals, as well as to contribute into development of new treatments. The Institute is committed to ensure proper animal care and use, training of the staffinvolved, careful planning of experiments, and taking all efforts to mitigate pain and distress for the animals.

An animal care and use (ACU) program at the Orbeli Institute of Physiology comprises all activities that have a direct impact on the animals' welfare, including animal and veterinary care, policies and procedures, personnel management, occupational health and safety, IACUC functions, animal facility design and management. The use of laboratory animals is governed by the regulatory requirements outlined in the Article 11 of the Republic of Armenia Law about veterinarian care approved on June 21, 2014 and comply with the Directive 2010/63/EU of the European Parliament and of the Council on the protection of animals used for scientific purposes and the European Convention for the Protection of Vertebrate Animals used for Experimental and Other Scientific Purposes.

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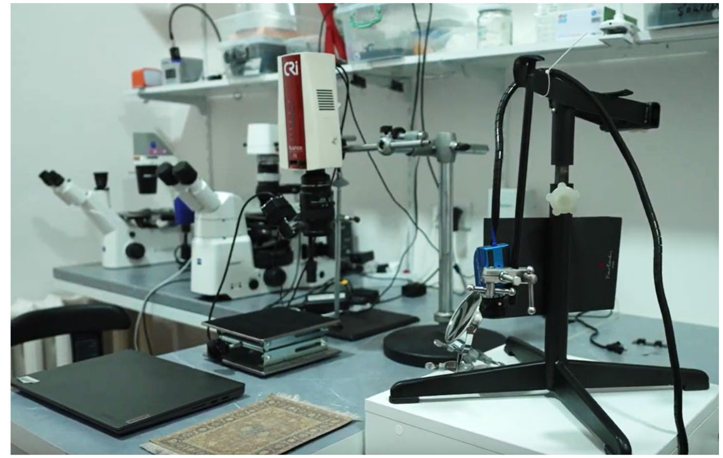
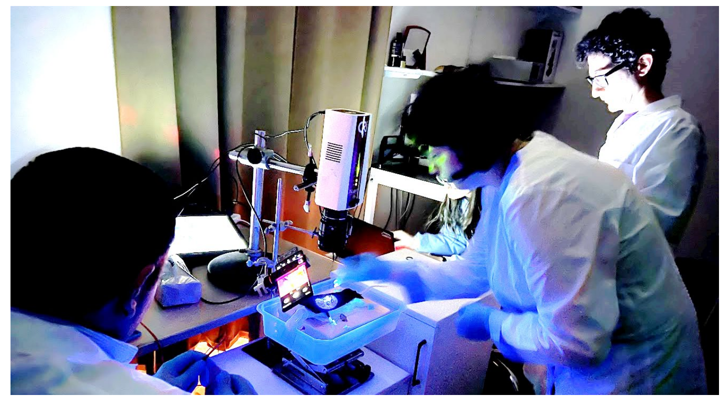
Lab space renovation: >200m3

Spectroscopy and Hyperspectral Imaging Instruments and Accessories:

- UV-Vis Spectrophotometer for measuring absorption and transmittance in samples across ultraviolet and visible light spectrums. Must feature a broad wavelength range and high spectral resolution.
- Relevant accessories like cuvette holders, fiber optic probes
- Tunable UV/Broadband/IR Xenon Light Source LED Arrays for tissue illumination w UV and white light
- Fast snapshot hyperspectral camera
- Frame-Based Hyperspectral Imaging Systems in UV, VIS and NIR ranges
- High-performance computing solutions with data analysis and visualization software specific to spectroscopic analysis (e.g., MATLAB, R with spectral analysis packages, and proprietary software bundled with instruments)





