A Green ICASSP 2020 in Virtual Barcelona

When we started to organize ICASSP in Barcelona, one of our goals was to promote an environmentally conscious conference by trying to reduce the use of paper, using recyclable plastic badges, replacing USB sticks with electronic downloads, and promoting the use of digital tools as an alternative to the conference booklet. Now that the conference is over, we can say that we promised a green ICASSP, and we certainly delivered!

It goes without saying that the conference we had originally planned for was quite different from what it eventually turned out to be. In fact, our plans for ICASSP were continuously evolving according to a rapidly changing reality dictated by a pandemic that moved forward beyond the imaginable. At the beginning, there was a common belief that the pandemic would only affect some geographical areas of the globe, so our efforts were devoted to identifying the most-affected sessions and moving them physically to an area of the conference venue that would permit remote presentations. At one point, we even tried to rent LCD screens for remote paper presentations and included a pair of Bluetooth earbuds as part of the registration package to have virtual poster sessions. Unfortunately, seven weeks before the conference started, we had to make the difficult decision to move the conference to a fully virtual event.

Judging by the current numbers, ICASSP 2020 has been a tremendous success. The total number of registrants is now more than 16,000, more than five times the highest number of registrants that ICASSP has ever had! Also, our 18 industry sponsors have been extremely supportive. This has created a great opportunity not only for academic interaction, but also for participating in the diverse industry activities.

This conference has been the result of teamwork, and it has been a wonderful experience. We have realized and sensed that there is a vibrant IEEE Signal Processing Society (SPS) community that is both active and supportive. The technical program chairs, Markus Rupp, Christian Jutten, and Pascale Fung, have been proactive from day one and key to building the foundations of ICASSP 2020. We thank them as well as the whole organizing committee and SPS staff, who incredibly teamed up in the last mile when we decided to go fully virtual. Without them, this conference would not have been a reality. The result has been a colorful program that offered a wide range of activities, and with content remained available one month after the end of the conference in May (i.e., available until 8 June).

Conference program highlights
ICASSP 2020 came with an excellent program, with five outstanding plenary speakers that generated a lot of expectation and an amazingly high turnout at their live virtual sessions: “From Compressed Sensing to Deep Learning: Tasks, Structures, and Models,” by Yonina Eldar, “Deep Representation Learning,” by Yoshua Bengio, “Gauss-Fourier-Wiener-Kalman Ensembles for Adaptivity and Robustness,” by Georgios Giannakis, “Multiantenna Precoding in Wireless Communication Systems,” by Björn Ottersten, and “Conversational Systems and the Marriage of Speech and Language,” by Mari Ostendorf. Thank you all for all of these amazing talks!

We also followed the lead of the organizers of Brighton’s edition, and included a series of nine “expert-to-nonexpert” (ETON) talks throughout the conference. We were aware that these talks had been very well received in the past, so we tried to allocate a higher number of those into the program. We tried to cover current hot topics, e.g., with talks such as “Distributed Machine Learning for Comms” (D. Gunduz), “Decentralized
One of the most important novel- ties of the technical program, compared to previous editions of ICASSP, was the introduction of an industrial track, chaired by Fa-Long Luo. This program included three invited speaker sessions on current hot topics of high industrial relevance, namely a session on signal processing for Internet of Things and DataNet, a session on computational sensing and vision technology, and a session on smart sound and voice processing for the digital society. This was complemented with three industry panel sessions on different aspects of current relevance in the signal processing industry, including:

- “The B5G/6G Challenge—A Race of Enabling Technologies and Design Principle,” organized by A. Alexiou and with participants R. Valenzuela, P. Popovski, J. Jornet, M. Debbah, and M. Junti
- “Signal Processing for Integrated Terrestrial, Airborne, and Satellite Networks,” organized by J. Grotz and with participants A. Khayrallah, J. Wigard, E. Callejo Luis, A. Franchi, O. Liberg, and O. Vidal
- “Signal Processing for Extended Reality,” organized by G. Hernandez Abrego and with participants D. Filip, I. Tashev, R. Mehra, E. Murphy-Chutorian, and A. Peck.

In parallel with the industrial panel sessions, we also had four industrial keynote speakers that explored a number of hot topics in industrial applications of signal processing, going from the connections between speech and finance artificial intelligence (L. Deng), 6G networks (P. Zhu), radar applications (A. Farina), and the value of technical standards (E. Au). The live industrial program was complemented by 27 “show and tell” demo presentations offered on demand, which generated considerable interest, judging from the high number of page visits they received.

