All scientists who are interested in one of the local focused areas and would like to contribute or participate in their activities are invited to join REACT.

In addition to the local focus areas, we have many more activities, totally open to other people to participate and enrich with their ideas and expertise.

- As a next event, we will have the "Mini-Project Competition" EO4SDG, where your ideas about how to solve environmental problems can be submitted with a short three-page proposal in relation to the SGDs. The short proposals are evaluated, and the first three best-rated ones will have the opportunity to be published in IEEE Geoscience and Remote Sensing Magazine.
- Further, we have regular webinars about the different topics offered with the local focused areas.
- At the IEEE International Symposium on Geoscience and Remote Sensing, we hold an annual meeting on one evening to exchange knowledge and collect ideas for new activities. Please watch out for the announcement of the REACT Technical Committee meeting.
- Currently, we are working on a new podcast series related to climate change and SDGs. The podcast will be launched in September/October 2023.
- We have a strong connection to the IEEE GRSS Young Professionals and are supported in different activities.

All activities are announced through social media and the GRSS home page https://www.grss-ieee.org. Please have a look at it. We look forward to welcoming you at the next event.

GEMINE VIVONE, DALTON LUNGA, FRANCESCOPAOLO SICA, GÜLŞEN TAŞKIN, UJJWAL VERMA, AND RONNY HÄNSCH

Computer Vision for Earth Observation—The First IEEE GRSS Image Analysis and Data Fusion School

The first edition of the IEEE Geoscience and Remote Sensing Society (GRSS) Image Analysis and Data Fusion (IADF) school (see Figure 1) was organized as an online event from 3 to 7 October 2022. It addressed topics related to computer vision (CV) in the context of Earth observation (EO). Nine lessons with both theoretical and hands-on sessions were provided, involving more than 17 lecturers.

We received more than 700 registrations from all over the world. The organizing committee selected 85 candidates to join the online class. The remaining applicants were free to attend the live stream on the GRSS YouTube channel (https://www.youtube.com/c/IEEEGRSS). The selection process relied on several objective criteria, including work experience, academic recognitions, number of publications, and h-index. Due to the high number of registrations, the prescreening also assessed fundamental skills such as programming expertise and CV background, which are of crucial importance to fruitfully attend such a school. Aspects regarding diversity and inclusion were also taken into account as well. The selected people consisted of approximately 50% Ph.D. students and roughly 30% women. The geographical distribution of the selected participants, coming from 33 different countries, is depicted in Figure 2.

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GOALS OF THE IADF SCHOOL ON COMPUTER VISION FOR EARTH OBSERVATION

EO data, in particular, imagery, had been mostly manually interpreted in the early days of remote sensing. With increasing digitization and computational resources, the automatic analysis of these images came into focus. However, most of the approaches were very close to the sensor, interpreting the data as well calibrated measurement of a physical process. They were mostly based on the statistical and/or physical models that describe the functional relation between measurement and the physical properties of the ground (and atmosphere). The advantage of these models is that their results can be assigned to a clear phenomenological context, and the connection to physical laws is maintained. A limitation, however, is that most of these models are based on simplifying assumptions to make their computation tractable.

With the success of CV in other areas (mostly the semantic or geometric interpretation of close-range imagery) a different type of model gained importance. CV emphasizes the "image" aspect of the acquired data, i.e., spectral–spatial relationships among pixels, instead of focusing at the information measured in a single pixel. Its methods are usually data driven, i.e., applying machine learning-based approaches to model the relationship between input data and target variables. This allows gains in flexibility, generalization, and complexity while potentially sacrificing interpretability and physical plausibility of the results.

Since the beginnings of CV in EO, community and methods have shown significant progress. The used approaches are not merely adopted versions of methods designed for close-range photographs anymore, but are increasingly directly tailored toward the specific characteristics of remote sensing data. Sophisticated methods address data particularities such as high-dimensional hyperspectral images or complex-valued synthetic aperture radar (SAR) data as well as task-specific characteristics such as label noise or the general scarcity of annotations.

