



# AI4AGRI Summer School 2024

## Artificial Intelligence for Earth Observation Data Analysis

### Call for participation

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8 – 14 May 2024

Brasov, Romania



Universitatea  
Transilvania  
din Braşov



UNIVERSITÉ  
TOULOUSE III  
PAUL SABATIER



UNIVERSITÉ TOULOUSE  
Jean Jaurès



TOR VERGATA  
UNIVERSITÀ DEGLI STUDI DI ROMA



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## Application guidelines and criteria

In order to apply for the participation to the summer school, please prepare the following documents, which should be sent to prof. Mihai Ivanovici (e-mail: [mihai.ivanovici@unitbv.ro](mailto:mihai.ivanovici@unitbv.ro)) from Transilvania University of Brasov (UNITBV), Romania, by **February 29<sup>th</sup>, 2024**.

**Identity of the candidate:** Full name, gender, date of birth, age, affiliation, country of origin (if different from affiliation country).

**One page (max.) presentation outlining your interest in participation to the summer school:**

- Why are you interested in attending the summer school?
- How the summer school is related to your domain of study or your main area of expertise?
- What are the topics you are mostly interested in the summer school curriculum?

**Annexes:** Please attach the following documents to your application file

- a curriculum vitae with photo
- a photocopy of the student card (if the case)
- a letter of recommendation signed by your PhD supervisor or mentor

## Selection criteria

**Successful applicants will:**

- be in the process of completing a BSc, MSc or PhD in a field relevant to the summer school, or be post-doctoral students or young / early-stage researchers;
- have a project related to the fields of Earth Observation, Artificial Intelligence, and/or Agriculture;
- meet the requirement for successful completion of the application;
- have an adequate background (types and contents of courses attended and results obtained by the applicant) with respect to the Earth Observation, Artificial Intelligence;
- be able to put the summer school training in perspective with their future career;

**The following criteria will be evaluated by the selection committee:**

- motivation to participate in the summer school
- AI and EO data using knowledge
- domain of study
- country of origin,

**The Selection Committee will use the following grid to perform the selection:**

Criteria	Relative weight for ranking
Applicant's profile	50%
Motivation and professional project / career	50%

## Participation

Participation to the AI4AGRI Summer School 2024 is for free and it will be face-to-face (in person). The participation fees are paid by the AI4AGRI European project. AI4AGRI will not pay for the travelling and other mission expenses.

## ECTS

Certificates of attendance will be provided, stating the total number of hours (to be considered by the responsible of your program or doctorate school, 30 hours  $\approx$  1 ECTS).

## Venue

The AI4AGRI summer school is planned to take place between 8-14 May 2024 in Brasov, Romania, being hosted by the R&D Institute of Transilvania University of Brasov.

## Accommodation

The accommodation will be ensured by the organizers, the participants will be accommodated in a hotel in Brasov City, free of charge if accepting to share a room, on a first-come-first served basis.

## Logistics

The participants are encouraged to bring their own laptops for the practical works.

## School program overview

<i>Day 1</i>	<i>8 May 2024</i>	<b>Introduction to AI models</b>
<i>Day 2</i>	<i>9 May 2024</i>	<b>Introduction to EO Data</b>
<i>Day 3</i>	<i>10 May 2024</i>	<b>Advanced AI models</b>
<i>Day 4</i>	<i>11 May 2024</i>	<b>A day in the potato field – outdoor activity</b>
<i>Day 5</i>	<i>12 May 2024</i>	<b>Social event – Junii Braşovului</b>
<i>Day 6</i>	<i>13 May 2024</i>	<b>EO Data and Image Analysis</b>
<i>Day 7</i>	<i>14 May 2024</i>	<b>Applications in Agriculture</b>