Equipment for Tissue Engineering and Cell Culture studies

- Biosafety cabinet for sterile work environments
- Two stacked CO2 Incubators to maintain cell culture conditions
- Microscope with phase-contrast capabilities for cell inspection
- Centrifuges for sample preparation
- Water distiller
- Liquid Nitrogen Storage for cell preservation
- Autoclaves for equipment sterilization
- Refrigerator and freezer for reagent and sample storage
- Water baths and heat blocks for sample incubation
- Perfusion pump for decellularization
- Pipettes, cell culture flasks, dishes, and multi-well plates
- Dissection tools
- Fluorescent dyes and probes
- Cell culture media and reagents
- Tissue culture plates and flasks
- Antibiotics and growth factors
- Microscope slides and coverslips
- Chemicals and biochemical reagents

Spectral pixels as images: CNN-based pixel classification of 4D hyperspectral data for nerve and ligament differentiation

Naira Matosyan[a,b], Narek Chilingaryan[c], Narine Sarvazyan[a,c,d], and Varduhi Yeghiazaryan[a]

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[b]Yerevan State University, Yerevan, Armenia
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[d]George Washington University, Washington, DC, United States

DEEP LEARNING CLASSIFICATION OF ABLATED ATRIAL TISSUE IN SPECTRALLY ENHANCED HYPERSPECTRAL IMAGES

Arpi Hunanyan[1*], Nazeli Ter-Petrosyan[1*], Fernando Villarruel[2], Tigran Soghomony
Narine Sarvazyan[1,2,3], Varduhi Yeghiazaryan[1], and Aram Butavyan[1]

[1]Akian College of Science and Engineering, American University of Armenia, Yerevan,
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[3]George Washington University, Washington, DC, United States

ABSTRACT

Text here

4D hyperspectral imaging for intraoperative tissue classification

Narek Chilingaryan[a], Fernando Villarruel[a], Tigran Soghomonyan[a], Varduhi Yeghiazaryan[b], and Narine Sarvazyan[a,b,c]

[a]L. A. Orbeli Institute of Physiology NAS RA, Yerevan, Armenia
[b]American University of Armenia, Yerevan, Armenia
[c]George Washington University, Washington, DC, United States

ABSTRACT

This study examines the use of 4D hyperspectral imaging (4D HSI) for visualizing clinically relevant targets. The approach relies on intrinsic optical properties of the tissue without the need for exogenous dyes or contrast agents. Here we compare autofluorescence-based 4D HSI to a traditional 3D HSI approach for its ability to distinguish between nerve and ligament bundles, isolated from adult cow trotters. Datacubes are captured within the 420–720 nm interval, under illumination wavelengths ranged from 280 to 420 nm. The unmixing outcomes of individual 3D HSI cubes prove inferior to those from multiple, even as few as three, 3D cubes sequentially combined into one. The data show an increase in the ratio of correctly identified pixels with the increased number of HSI cubes taken at different excitation wavelengths. Combining multiple 3D HSI cubes into a single 4D dataset improves target identification and reveals additional features, such as damaged nerve with torn epineurium. The 4D HSI approach merges excitation-emission matrices with traditional HSI and delivers higher accuracy in distinguishing different tissue structures. Furthermore, more advanced analysis techniques, such as deep neural networks, can potentially utilize 4D HSI data further to distinguish surgical targets. The data suggests that 4D HSI has significant potential for various clinical applications, including surgical procedures, dental applications, and cancerous lesion identification, leveraging small spectral changes for improved visualization and clinical outcomes.

Keywords: 4D hyperspectral imaging, excitation–emission matrices, surgery

1. INTRODUCTION

This study builds upon earlier efforts by us and others to use the intrinsic optical properties of tissues for visualization of clinically relevant targets without the need for exogenous dyes or contrast agents.[1–4] Here we explore the advantages of the 4D hyperspectral imaging (4D HSI) modality that collects and processes data acquired from both excitation and emission axes. Recent advances in optics, such as fast tunable light sources and snapshot cameras, made the 4D HSI approach suitable for intraoperative monitoring of the surgical field-of-view. Each 4D HSI dataset contains values from four axes: two spatial dimensions (x and y) and two spectral dimensions (excitation and emission wavelengths). This study compares the performance of autofluorescence-based 4D HSI to the traditional emission-based 3D HSI approach. Excised bovine nerve and ligament bundles were used as examples of targets to be distinguished in order to allow to avoid inadvertent nerve damage during surgery. Such damage can result from inter-patient anatomical variability and visual similarity of nerve fibers to nearby structures, posing significant risks including loss of sensation and paralysis.[5] This study highlights the potential of the 4D HSI approach as a promising candidate for developing new imaging methods to distinguish nerves intraoperatively.