The goal of this first IEEE GRSS IADF School on Computer Vision for Earth Observation (CV4EO) was to provide a general overview about the multitude of different aspects of how CV is used in EO applications, together with deep insights into modern methods to automatically process and analyze remote sensing images.

FIGURE 1. Logo of the first IEEE GRSS IADF School on Computer Vision for Earth Observation.

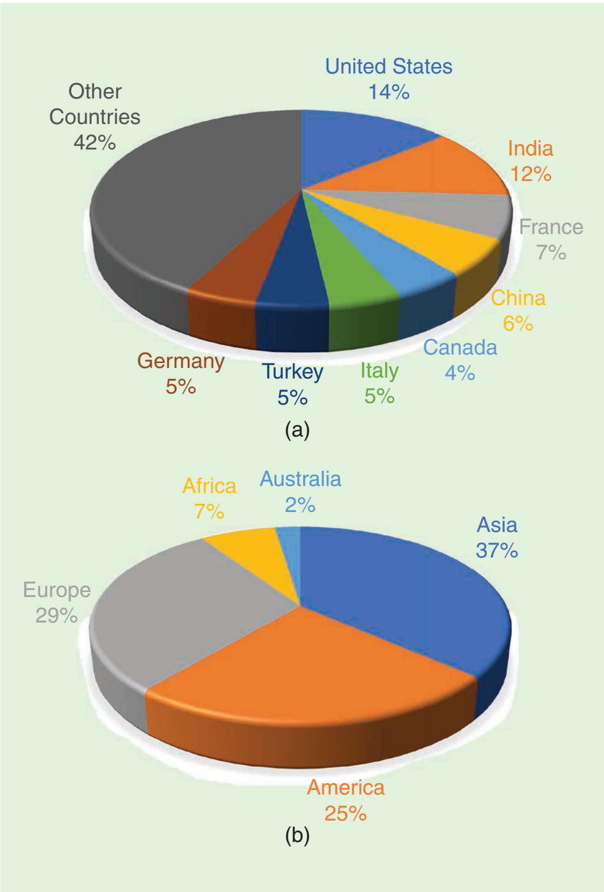

FIGURE 2. A geographical distribution of the selected participants. (a) The countries and (b) continents.

ORGANIZATION OF THE FIRST IEEE GRSS IADF SCHOOL

ORGANIZING COMMITTEE

The school was organized by the IADF Technical Committee (IADF TC) of the GRSS. The organizing committee consists of the following members (Figure 3):

- Gemine Vivone, National Research Council, Italy
- Ronny Hänsch, German Aerospace Center, Germany
- Claudio Persello, University of Twente, The Netherlands
- Dalton Lunga, Oak Ridge National Laboratory, USA
- Gülşen Taşkın, Istanbul Technical University, Turkey
- Ujjwal Verma, Manipal Institute of Technology Bengaluru, India
- Francescopaolo Sica, University of the Bundeswehr Munich, Germany
- Srija Chakraborty, NASA's Goddard Space Flight Center, Universities Space Research Association, USA.

PROGRAM

Remote sensing generates vast amounts of image data that can be difficult and time consuming to analyze using