## Day-by-day school programme

<b>Day 1 – Introduction to AI models</b>	
Participant registration	8:00 – 9:00
M. Ivanovici – Welcome speech and program presentation	9:00 – 9:15
J. Mothe – Introduction to AI models	9:15 – 12:30
Coffee break	10:30 – 11:00
Lunch	12:30 – 13:30
J. Mothe, N. Neptune – Introduction to Deep Learning for EO	13:30 – 17:00
Coffee break	15:30 – 16:00

<b>Day 2 – Introduction to EO Data and Applications</b>	
F. Del Frate – Introduction to EO data	9:00 – 10:00
Coffee break	10:00 – 10:30
F. Del Frate – Applications of SAR data in agriculture	10:30 – 12:30
Lunch	12:30 – 13:30
F. Del Frate – Multispectral and Hyperspectral data – Use of optical and infrared data for applications in agriculture	13:30 – 15:30
Coffee break	15:30 – 16:00
F. Del Frate – UAV applications in agriculture	16:00 – 17:00

<b>Day 3 – Advanced AI Models and Applications</b>	
R. Coliban – Visualization of hyperspectral images using AI	9:00 – 10:00
Coffee break	10:30 – 11:00
C. Florea – Semantic Segmentation and Object Detection for Applications in Agriculture	11:00 – 12:30
Lunch	12:30 – 13:30
Yajing YAN – SAR Image Data Processing and Analysis	13:30 – 16:30
Coffee break	15:00 – 15:30

<b>Day 4 – Social outdoor activity</b>	
A day in the potato field (hosted by the National Institute of Research and Development for Potato and Sugar Beet, Brasov, Romania)	10:00 – 13:00
Brasov city tour (free program)	

<b>Day 5 – Social event</b>	
Participation to Junii Braşovului descent on horses	11:00 – 14:00

<b>Day 6 – EO Data and Image Analysis</b>	
B. Rasti – Hyperspectral Unmixing for Earth Observation	9:00 – 11:00
Coffee break	11:00 – 11:30
M. Ivanovici – A fractal texture model for multi-spectral images	11:30 – 12:30
Lunch	12:30 – 13:30
E. Borgogno – UAV data processing: from images to measures	13:30 – 17:00
Coffee break	15:30 – 16:00

<b>Day 7 – Applications in Agriculture</b>	
M. Nita - How to become a GEDI Master using High-Resolution Lasers for Earth's Forest Monitoring	9:00 – 11:00
Coffee break	11:00 – 11:30
M. Ivanovici – Digital transformation in agriculture. NDVI Analytics.	11:30 – 12:30
Lunch	12:30 – 13:30
M. Datcu – Explainable AI for Earth Observation	13:30 – 15:30
Coffee break	15:30 – 16:00
M. Ivanovici – closing word, participation certificates and conclusions	16:00 – 17:00

## Modules description

### **J. Mothe – *Introduction to ML***

Brief introduction to machine learning (ML), supervised and non-supervised ML, well-established examples of methods from each category (K-means and agglomerative clustering, linear regression, decision tree and SVM). Principles of Neural Network ML: perceptron, retro-propagation, with examples of some multi-layer NN deep architectures.

### **J. Mothe, N. Neptune – *Introduction to Deep Learning for EO – multispectral images***

Practical work in PyTorch, on hyperspectral EO image classification using a deep learning architecture (CNN). Classification result evaluation based on a ground truth. Apply data transformation and augmentation and see how this affects the results. Practice transfer learning.

### **F. Del Frate – *Introduction to EO data***

Presentation of Earth Observation today.

### **F. Del Frate – *SAR images in Agriculture***

Introduction to SAR images, applications of SAR data in agriculture

### **F. Del Frate – *Multispectral and Hyperspectral data***

Description of the use of multi/hyper-spectral images for applications in agriculture

### **R. Coliban – *Visualization of hyperspectral images***

Hyperspectral image visualization will be introduced and a series of visualization techniques will be presented and discussed, followed by a practical work using MATLAB.

### **C. Florea – *Semantic Segmentation and Object Detection for Agriculture***

Starting from CNN and going to more advanced AI models used for semantic segmentation and object detection for applications in agriculture.