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COMBINING 4D HYPERSPECTRAL IMAGING WITH CNN FOR NERVE AND LIGAMENT DIFFERENTIATION

Naira Matosyan[a], Narek Chilingaryan[b*], Narine Sarvazyan[abc], Varduhi Yeghiazaryan[a]*

[a] American University of Armenia, Akian College of Science and Engineering, Yerevan, Armenia
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ABSTRACT

Iatrogenic nerve injuries, inadvertently caused by an operating physician, occur at a significant annual rate. A major reason for such intraoperative damage is poor nerve visualization, which results in the transection of incorrect structures or the misidentification of nerves as vessels or ligaments. Previously, diffuse reflectance-based hyperspectral imaging (HSI) has been applied to the nerve differentiation issue in the surgical context. In contrast, our study addresses the task of differentiating between nerves and ligaments using 3D and 4D autofluorescence HSI, followed by classification using CNN and linear unmixing. Our experiments use excised bovine nerve and ligament samples. The data indicate that utilizing a 4D HSI configuration increases classification performance by up to 10%, achieving nearly 98.9% accuracy in most cases. Furthermore, CNNs consistently outperform linear unmixing, at times by more than 15%. We conclude that combining multiple autofluorescence HSI datacubes acquired at several narrow-band excitation wavelengths with a CNN approach enables superior differentiation

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Digital Object Identifier 10.1109/ACCESS.2023.0322000

Comparative Analysis of Deep Learning Methods for Classification of Ablated Regions in Hyperspectral Images of Atrial Tissue

Yeva Gabrielyan[1], Arpi Hunanyan[1], Sona Bezirganyan[1], Lusine Davtyan[1], Ani Avetisyan[2], Narine Sarvazyan[1,2,3], Aram Butavyan[1], and Varduhi Yeghiazaryan[1]

MULTIEXCITATION HYPERSPECTRAL IMAGING TOWARD IMPROVED LICHEN IDENTIFICATION

Narek Chilingaryan[1], Arsen Gasparyan[2,3], Narine Sarvazyan[1,2,4]

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[2]American University of Armenia, Yerevan, Armenia
[3]Institute of Botany after A. Takhtajyan NAS RA, Yerevan, Armenia
[4]George Washington University, Washington, DC, United States

ABSTRACT

Hyperspectral imaging (HSI) has significantly advanced the identification and characterization of biological specimens by utilizing high-resolution data across multiple spectral bands. In the study of lichens, which are symbiotic entities formed by fungi and photosynthetic partners, our novel approach leverages the potential of HSI through a technique referred to as multi-excitation HSI (ME-HSI). This method differentiates itself by employing multiple ultraviolet wavelengths for illumination, capturing data in the visible range, and subsequently integrating these hyperspectral cubes. Our research demonstrates that this innovative technique provides superior effectiveness in identifying lichen species. By detailing unique spectral signatures, ME-HSI facilitates species differentiation, enhancing the accuracy of ecological monitoring and conservation efforts through non-invasive methods.

Index Terms— Hyperspectral Imaging, Autofluorescence, Lichenology, Taxonomy, Environment

1. INTRODUCTION

Lichens play a critical role as bioindicators due to their sensitivity to environmental changes and pollutants. They contribute to ecosystem health by participating in nutrient cycling and soil formation [1]. In Armenia, a region with diverse climatic zones and rich biodiversity, the accurate identification and monitoring of lichens are particularly crucial [2]. Lichen diversity in Armenia not only reflects the region's unique ecological conditions but also provides insights into environmental changes and the impacts of anthropogenic activities. However, identifying different lichen species is notoriously difficult given their visual similarities and complex structures [3]. Our research seeks to address these needs by advancing identification methods through multi-excitation hyperspectral imaging (ME-HSI). In the past, reflectance-based hyperspectral imaging has shown to be effective for daylight aerial monitoring of lichen growth and distribution [4]. However, this approach works only for lichen species that exhibit significant differences in their reflectance spectra, i.e., their color. Yet many species of lichens are indistinguishable by color in which case additional physical factors or properties needs to be explored.