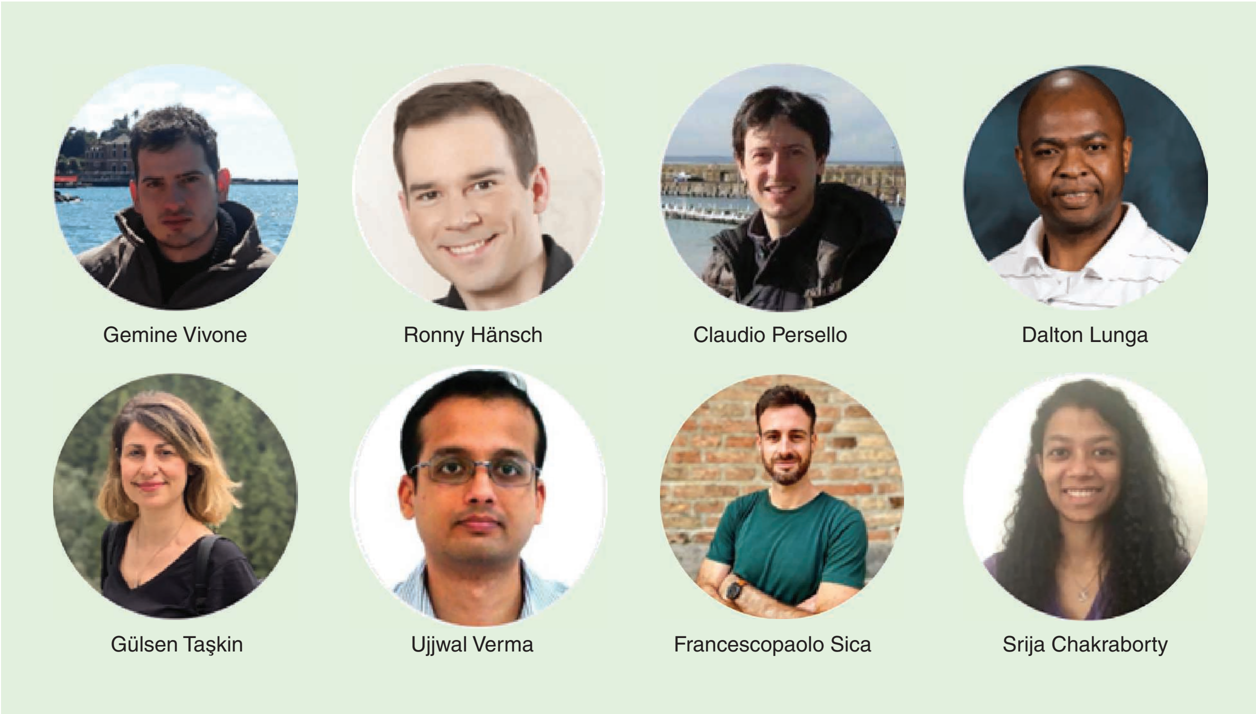

FIGURE 3. The Organizing Committee of the first IEEE GRSS IADF School on CV4EO.

conventional image processing techniques. CV algorithms enable the automatic interpretation of large data, allowing remote sensing to be used for a wide range of applications, including environmental monitoring, land use/cover mapping, and natural resource management. Thus, the IADF TC aimed for prioritizing topics that integrate CV into remote sensing data analysis. The first IADF school focused on applying CV techniques to address modern remote sensing challenges, consisting of a series of lectures

Oct. 3 - Part 1
Oct. 3 - Part 2
Oct. 4 - Part 1
Oct. 4 - Part 2
Oct. 5 - Part 1
Oct. 5 - Part 2
Oct. 6 - Part 1
Oct. 6 - Part 2
Oct. 7 - Part 1

discussing current methods for analyzing satellite images. The covered topics were image fusion, explainable artificial intelligence (AI) for Earth science, big geo-data, multisource image analysis, deep learning for spectral unmixing, SAR image analysis, and learning with zero/few labels. The technical program of the IADF school is depicted in Figure 4.