### **Y. Yan – *SAR Image Processing and Analysis***

Introduction to Synthetic Aperture RADAR (SAR) image processing and analysis.

### **B. Rasti – *Hyperspectral Unmixing for Earth Observation***

Discussion on supervised, semi-supervised, and blind unmixing techniques, and presentation of recent unmixing methods (EDAA, SUnAA, Misicnet, SUnCNN) and comparison with SOTA.

### **M. Ivanovici – *A fractal texture model for multi-spectral images***

The link between fractal geometry and the digital image analysis, with particular application to texture characterization for remotely-sensed multi-spectral images.

**E. Borgogno – UAV Data Processing: from images to measures**

A deep dive into UAV data processing with special focus on how to compute useful measures from digital images.

**M. Nita - How to become a GEDI Master using High-Resolution Lasers for Earth's Forest Monitoring**

Global Ecosystem Dynamics Investigation (GEDI) data and instrument and the power of the Google Earth Engine platform to produce wall-to-wall maps of forest characteristics such as forest canopy height and canopy vertical structure. Dealing with GEDI data, pre-process, integration in the GEE platform, applying ML and export raster GeoTiff files with predicted data.

**M. Ivanovici – Digital Transformation in Agriculture. NDVI Analytics**

A perspective on the digital transformation in agriculture, followed by applications on NDVI analysis and interpretation.

**M. Datcu – Explainable AI for Earth Observation**

New approaches of EO imaging, leveraging the recent advances in physical process-based AI methods and signal processing, and leading to explainable paradigms where intelligence is the analytical component of the end-to-end sensor and Data Science chain design. A particular focus is on the semantic aspects as a key component in the explainable learning paradigms.

**Social event – Junii Brasovului**



## Lecturers' biographies



Prof. Josiane Mothe is full professor in computer science since 2002 at the CNRS IRIT lab. She is a specialist in information retrieval, data mining, big data and applied machine learning. She obtained accreditation to direct research in 2000 and 20 PhD students were or still are under her supervision. From 2012 to 2015, she led the Information Retrieval – Exploration and visualization team of the IRIT lab. She was responsible for the ANR CAAS project which ended in 2014, and participated to 3 FP7 projects. She was the scientific manager for UPS-IRIT in the FREMIT federation until 2013. Since 2020, she has been the co-publisher of the ACM SIGIR-Forum journal, after holding the editor-in-chief position for Europe and Africa at the Information Retrieval Journal, Springer (2004-2014). She acted as co-chair for CLEF 2015 and as program committee chair for CORIA 2018, CLEF 2018, ECIR 2020 (short papers). She is a program committee member of the leading national and international conference on that field (SIGIR, CIKM, ECIR, CORIA). She led the FabSpace 2.0 (2016-19) H2020 European project which gathered 15 partners and the InnEO Space PhD project (dec 2020-23) H2020 which gathered 5 European partners, and she also participates in the UNIVERSEH, Erasmus+ project (2020-2023).



Prof. Fabio Del Frate is Full Professor at University of Rome "Tor Vergata" since 1999, where he is currently a Full Professor, teaching courses on Remote Sensing and Applied Electromagnetism in various Master and PhD Programs. He is the Coordinator of the "Design, Application, Regulation of UAVs" MSc program and Erasmus coordinator for the Engineering Macroarea. He is, or has been, principal investigator/project manager in several ESA and Italian Space Agency (ASI) funded research projects, author of more than 200 international scientific publications with a special focus on feature extraction algorithms from EO data using neural networks. He has been session organizer and in technical boards of International Conferences and Workshops focused on Geoscience and Remote Sensing. He has been Associate Editor for Geoscience and Remote Sensing Letters, Guest Editor for EURASIP Journal on Advances in Signal Processing and Remote Sensing. Currently he is a Member of the scientific section board of the Remote Sensing journal and Associate Editor for Frontiers of Remote Sensing. He has been a member of the ESA GOME ozone profile retrieval working group. In 2006 and 2007 he was a member of the group winning the IEEE data fusion contest. In 2015 he was appointed EUMETSAT Associate Scientist for activities regarding the estimation of precipitation rate from satellite data. From 2019 to 2022 he received an appointment by ESA as Visiting Professor at the ESA ESRIN centre to provide support in the use of AI for EO data processing. In 2006 he co-founded GEO-K srl, the 1st spin-off company of the University of "Tor Vergata".