The ability to rapidly and straightforwardly differentiate species using HSI is especially useful for researchers focused on ecological monitoring, biodiversity, lichen conservation efforts and sustainable ecosystem management. Here we focus on the use of ME-HSI, which employs multiple ultraviolet and visible wavelengths to illuminate the samples while capturing images in the visible range. Using this approach, we attempted to differentiate three species of lichens that are visually indistinguishable color-wise. The data have confirmed the enhanced capacity of ME-HSI to reveal subtle spectral differences. Our findings support the use of ME-HSI for ecological and preservation purposes, going beyond current remote sensing paradigms.

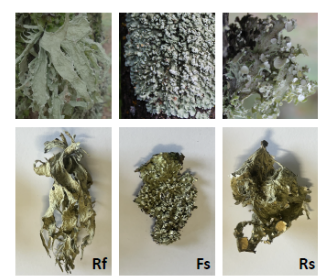
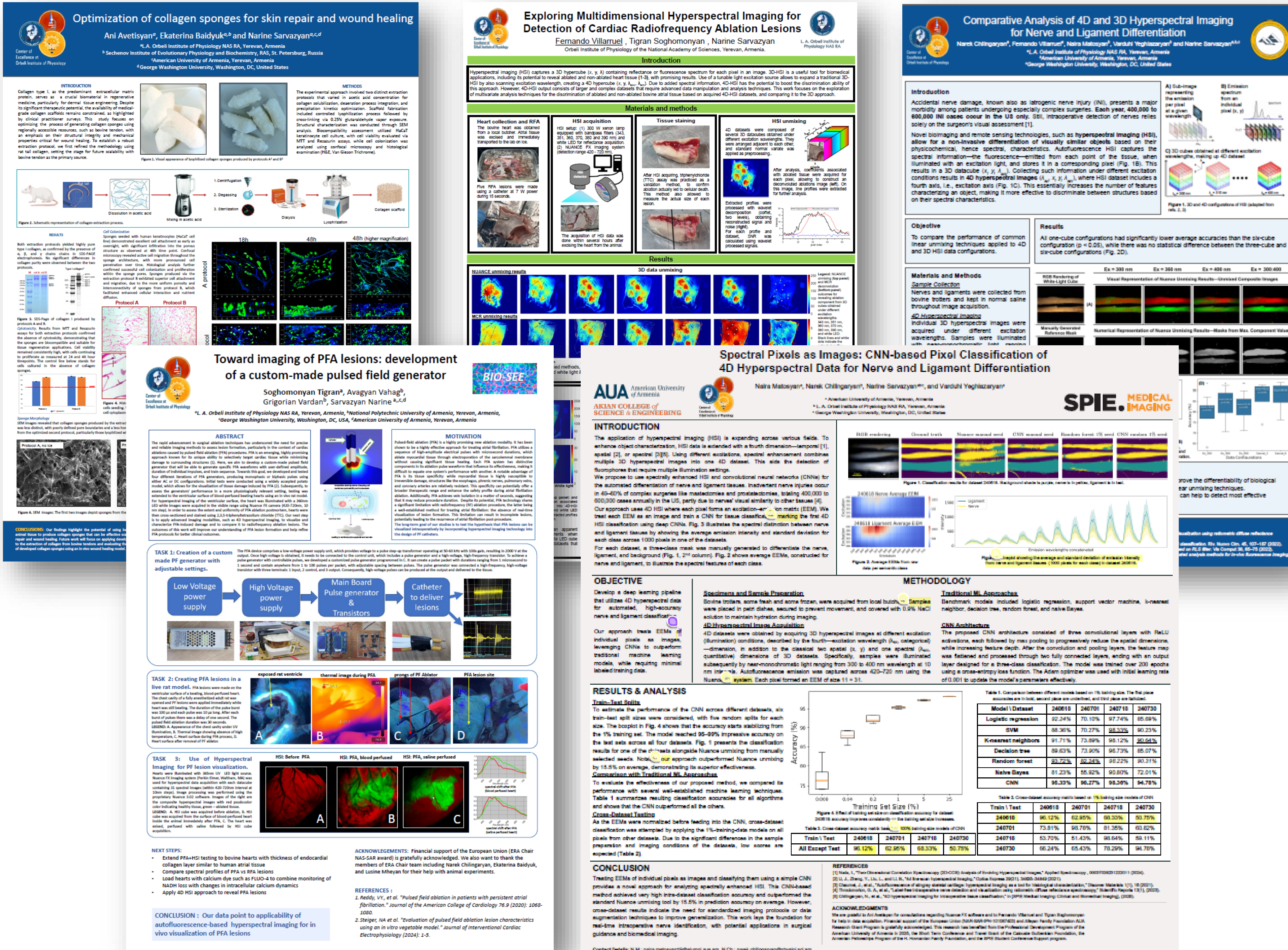


