BY JAMES L. GARRISON

Introducing the March Issue

Welcome to the March 2021 issue of *IEEE Geoscience and Remote Sensing Magazine* (*GRSM*)! We have a large issue this quarter. A total of ten feature articles review advances in a diverse variety of remote sensing methods [pansharpening, synthetic aperture radar (SAR), and small-loop frequency-domain electromagnetic systems (FDEMs)] and remote sensing applications (open source maps, crop phenotyping, ecological studies, and monitoring of gas flaring).

The first two features cover pansharpening, a technique for fusing high-spatial-resolution panchromatic images with high-spectral-resolution (but low-spatial-resolution) multispectral images. The result can produce the best of both worlds, exhibiting high resolution, both spatially and spectrally. The two articles provide an extensive review and discussion of the various approaches to pansharpening and address the important need for evaluating these different methods under a variety of scenarios. Meng et al. describe a large database collected from six remote sensing satellites and use these data to perform extensive statistical comparisons among the various methods. Vivone et al. look at the benchmarks that can be used for assessing the quality of pansharpened images and apply them to evaluate 26 different pansharpening methods using six performance indices.

We next move on to SAR, with a two-article sequence by Yue et al. on statistical modeling. Statistical models are important for the automatic processing of SAR images and simplifying the interpretation of electromagnetic scattering models, representing the result of more complex scattering mechanisms in terms of pixel value characteristics. The first article by these authors looks at the statistics of single pixels in the SAR image. Although single-pixel models have been well developed, they cannot fully describe the texture characteristics of an image because they omit important information that may be embedded in the SAR image. The second article addresses the state of the art in two-pixel statistical models, which further characterize texture information in the spatial variation in SAR imagery. Such spatially correlated modeling can be described using the power spectrum and autocorrelation function.

The third article related to SAR provides a comparative analysis of target recognition methods. Dong et al. first review previous work on target recognition using a holistic feature and then introduce more recent work on keypoint-based local descriptors. The target recognition accuracies of different methods are compared using two sets of publicly available SAR data: the Moving and Stationary Target Recognition (MSTAR) database of military and civilian vehicles and the OpenSARShip collection of *Sentinel-1* scene images. To further the study of this important application, the authors have provided their source code on github.

The final feature related to radio frequency methods is a tutorial on high-resolution surveying with small-loop FDEM systems. These systems are used near the surface to make subsurface electrical and magnetic measurements. Efficient design of the survey and processing of the data are important. In this article, Hanssens et al. aim to provide an overview of practical measures to optimize FDEM surveys. They describe aspects such as the importance of setting the inter- and inline sampling interval prior to surveying.

The final four features in this issue cover various applications of remote sensing, starting with a review of OpenStreetMap (OSM) by Vargas-Muñoz et al. This community-based, editable map service has found utility in a variety of applications, including validation of land cover/land use maps, traffic estimation, the detection of buildings and roads in aerial imagery, and location-based services. With the rise of deep learning

Digital Object Identifier 10.1109/MGRS.2021.3056862
Date of current version: 8 March 2021

for interpreting Earth observation images, OSM has also become a valuable source of training information.

Genomics-assisted plant breeding has become a vital tool for improving agricultural productivity and food security. The complex relationship between environmental conditions and the genotype ultimately determines the characteristics, known as the *phenotype*, of a specific crop. Phenotyping, the use of protocols and methodologies to obtain a particular trait linked to crop functions and structures, is important for monitoring plant breeding and production. In our second applications feature, Jin et al. introduce the basics of crop phenotyping and review the variety of sensors currently in use for this purpose. They describe how ground and aerial platforms can be used for crop phenotyping in the field. The article concludes by discussing new opportunities, directions, and technological improvements for crop phenotyping, with the goal of improving the efficiency of new trait identification.

Ecological studies using 3D lidar observations are the focus of the feature article by Guo et al. The use of lidar for ecological observations and understanding important ecological processes is reviewed, starting with the current state of lidar hardware and related algorithms. The article then progresses from 2D to 3D observations, leading into the use of these observations in the big data era. The authors conclude by discussing the challenges and opportunities of multiplatform data fusion.

Our final feature, by Faruolo et al., reviews the application of remote sensing to monitoring the important problem of gas flaring, the controlled burning of unusable natural gas. Gas flaring is a significant source of air pollution, a contributor to climate change, and a waste of potentially usable energy. Satellite-based observations have been used for regional or global detection and characterization of flaring sites, estimating the volume of gas being flared, and assessing the contribution to air pollution and greenhouse gas emissions.

