Report on the 2022 IEEE Geoscience and Remote Sensing Society Data Fusion Contest

Semisupervised learning

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The Image Analysis and Data Fusion (IADF) Technical Committee (TC) of the IEEE Geoscience and Remote Sensing Society (GRSS) has been organizing the annual Data Fusion Contest (DFC) since 2006. The contest promotes the development of methods for extracting geospatial information from large-scale, multisensor, multimodal, and multitemporal data. It aims to propose new problem settings that are challenging to address with existing techniques and to establish new benchmarks for scientific challenges in remote sensing image analysis [1], [2], [3], [4], [5], [6], [7], [8], [9], [10], [11], [12], [13], [14], [15], [16], [17], [18], [19].

THE 2022 DATA FUSION CONTEST

The DFC 2022 promoted interdisciplinary research on automatic land cover classification from only partially annotated training data. The ultimate goal of the contest was to build models that leverage a large amount of available unlabeled input data while relying on only a small annotated training set. This contest was designed as a benchmarking competition, following previous editions [12], [13], [14], [15], [16], [17], [18]. DFC 2022 had two tracks running in parallel:

- semisupervised land cover mapping (SLM)
- brave new ideas (BNIs).

Both tracks were co-organized with Université Bretagne-Sud, ONERA, and the European Space Agency (ESA) Φ-lab. The DFC 2022 data set extends and modifies MiniFrance (MF) [20], a data set for semisupervised semantic segmentation that includes both labeled and unlabeled imagery for developing and training algorithms. The multimodal MF–DFC 2022 data set contains aerial images, digital elevation model (DEM) information, and land use/land cover maps corresponding to 19 conurbations and their surroundings from different regions in France. It includes urban and countryside scenes: residential areas, industrial and commercial zones, fields, forests, seashore, and low mountains. It gathers data from three sources:

- open data very high-resolution aerial images from the French National Institute of Geographical and Forest Information (IGN) BD ORTHO database
- open data DEM tiles from the IGN RGE ALTI database
- labeled class reference from the UrbanAtlas 2012 database.

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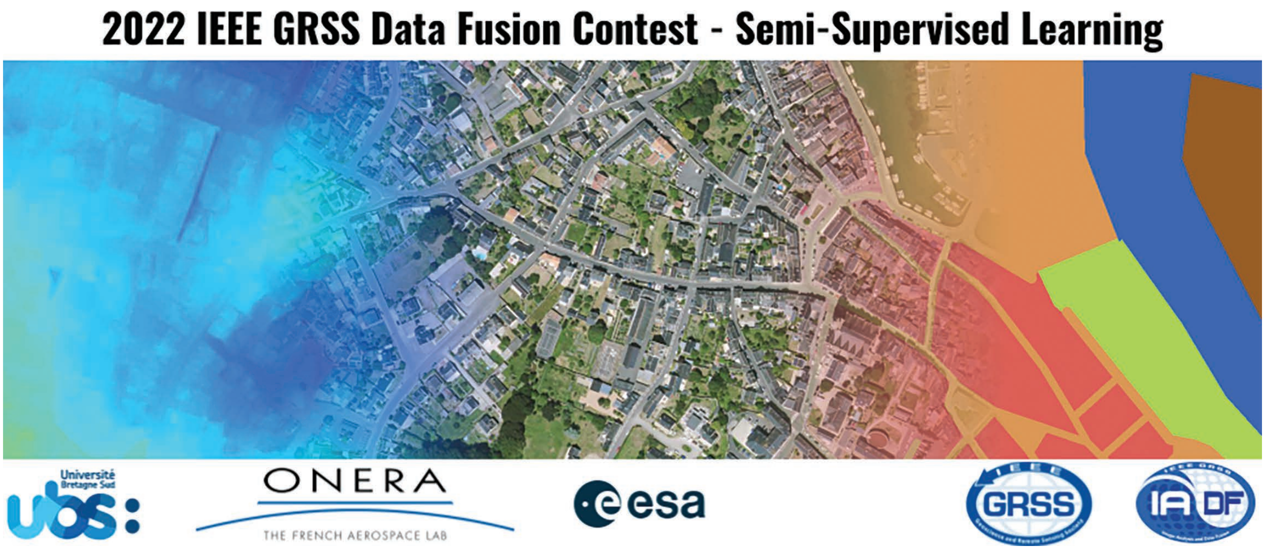

Track SLM was a traditional benchmarking contest: the estimates of the participants were compared against the reference data via the mean intersection-over-union score. During the development phase, the UrbanAtlas 2012 data served as the reference. However, the test phase used annotations that had been carefully created from the test images. Track BNI allowed exploring new ideas more freely without being limited to land cover classification. In this track, all was possible, and all was allowed as long as it was novel and exciting. The ranking in track BNI was based on the evaluation of a methodological description of the approach by the DFC committee.