Fig. 1: Images of three lichen species in the wild and as a dried specimen. Label Rf stands for Ramalina fraxinea, Fs for Flavopunctelia soredica, and Rs for Ramalina sinensis. Upper row photographs are courtesy of Naira Sargsyan.


Optimization of collagen sponges for skin repair and wound healing
Ani Avetisyan, Ekaterina Baidyuk and Narine Sarvazyan
Exploring Multidimensional Hyperspectral Imaging for Detection of Cardiac Radiofrequency Ablation Lesions
Fernando Villarruel, Tigran Soghomonyan, Narine Sarvazyan
Introduction
Materials and methods
Results
Comparative Analysis of 4D and 3D Hyperspectral Imaging for Nerve and Ligament Differentiation
Toward imaging of PFA lesions: development of a custom-made pulsed field generator
Soghomonyan Tigran, Avagyan Vahag, Grigorian Vardan, Sarvazyan Narine
ABSTRACT
MOTIVATION
Low Voltage power supply
High Voltage power supply
Main Board Pulse generator & Transistors
Catheter to deliver lesions
Spectral Pixels as Images: CNN-based Pixel Classification of 4D Hyperspectral Data for Nerve and Ligament Differentiation
SPIE. MEDICAL IMAGING
INTRODUCTION
OBJECTIVE
METHODOLOGY
RESULTS & ANALYSIS
CONCLUSION

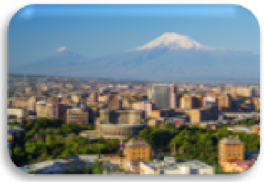
Center of Excellence at Orbeli Institute of Physiology

Co-funded by the European Union

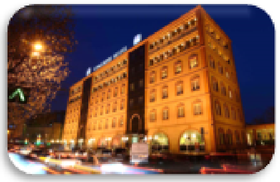
CHAN ZUCKERBERG INITIATIVE

BIO-SEE

Solving Nature's Mysteries Using Advanced Bioimaging Approaches



4-6 November, 2024
Yerevan, Armenia



The 3-day conference will bring together researchers and professionals who utilize advanced imaging techniques to address a variety of biomedical questions and challenges. The program will include talks on cardiac imaging, neurophysiology, toxinology, computational approaches and emerging new technologies. The list of invited distinguished speakers includes, among others, Sandor Gyorke (Ohio State University, USA), Sergei Kazarian (Imperial College London), and Emilia Encheva (George Washington University, USA).

Jointly organized by the BIO-SEE society, funded by the Chan Zuckerberg Initiative, the ERA Chair project, funded by the European Union, and the Orbeli Institute of Physiology of the Armenian National Academy of Sciences, this international conference will feature invited talks, poster session, best image competition, roundtable discussions and social program.