In parallel with the industrial track, we offered five workshops, three of them organized by our diamond patrons (Amazon, Sony, and Huawei), another one by our silver patron (MathWorks), and finally the traditional SPS-organized interactive workshop for Young Professionals, which this year was devoted to the use of social media as a tool for the scientist. Other SPS-organized events were adapted to the virtual format, such as the Women in Signal Processing (WiSP) event (which this year changed format and featured a very interesting talk by L. Duro on radiowave waste management), the SP Cup 2020 competition (which was offered as a live event), and a novel activity titled the “SPS 5-Minute Video Clip Contest,” which featured several teams creating a video that would disseminate signal processing topics (which featured beamforming as this year’s topic) to a wider audience.

Another important novelty of the ICASSP 2020 program was the inclusion of two specific collaborative sessions in data science, initiated by T. Adali and P. Schreier, which consisted of papers originally submitted to multiple technical tracks with the common denominator being data science, honoring our motto “Signal Processing: From Sensors to Information, at the Heart of Data Science.” In particular, two collaborative sessions were organized, the first one dealing with highly complex, heterogeneous, and high-dimensional data and the second on robustness, reproducibility, and replicability. These sessions had a significant number of virtual attendees, which confirmed the interest of our audience in data science topics. Judging by the results, collaboration between different technical committees (TCs) is highly recommended in future editions of the conference.

We also continued the longstanding tradition of ICASSP in offering a set of 11 high-quality tutorials. These were extremely well received, since preliminary statistics indicate that almost half of the total live event views during the whole conference (according to Zoom reports) was at one of these tutorials. These tutorials were available on demand, first at the conference platform and now at the SPS resource center, so do not miss the chance to watch them again!

Tutorials included:
- “Machine Learning and Wireless Communications” (Y. Eldar, V. Poor, and N. Shlezinger), “Distributed and Efficient Deep Learning” (W. Samek and F. Sattler), “Graph Filters With Applications to Distributed Optimization and Neural Networks” (G. Leus, E. Isufi, and M. Coutino), “Quantum Signal Processing and Communications—A Glimpse Beyond Moore’s Law” (L. Hanzo, A. Sera Cacciapuoti, and M. Caleffi), “Robust Data Science: Modern Tools for Detection, Clustering, and Cluster Enumeration” (M. Faß, M. Muma, and A.M. Zoubir), “Signal Processing for MIMO Communications Beyond 5G” (E. Björnson and J. Zhang), “Adversarial Robustness of Deep Learning Models: Attack, Defense and Verification” (P.-Y. Chen), “Graph Neural Networks” (A. Ribeiro and F. Gama), “Biomedical Image Reconstruction—From Foundations to Deep Neural Networks” (M. Unser and P. del Aguilá), “Game Theoretic Learning and Applications to Spectrum Collaboration” (A. Leshem and K. Cohen), and “Information Extraction in Joint Millimeter-Wave State Sensing and Communications: Fundamentals to Applications” (K.V. Mishra, B. Shankar, and M. Kobayashi).
Finally, one regular and two student best papers were awarded at ICASSP 2020. These awards were managed by two ad hoc committees, which required some preliminary tasks to area technical chairs and involved the Technical Program Committee (TPC), student chairs, and special sessions chairs.

**Paper statistics and review process**

The number of paper submissions to ICASSP 2020 showed a substantial increase with respect to the previous editions. A total of 3,939 papers were submitted to regular sessions (leaving journal presentations aside), out of which 1,922 were accepted for presentation during the conference (a 47.2% acceptance ratio). This was around a 12% increase in the number of submissions compared to the previous edition of ICASSP. As shown in Figure 1, most of the accepted papers came from the United States (24%), China (21%), France (6%), Japan (6%), Germany (5%), and the United Kingdom (4%). The paper tracks with the most accepted papers were the speech processing track (20%) and the machine learning track (13%).

In this year’s edition, we followed the trend initiated in Brighton and accepted a relatively high number of special sessions (30). To handle the increased number of special session papers, we tried to involve the TCs in the paper decision process. Each special session paper had two different types of reviewers: some reviewers appointed by the session organizers and some additional reviewers appointed by the TCs. This blended review process guaranteed that the technical quality of the accepted papers was fully in line with the rest of the conference, while ensuring that these papers were being reviewed by competent scientists, with backgrounds close to their domain of application.

The review process of the regular papers was conducted by a huge workforce of 2,471 reviewers, and to them we show our utmost gratitude! While most of the reviewers carried out a reasonable number of reviews (between one and five), almost half of the reviews fell upon a small group of volunteers with a much higher review load. More specifically, around 48% of the papers were reviewed by volunteers that had to submit their recommendations on six to 15 papers. This is something that we should all try to equalize in future events, since we believe it would be more desirable that all reviewers shared approximately the same workload.