Prof. Mihai Datcu (Fellow, IEEE) is a Full Professor at Politehnica University of Bucharest, Romania, since 1981. Since 1993, he has been a Scientist with the German Aerospace Center (DLR), Wessling, Germany. He is developing algorithms for model-based information retrieval from high-complexity signals and methods for scene understanding from SAR data. Since 2011, he has been leading the Immersive Visual Information Mining Research Laboratory, Munich Aerospace Faculty, and he is the Director of the Research Center for Spatial Information, UPB. Since 2001, he had been initiating and leading the Competence Center on Information Extraction and Image Understanding for EO, ParisTech, Paris Institute of Technology, Telecom Paris, Paris, France, a collaboration of DLR with the French Space Agency (CNES). He has been a Professor with the DLR-CNES Chair, ParisTech, Paris Institute of Technology, Telecom Paris. He has initiated the European frame of projects for image information mining (IIM)

and is involved in research programs for information extraction, data mining and knowledge discovery, and data understanding with the ESA, NASA, and in a variety of national and European projects. He and his team have developed and are developing the operational IIM processor in the Payload Ground Segment systems for the German missions, TerraSAR-X, TanDEM-X, and the ESA Sentinel-1 and Sentinel-2. He is a Senior Scientist and the Data Intelligence and Knowledge Discovery Research Group Leader with the Remote Sensing Technology Institute, DLR and involved in the DLR-ONERA Joint Virtual Center for AI in Aerospace. His research interests include explainable and physics aware AI, smart sensors design, and quantum ML with applications in EO. He is a member of the ESA Working Group Big Data from Space and Visiting Professor with the ESA's  $\Phi$ -Lab. He has served as a Co-organizer for international conferences and workshops and as Guest Editor for a special issue on AI and Big Data of the IEEE and other journals.



Enrico Borgogno Mondino he is Full Professor in Geomatics at the Dept. of Agricultural, Forest and Food Sciences, University of Torino. His main research topics concern agro/forestry applications of Geomatics, included optical and SAR satellite, airborne and UAV remote sensing, digital photogrammetry, LiDAR, GIS and survey. Author of more than 150 papers in National and International Scientific Proceedings, Journals and Books. President of the Italian Association of Remote Sensing. President of the ASITA Scientific Committee. Vice-President of the Italian Confederation of Scientific Associations for Territorial and Environmental Information. Chair of the Agriculture Special Interest Group of the European Association of Remote Sensing Laboratories EARSeL. He is/has been scientific responsible of various national and international research projects. He is Editorial board member in MDPI Remote Sensing, MDPI Agronomy, MDPI Geomatics and has been Guest editor of Special Issues in the European Journal of Remote Sensing, MDPI Land, MDPI Remote Sensing, Frontiers in Forests and Global Change.



Yajing Yan received Ph.D. degree in geosciences and environment from the Laboratoire d'Informatique, Systèmes, Traitement de l'Information et de la Connaissance (LISTIC) and the Institut des Sciences de la Terre (ISTerre), Université Savoie Mont Blanc, Annecy-le-Vieux, France, in 2011. She was a Post-Doctoral Fellow with the Institut d'Électronique et des Télécommunications de Rennes, France, from January 2012 to June 2012, and with the Geo-Hydrodynamics and Environment Research group, University of Liège, Liège, Belgium, from July 2012 to August 2014. Since September 2014, she has been an Associate Professor with LISTIC, Université Savoie Mont Blanc. Her research interests include multitemporal interferometric synthetic aperture radar (InSAR) processing, data fusion, data assimilation and ML.