During the first day of the school, the "Deep/Machine Learning for Spectral Unmixing" lecture covered various topics related to linear hyperspectral unmixing. These included geometrical approaches, blind linear unmixing, and sparse unmixing. Additionally, the course delved into the utilization of autoencoders and convolutional networks for unmixing purposes. The lecture was followed by "Change Detection (TorchGeo)," which elaborated on the utilization of TorchGeo with PyTorch for training change detection models using satellite imagery. On the second day of the school, the "Learning with Zero/Few Labels" lecture discussed recent developments in machine learning with limited label data in EO, including semisupervised learning, weakly supervised learning, and self-supervised learning. The subsequent "SAR Processing" lecture covered various topics, including the analysis of SAR images with different polarimetric channels, the geometry of SAR image

REMOTE SENSING GENERATES VAST AMOUNTS OF IMAGE DATA THAT CAN BE DIFFICULT AND TIME CONSUMING TO ANALYZE USING CONVENTIONAL IMAGE PROCESSING TECHNIQUES.

acquisition, radiometric calibration, and generation of the SAR backscatter image.

On the third day, the "Semantic Segmentation" lecture started with a focus on recent advancements in methods and datasets for the task of semantic segmentation of remote sensing images. This lecture was followed by a practical exercise. During the exercise, participants had the opportunity to train and test a model for this particular task. The school proceeded with a lecture, "Big Geo-Data," which explored the latest developments in machine learning. Practical considerations were presented to effectively deploy these advancements for analyzing high-resolution geospatial imagery across a wide range of applications including ecosystem monitoring, natural hazards, and urban land-cover/land-use patterns. On the fourth day of the school, the "Image Fusion" lecture discussed theoretical and practical elements to develop convolutional neural networks for pansharpening. The "XAI for Earth Science" lecture discussed the methods of explainable AI and demonstrated their use to interpret pretrained models for weather hazard forecasting. The school concluded with a lecture about "PolSAR," which focused on statistical models for fully polarimetric SAR data that arise in practical applications.

DISTRIBUTED MATERIAL

Through lectures, hands-on exercises, and demonstrations, participants gained a deep understanding of key topics in CV4EO, including image fusion, explainable AI, multisource image analysis, deep learning for spectral unmixing, SAR image analysis, and unsupervised and self-supervised learning. The lectures were recorded and

	Topics	Speakers	Affiliations
3 October			
10 a.m.–2 p.m. (UTC +2)	Deep/Machine Learning for Spectral Unmixing	Dr. Behnood Rasti	Helmholtz-Zentrum Dresden-Rossendorf (Germany)
2 p.m.–6 p.m. (UTC +2)	Change Detection (TorchGeo)	Dr. Caleb Robinson	Microsoft (USA)
4 October			
10 a.m.–2 p.m. (UTC +2)	Learning With Zero/Few Labels	Dr. Sudipan Saha, Dr. Angelica I. Aviles-Rivero, Dr. Lichao Mou, Prof. Carola-Bibiane Schönlieb, and Prof. Xiao Xiang Zhu	Technical University of Munich (Germany), German Aerospace Center (Germany), and University of Cambridge (U.K.)
2 p.m.–6 p.m. (UTC +2)	SAR Processing	Dr. Shashi Kumar	IIRS, ISRO (India)
5 October			
10 a.m.–2 p.m. (UTC +2)	Semantic Segmentation	Prof. Sylvain Lobry	Universitè de Paris (France)
2 p.m.–6 p.m. (UTC +2)	Big Geo-Data	Prof. Saurabh Prasad, and Prof. Melba Crawford	University of Houston (USA), and Purdue University (USA)
6 October			
10 a.m.–2 p.m. (UTC +2)	Image Fusion	Prof. Giuseppe Scarpa, and Dr. Matteo Ciotola	University of Naples "Federico II" (Italy)
2 p.m.–6 p.m. (UTC +2)	XAI for Earth Science	Dr. Michele Ronco	University of Valencia (Spain)
7 October			
9 a.m.–1 p.m. (UTC +2)	PolSAR	Prof. Avik Bhattacharya, Prof. Alejandro Frery, and Dr. Dipankar Mandal	Indian Institute of Technology Bombay (India), Victoria University of Wellington (New Zealand), and Kansas State University (USA)

FIGURE 4. The technical program of the first IEEE GRSS IADF School on CV4EO. IIRS, ISRO: Indian Institute of Remote Sensing, Indian Space Research Organisation.