**Choosing a virtual platform**

One of the biggest issues of the whole process was to choose the platform that would host the virtual conference. Given the technical complexity of the program, together with the extremely tight schedule leading up to the conference, we decided from the very beginning that the main part of the technical program would be available on demand in the form of video presentation recordings.
ICASSP has always regarded poster and lecture sessions as being of the same technical quality. It made sense that both types of presentations were offered the same possibilities on the virtual platform. For this reason, we decided to have them all as 15-min video presentations, irrespective of whether the original presentation format assigned to the paper was a lecture or a poster.

The choice of a virtual conference platform was made with three strong requirements in mind:

1) The content should be available all over the world.

2) We needed a full integration with the company that implemented the entire technical program, which meant that the two teams had to work hand in hand to achieve a complete migration.

3) Most importantly, everything had to be done in a very short time period, since we had only a few weeks before the conference started.

Here, once again, the help of the SPS team was the key to our success, and we will always be indebted for their assistance during this time.

**New conference structure**

With the short notice of the lockdown, we had to make fast decisions, one being that we stick to the planned dates and keep the program as we had originally drawn it up for the on-site event. The technical program was completely finalized, and by following the original schedule, we could also capture, as much as possible, the feeling of the conference and the sense that many attendees were simultaneously present. However, as we have already commented, we had to restructure the conference, as not all activities could go live. Therefore, we developed two parallel paths: the live program and the on-demand sessions.

The live program was devoted to the special activities, such as tutorials, opening ceremony, keynotes talks, ETON talks, industry panels, WiSP forum, patron’s workshops, Young Professionals’ workshop, student job fair, social and cultural meet-ups, president’s town hall, and the awards ceremony. All these activities were scheduled following Central European Summer Time (CEST) (GMT + 2), that is, Barcelona’s time zone, and were available at the ICASSP 2020 virtual platform once they had taken place. A live program meant a live Q&A forum and presentation (the latter depending on the speaker’s availability). To maximize the time zone range compatibility for live viewing around the globe, the main talks were scheduled in the afternoon, CEST. The regular and special sessions (either oral or poster), together with the show and tell demos, were prerecorded and offered in the on-demand path. They were released at 8:00 a.m. CEST on the day they were programmed.

Due to going fully virtual, various other conference aspects changed. First, we decided to make the conference open for everyone, including nonauthors. In this way we took the opportunity that a virtual platform offered to maximize the visibility, participation, and impact of the conference. The proceedings were also open access for one-and-a-half months, instead of the usual one month. Our motto was to be flexible, inclusive, and global.

Second, the choice of Zoom meetings offered by the virtual platform proved to be a good decision, as it allowed for a good management of speakers and audience. It also allowed either prerecorded or live presentations, and both showed high number of page views (posters: 120,139; lectures: 70,944; live program: 53,352; and social-cultural: 4,749, with an average time spent on each page of 2 min. Figure 1 shows more details. Scaling a fully live approach would have been possible if we had more than barely one month to carry out the whole transition. This is because, among other things, rehearsals with each participant in the live program turned out to be key to ensure a good experience, which is a third aspect that changed with respect to an on-site event. Fourth, a chat channel within Zoom and a written Q&A offered by the virtual platform were the main tools for discussion. In fact, a no-show policy, combined with the role of the session chairs, relied heavily on the Q&A forums; authors were requested to upload a video presenting their paper and be available to answer the Q&A forum within a certain time frame, as stated in the conference policies. The session chairs’ role was to monitor this activity. Fifth, and very important to promote good interaction, was the goal to foster attendees’ use of their full complete name and email address when participating in the virtual conference.

During the preparation of the on-site ICASSP, we put a lot of effort in attracting exhibitors and sponsors, and we had succeeded in gaining commitments from 31 different companies. After the virtual meeting announcement, 13 of them cancelled their participation. However, 18 important patrons remained, which was good news, but they required additional effort to be accommodated in the online format. We did not know how to accommodate their publicity expectations, but the outcome was successful for them, with an unexpected attendance to their workshops and an amount of useful attendee data and statistics. All in all, the virtual conference resulted in a good marketplace for sponsors.

Finally, it was essential to communicate the new structure and features by email in advance and daily during the conference. Among other things, we presented virtual tours that showed different pieces of Barcelona and Catalan culture: Sagrada Familia, Dali museum, Gaudi’s modernism, and others. They gave a moving experience to those that attended these tours. Amazingly, they were organized one week before the conference started. When all of us were living as on a roller coaster of a series of unforeseen events, working around and against the clock, someone suggested “what about having some social-cultural experiences?” We did not have time
to think it over and simply went for it… and it was a hit.