Behnood Rasti (Senior Member, IEEE) received Ph.D. degree in electrical and computer engineering from the University of Iceland, Reykjavik, Iceland, in 2014. In 2015 and 2016, he worked as a Post-Doctoral Researcher with the Electrical and Computer Engineering Department, University of Iceland. From 2016 to 2019, he was a Lecturer with the Center of Engineering Technology and Applied Sciences, Department of Electrical and Computer Engineering, University of Iceland. He is currently a Principal Research Associate with Helmholtz-Zentrum Dresden-Rossendorf (HZDR), Helmholtz Institute Freiberg for Resource Technology, Freiberg, Germany. His research interests include signal and image processing, machine/deep learning, remote sensing, and AI. Dr. Rasti was a Humboldt Research Fellow in 2020 and 2021. He won the Doctoral Grant of the University of Iceland Research Fund "The Eimskip University Fund" and the "Alexander von Humboldt Research Fellowship Grant" in 2013 and 2019, respectively. He serves as an Associate Editor for the IEEE Geoscience and Remote Sensing Letters.



Nathalie Neptune got her Ph.D. degree in Computer Science from Université Toulouse III, Paul Sabatier, in Toulouse, France. Her PhD thesis topic was on big data and geo data for sustainable development, spatial thinking and visualization. She was a Schlumberger Foundation Faculty for the Future fellow from 2017 to 2020. During her PhD, she proposed a novel method to annotate satellite images showing changes in forests with words extracted from scientific publications with the proof of concept developed using Python and PyTorch. Her research interests include multimodal data mining using deep learning approaches for environmental phenomena detection and monitoring.



Corneliu Florea, after a stint with digital still camera software industry, he is currently a Full Professor at the Politehnia University of Bucharest, Romania, within Image Processing and Analysis group. There he lectures on machine learning, statistical signal and computer vision. His research interests include statistical approaches to machine learning and computer vision with a focus on non-supervised learning. He is author of more than 80 peer-reviewed papers and of more than 25 US patents.



Professor Mihai Nita is a Full Professor in the Department of Forest Engineering, Transilvania University of Brasov, specializing in Remote Sensing, GIS, Watershed Management and Hydrotechnical Structures. His research is centered on forest management and monitoring, leveraging expertise in RS-GIS for LULUCF applications, drone mapping, and Forest Ecosystem Services evaluation. Prof. Nita's career encompasses a broad spectrum of expertise in forestry, environmental management, and sustainable resource utilization. He has significantly contributed to various projects and research endeavors, enhancing the understanding and conservation of natural environments. His work spans forest management, geospatial analysis, environmental policy development, sustainable resource utilization, and extensive international collaboration.



Radu-Mihai Coliban is an Assistant Professor, holding a PhD degree from Transilvania University of Brasov, Romania in electronics (2017). His PhD thesis was entitled „Data acquisition and nonlinear processing – applications in imaging and complex experiments in physics“. He is a regular member of IEEE. His research interests include multivariate image processing and analysis (including color, multi-spectral and hyper-spectral), remotely-sensed satellite image analysis, data acquisition and processing, data fusion, digital hardware design, FPGA programming and ASIC design.



Prof. Mihai Ivanovici holds a PhD in electronics from Politehnica University of Bucharest, Romania. He is a full professor and has 15 years of experience in managing various research projects (funded by EU structural funds and the Romanian government, the Ministry of Education and Research or by Romanian private companies) and participating as researcher in national and international research projects (e.g. The ATLAS Experiment at LHC). He is head of MIV Laboratory, within Department of Electronics and Computers, Transilvania University of Braşov, România and member of the IEEE Signal Processing and IEEE Geoscience and Remote Sensing societies. He is a member of the Reviewers Board for MDPI Remote Sensing journal. His research interest and expertise are in the field of colour, multispectral and hyperspectral image processing and analysis. He is supervising PhD in the field of electronics, telecommunications and information technologies.