Main Venue: ***Congress Hotel, Yerevan***
Registration Deadline: ***August 12, 2024***
Abstract Submission Deadline: ***October 1, 2024***

Scan to register

Scan to submit abstract

Registered participants will have full access to conference meeting rooms, coffee breaks and lunches. A discounted hotel rate is available for those who register on time. Accepted abstracts will be included in the conference booklet with an assigned ISBN number.

Contacts for additional information:
For programmatic inquiries: Narine Sarvazyan, PhD, at phynas@gwu.edu
For organizational matters: Evelina Harutyunyan at evaharutyunyan@physiol.sci.am

Ongoing trainings and collaborative activities

Center of
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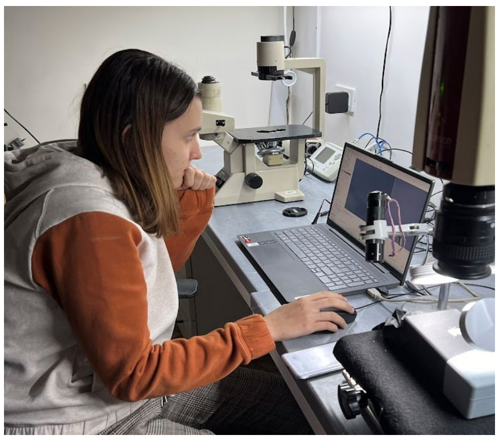
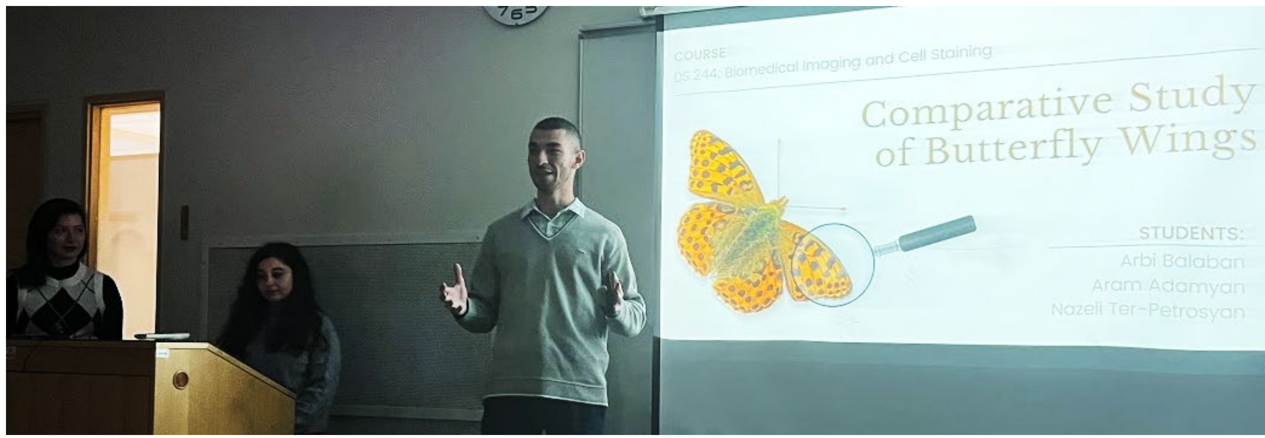
Orbeli Institute of Physiology

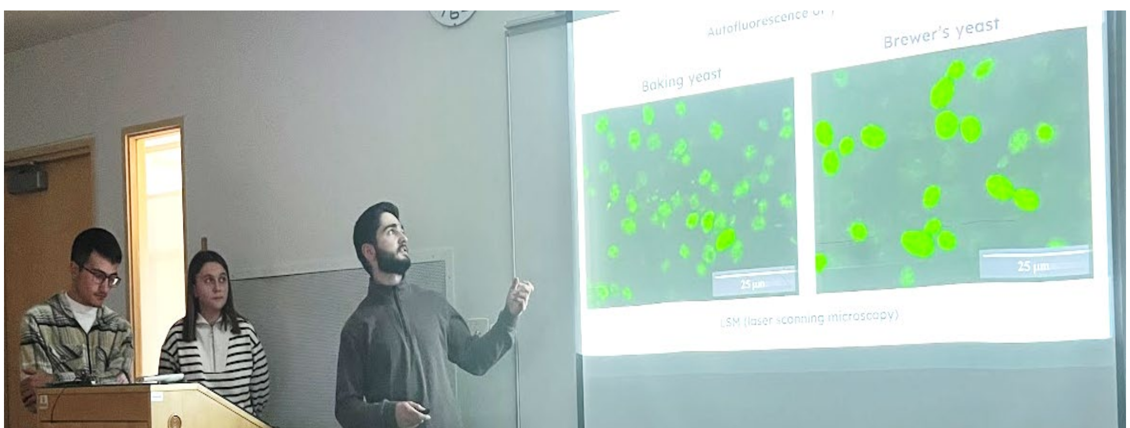
Hands-on Courses in Advanced Bioimaging Techniques