DFC 2022 tackled two fundamental technical challenges rooted in realistic Earth observation applications: 1) analysis of multisensor and multiresolution data and 2) learning from scarcely annotated data. These two issues are major challenges in a wide range of fields, from Earth observation to computer vision and machine learning. The most important feature of DFC 2022 was that it was directly related to real-world challenges, such as label scarcity and label noise. The results of the contest will have a significant impact, in particular, in terms of the technological development of methods addressing semi- and self-supervised learning.

OUTCOME OF THE CONTEST

While track SLM saw overwhelming participation from a large number of competing international teams, track BNI did not receive a sufficient number of valid submissions. As a consequence, the organizers decided to cancel that track and instead award the top four teams in track SLM. Thus, the first- to fourth-ranked teams in track SLM were awarded as winners of the contest and presented their solutions during the 2022 IEEE International Geoscience and Remote Sensing Symposium (IGARSS).

The four winning teams in track SLM were

- *First place*: the IPIU-XDU team of Xiaoqiang Lu, Guojin Cao, and Tong Gou, of Xidian University, the Chinese Ministry of Education, and Xi'an University of Technology, respectively, for "Student–Teacher-Based Self-Training With Adaptive Filtering to Balance the Annotations and Strong Data Augmentation" [21]
- *Second place*: the Ashelee team of Zhuohong Li, Jiaqi Zou, Fangxiao Lu, and Hongyan Zhang, Wuhan University, for "Ensembling Multiple Models to Generate Pseudo-Labels Used for Finetuning Combined With Class-Specific Post-Processing Steps" [22]
- *Third place*: the BXH team of Qi Zang, Xidian University, for "Self-Distillation of Swin-Transformers With Class-Dependent Regularization" [23]
- *Third place*: the YGJWSL team of Yi Gao, Xingyu Ding, and Guangyi Yang, Wuhan University, for "Strong Data Augmentation Combined With Multi-Modal Fusion Modules and Pseudo-Labels From a Small Network Ensemble [24].

At the end of the competition, all winning teams wrote a four-page paper on their approach, which was peer-reviewed by the DFC organizing committee. These papers were included in the technical program of IGARSS 2022 and presented in an invited session on the DFC during the symposium. All these teams were awarded an IEEE Certificate of Recognition for their winning participation during the virtual award ceremony of IGARSS 2022 (see Figure 1). The winning teams in each track received special prizes thanks to Microsoft AI. An extended article discussing the

Additional Information

The data from the 2022 Data Fusion Contest (DFC) and its CodaLab evaluation website (https://codalab.lisn.upsaclay.fr/competitions/880) with the public leaderboard will remain available to the IEEE Geoscience and Remote Sensing Society (GRSS) community for benchmarking algorithms and publishing research work. The data are usable free of charge for scientific purposes, but the contest terms and conditions, on the contest webpage, remain applicable. Please read them carefully at https://www.grss-ieee.org/community/technical-committees/2022-ieee-grss-data-fusion-contest/.

You can contact the GRSS Image Analysis and Data Fusion (IADF) Technical Committee (TC) chairs at iadf_chairs@grss-ieee.org. If you are interested in joining the IADF TC, please fill out the form on our website: https://www.grss-ieee.org/technical-committees/image-analysis-and-data-fusion. Members receive information regarding research and applications on image analysis and data fusion topics and updates on the annual DFC and on all other activities of the IADF TC. Membership in the IADF TC is free. Also, you can join the LinkedIn GRSS Data Fusion Discussion Forum (https://www.linkedin.com/groups/3678437/) and Twitter channel, @GrssIadf.

FIGURE 1. The awards for DFC 20222 were handed out during the virtual award ceremony of IGARSS 2022, which included representatives of all four winning teams as well as the IADF chair.

winning solutions of the first- and second-ranked teams will be submitted for peer review to the open-access *IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing*.

As in previous years, DFC 2022 attracted participants from a variety of disciplines, including artificial intelligence and machine learning as well as the remote sensing community. The participation of such a diverse range of disciplines promotes the development of novel and interdisciplinary approaches to solve technical problems in the remote sensing and geoscience communities and also leads to a movement to challenge global issues by bringing together knowledge from different fields. The winning teams have been mostly student led, and their extraordinary efforts have led to dramatic advances in technology for the new problems addressed in this competition and to the formation of a vibrant community.

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