**Some overview analytics**

As we previously mentioned, the total number of registrants (16,000+) surpassed all of the expectations and represented more than five times the maximum number ever achieved at an ICASSP before. There is little doubt that the fact that registrations were offered free of charge had something to do with these figures, but it was nevertheless surprising to see that ICASSP generated such a huge wave of interest all over the world. More than 40% of the registrants were not IEEE Members, a fact that indicated that going virtual substantially increased the visibility of the conference. In addition, the number of student registrations increased to around 30% of the total, a substantial increase with respect to previous ICASSP editions (there were around 25% in ICASSP 2019). Clearly, offering free registrations lured a wider spectrum of students into the conference.

Figure 2 shows the geographical distribution of the registrants: around 21% were based in the United States, 10% in China, and 8% in India. It is somewhat surprising to see that China contributed to around 25% of the paper submissions and only 10% of the registrations, and the reason for this may well be time zone differences or quality of experience of the virtual platform. Perhaps the ICASSP survey that has been launched sheds some light into the reasons for this imbalance.

By the end of the conference, the total number of pageviews and sessions were 543,743 and 79,461, respectively. Figure 3 plots the daily active sessions and page views, not only during the conference, but also two weeks after the conference, when the on-demand material and open preview papers were available. During these two weeks, the number of active sessions and page views increased above

![Figure 2. The geographical distribution of the registrations.](image)

![Figure 3. The daily active sessions and page views.](image)
40%. In terms of participation in the different live program events with Zoom meetings, Figure 4 plots the number of page views for both the on-demand and the live program (i.e., Zoom sessions), giving the details of their different activities.

**Sponsors**

After the announcement on 16 March that ICASSP 2020 was moved to a fully virtual conference, SPS dropped the target of a 20% surplus and aimed at a break-even budget. By that date, the number of registered participants was 2,219 and an immediate refund policy was created. After applying it to non-author registrations, a total of 1,267 authors remained to be refunded after the conference. No additional income was generated since the registration to the virtual conference was free.

One of the nicest surprises was the fact that almost all sponsors (especially the high-tier ones) kept their financial support, and in some cases they even increased it! We cannot finish this article without expressing our deepest gratitude to all of them. Thanks to them, ICASSP 2020 has been able to refund part of the registration fees to those authors that were covering a paper. They were extremely supportive during the most difficult times when we really needed them, and they were always patient and understanding when the situation was most unclear. This ICASSP would never have happened without you. Thank you!

**Lessons learned**

“A small event as tiny as a drop of a pin can change the direction of your entire life.” [1] well, at least that of ICASSP 2020. It has been a great opportunity to be creative and lead. Our SPS community definitely will have to work bigger and more complex every year. The only way to manage it is with a large, well-organized, and supportive team. For all of the technical program aspects, the contributions and efficiency of the TC are essential for a conference of ICASSP’s size.

Concerning the technical content of the ICASSP that we organized this year, there were some innovations that worked well, as we have commented in this article. The industrial track, the collaborative sessions on data science, and the new format of WiSP are activities worth keeping in future ICASSP editions. Due to the cumulative innovations, ICASSP is getting bigger and more complex every year. The only way to manage it is with a large, well-organized, and supportive team. For all of the technical program aspects, the contributions and efficiency of the TC are essential for a conference of the quality and size of ICASSP. They organize the review process and session design in their area. To interact with them in a fast and friendly way, the general chairs have to choose a qualified TPC team, and assign to them clear responsibilities: 1) during the prereview process, and together with the technical committees, by providing a first sketch of the program, 2) during the review to achieve a fair outcome, 3) during the rebuttal process, and 4) for the conference awards. Contributions and efficiency of TC chairs are also essential for a conference of ICASSP’s size.

Finally, the team does not only consist of the organizing committee, but also of all of the services that are outsourced. A friendly relationship with the professional service organizers and the SPS staff, to mention a few, is key. We wholeheartedly thank you all!

Our message to the organizers of ICASSP2021 in Toronto is that you can count on us. Paraphrasing what the organizers of ICASSP2019 told us, “What would our happiness be but for our successors, ICASSP 2021 in Toronto, to surpass the heights of any previous ICASSP?”

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**Reference**

[1] B. Habarumana, Pearls of Eternity, Los Gatos, CA: Smashwords, Aug. 19, 2016.