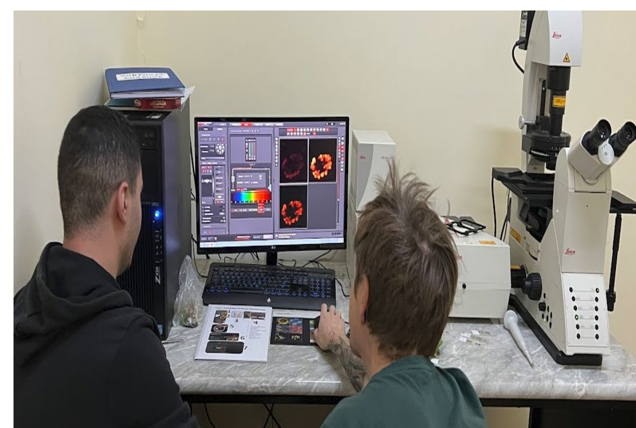
AMERICAN UNIVERSITY OF ARMENIA

Center of Excellence at Orbeli Institute of Physiology









EDUCATIONAL ACTIVITIES / OUTREACH

Science outreach activities for regional schools

Center of Excellence at Orbeli Institute of Physiology

2025: Vivarium renovation

Vivarium renovation – done!

Partners/Collaborators

Joint Projects and/or signed MoUs

- Katholeik University of Leuven, Belgium
- George Washington University, USA
- BGBM, Berlin, Germany (Freie University)
- University of Florence, Italy
- University of Granada, Spain
- Instituto de Biomedicina de Valencia, Spain
- Institute of Immunology, Zagreb, Croatia
- Instituto Butantan, Brazil
- Armenian Bone Marrow Donor Registry, RA
- University of Reading, UK
- Institute of Biophysics and Cell Engineering, Moldova

SUBMITTED GRANTS

This proposal version was submitted by on Brussels Local Time. Issued by the Funding & Tenders Portal Submission System.

Application forms

Proposal ID **SEP-211076846**

Acronym **NPDT-for-AMEEV**

1 - General information

Fields marked * are mandatory to fill.

Topic	ERC-2024-ADG	Type of Action	HORIZON-ERC
Call	ERC-2024-ADG	Type of Model Grant Agreement	HORIZON-AG-LS

Acronym NPDT-for-AMEEV

Proposal title: Development of drug-based, non-plasma-derived biological therapies for viper snakebite treatment in Africa, Middle East and Europe; in silico, in vitro and in vivo approaches

101201618 - NPDT-for-AMEEV

WT reference N320005/Z/24/Z

Draft (0) | **Waiting for Wellcome decision (1)** | Past (3)

1 application awaiting decision

Sorted by recently submitted

Received by Wellcome

Reference number: 320005/Z/24/Z

Discovery Award

Discovery of a universal snakebite antivenom based on 3D-AI-guided screening and design

Lead applicant: Naira Ayvazyan (you)

Application submitted: 3 December 2024

22-OCT-25

Acknowledgements

HORIZON EUROPE

Funded by
the European Union

L. A. Orbeli Institute of
Physiology NAS RA

AMERICAN UNIVERSITY OF ARMENIA

The RA Ministry of Education, Science, Culture and Sports
Higher Education and Science Committee