I am saddened to report that last year we lost of one of the pioneers of multispectral remote sensing, and fellow Purdue faculty member, Prof. David Landgrebe. A memorial to him, with a brief summary of his important contributions to our field, can be found on page 282. Other columns in this issue include a report on the 2020 IGARSS conference, held as a virtual event due to the COVID-19 pandemic; a "Women in GRSS" column on the topic of women who inspire and empower; and a "Technical Committees" column that introduces the very popular Data Fusion Contest conducted by the Image Analysis and Data Fusion Technical Committee.

(continued on p. 7)

and Remote Sensing Symposium (InGARSS 2020). This conference was originally intended to be an in-person meeting and was the third regional symposium planned by the GRSS for 2020. However, as with many other symposia, the pandemic forced InGARSS 2020 to be virtual. The conference, held on 1–4 December, offered six tutorials, and more than 80 technical papers were presented. A special track devoted to focused discussions on Young Professionals, Women in Engineering, and Industry Partners was also provided. This first InGARSS, cochaired by Dr. Shiv Mohan and Dr. Paul Rosen, was a nice success to end 2020. I would like to thank the many volunteers who enabled this meeting to occur during difficult times and guided it to this success.

Another achievement is the high interest in GRSS ad hoc webinars. The webinar series continues to enjoy a great following since the series began during the period leading up to the September online IGARSS. As reported by Paolo Gamba [1] in this column in December 2020, you can view the ad hoc webinar series on the dedicated GRSS YouTube channel (please see https://www.youtube.com/channel/UCNOdGBo--6UVCiwKSNTMqyg).

Last fall, the AdCom also approved the realization of an outreach video to help explain who we are as a Society and to attract new members. The video was shown at the fall 2020 AGU conference and is now available in three different versions for other events in which the Society may be involved. For instance, we may think of running a short version at the beginning of a lecture by one of the GRSS Distinguished Lecturers or Industrial Speakers. A longer version may be useful for GRSS Chapters to run at their events and so on. All versions are available on the GRSS YouTube channel:

- 1-min video: https://youtu.be/JZrCOuquSN0
- 4-min video: https://youtu.be/tdBXEpGAn_g
- 7-min video: https://youtu.be/ytyfajp_DFQ.

By the time you read this, I anticipate that you will have had a chance to thoroughly explore the look and organization of our new GRSS webpage. I hope that it is easier to use, well organized, and filled with helpful resources. This upgrade required a significant effort on the part of the Information Resources Portfolio led by Mariko Burgin last year and this year by Sid Misra.

Among the other achievements I want to highlight is our GRSS remote sensing course, now available on Coursera, titled "Remote Sensing Image Acquisition, Analysis, and Applications." This project, which has been in the works for more than two years and is produced by John Richards of the University of New South Wales, has now come to fruition. The positive response to this offering has been wonderful to see as well.

Before ending this message, I need to report that we are saddened by the passing last November of Prof. David Landgrebe, a pioneer in the development and use of quantitative remote sensing. Prof. Landgrebe was a champion of hyperspectral imaging and developed algorithms to address the topic's associated opportunities and challenges. The Society established the David Landgrebe Award to be considered annually for outstanding contributions in the field of remote sensing image analysis. You can read about Prof. Landgrebe and his contributions in this issue's "In Memoriam" column and at the following web address: http://www.grss-ieee.org/news/david-landgrebe-1934-2020/. He will be very much missed within the remote sensing and *Landsat* communities.

In closing, I'd like to take another moment to thank all of you for your contributions to the GRSS during these difficult times. I believe that we are a very special Society within IEEE, and this is demonstrated not only by the quality of our publications and conferences but also by the response, enthusiasm, and dedication of our volunteers. Our membership numbers also confirm this. I look forward to working with you all to make 2021 an exciting and productive year for the GRSS.

REFERENCE

[1] P. Gamba, "2020: A year of challenges and triumphs," *IEEE Geosci. Remote Sens. Mag.*, vol. 8, no. 4, pp. 6–7, Dec. 2020. doi: 10.1109/MGRS.2020.3037005.

GRS

FROM THE EDITOR *(continued from p. 5)*

In past issues, I have mentioned that *GRSM* will soon implement a two-stage review process in order to give more timely feedback to potential authors. Short five-page (or fewer) white papers are to be submitted first. These will then be reviewed by associate editors or members of the editorial board. Following a positive review of the white paper, authors may be invited to submit a full manuscript, which will then undergo a complete peer review.

Contributions to our regular columns—"Chapters," "Space Agencies," "Women in GRSS," "Education," "Software and Data Sets," "Technical Committees," and "Conference Reports"—are always welcome. White papers, columns, and invited manuscripts should be submitted through Manuscript Central at http://mc.manuscriptcentral.com/grsm. Proposals for special issues should be sent to me directly at jlg@ieee.org.

Best wishes for 2021, and stay safe! *GRS*