FIGURE 5. Speakers of the first IEEE GRSS IADF School on CV4EO.

made available online on a daily basis on the GRSS YouTube channel. Links to the daily lectures are provided for reference.

SPEAKERS

The first edition of the IEEE GRSS IADF school invited a diverse group of experts from four continents. As shown in Figure 5, the list includes the following:

- Prof. Melba Crawford, professor of civil engineering, Purdue University, USA
- Prof. Saurabh Prasad, associate professor, the Department of Electrical and Computer Engineering, the University of Houston, USA
- Dr. Caleb Robinson, data scientist, the Microsoft AI for Good Research Lab, USA
- Dr. Behnood Rasti, principal research associate, Helmholtz–Zentrum Dresden–Rossendorf, Freiberg, Germany
- Prof. Giuseppe Scarpa and Dr. Matteo Ciotola, associate professor and Ph.D. fellow, respectively, the University of Naples “Federico II”, Italy
- Dr. Sudipan Saha, postdoctoral researcher, Technical University of Munich, Germany
- Dr. Angelica I. Aviles-Rivero, senior research associate, the Department of Applied Mathematics and Theoretical Physics, the University of Cambridge, U.K.
- Dr. Lichao Mou, head of the Visual Learning and Reasoning Team, Remote Sensing Technology Institute, German Aerospace Center, Weßling
- Prof. Carola-Bibiane Schönlieb, professor of applied mathematics, the University of Cambridge, U.K.
- Prof. Xiao Xiang Zhu, professor for data science in EO, Technical University of Munich, Germany

Join the GRSS IADF TC

You can contact the Image Analysis Data Fusion Technical Committee (IADF TC) chairs at iadf_chairs@grss-ieee.org. If you are interested in joining the IADF TC, please complete the form on our website (https://www.grss-ieee.org/technical-committees/image-analysis-and-data-fusion) or send an email to us including your

- first and last name
- institution/company
- country
- IEEE membership number (if available)
- email address.

Members receive information regarding research and applications on image analysis and data fusion topics, and updates on the annual Data Fusion Contest and on all other activities of the IADF TC. Membership in the IADF TC is free! Also, you can join the LinkedIn IEEE GRSS data fusion discussion forum, https://www.linkedin.com/groups/3678437/, or join us on Twitter: Grssiadf.

- Prof. Avik Bhattacharya, professor, the Centre of Studies in Resources Engineering, Indian Institute of Technology Bombay, Mumbai, India
- Prof. Alejandro Frery, professor of statistics and data science, the Victoria University of Wellington, New Zealand
- Dr. Dipankar Mandal, postdoctoral fellow, Department of Agronomy, Kansas State University, USA
- Dr. Shashi Kumar, scientist, the Indian Institute of Remote Sensing, Indian Space Research Organisation, Dehradun, India
- Prof. Sylvain Lobry, associate professor, the Université Paris Cité, the Laboratoire d'Informatique de Paris Descartes, France
- Dr. Michele Ronco, postdoctoral researcher, the Image Processing Laboratory, the University of Valencia.

IEEE GRSS IADF SCHOOL: FIND OUT THE NEXT EDITION!

After the successful first edition of the IEEE GRSS IADF school, a second one will be announced soon. It will follow the same theme as the 2022 edition, i.e., CV4EO. It will be an in-person event and take place at the University of Sannio, Benevento, Italy, 13–15 September 2023. We look forward to seeing you in Benevento! Please stay tuned!

CONCLUSION

We would like to thank the GRSS and the IADF for their support, and all the lecturers who gave so freely of their time and expertise. A survey among the participants conducted after the school clearly showed that the event received high attention and provided an exciting experience. All the comments have been collected and will be used to improve the format of the next editions.

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