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Ethical Dilemmas in the Sciences

"Science without conscience is only ruin of the soul" said François Rabelais. This centuries-old quote still resonates, today maybe louder than ever. I began to write this editorial at the end of February when Russian tanks and soldiers invaded Ukraine and waves of bombers began dropping their bombs on Ukrainian cities, targeting civilian buildings, hospitals, and schools. This dramatic event was a shock to Europeans, since most of them have lived in relative peace for more than 70 years. Most of them probably pay minimal attention to the wars, however continuous, that have been taking place far from Europe, in Asia or Africa. The surprise and amazement were total and people became aware of the destructive power of a few humans. If only we could bring back Roland Magdane, a French humorist, and his 1981 sketch: "The kings of fools" (in French) [1]. In this editorial, I would like to first address some of the dilemmas scientists are facing in their professional activities.

When we speak about missiles, tanks, and bombers, we immediately think about how these weapons benefit from our work and the advances in our fields. But then, ethical questions arise. Of course, most of us are working to improve quality of life, to progress medicine, to realize more durable and ecological agriculture. But, we are aware that people in poor countries often do not benefit from, for instance, the advancements achieved in the medical field. This is a dilemma for scientists!

In addition, it is clear that it is far too easy for people with bad intentions to divert these inventions from their beneficial uses to ones of destruction. As an example, with advanced satellite imaging methods, one is able to understand the universe, to detect pollution or study the evolution of cultures. But the same tools can be used by armies for keeping an eye on other countries for defensive or agressive goals. Another dilemma for scientists!

But, let's not be naive! A completely passive country would be easy prey for predators. And dissuasive weapons are mandatory—even if not sufficient—for preserving peace. Remember the Latin adage: "Si vis pacem, para bellum". Still, a dilemma!

We scientists also promote open and reproducible science. Sure, it is very important for society to have confidence in science, in the scientists themselves, and in their results. During the COVID-19 pandemic, remember how fake news and complotist messages were disseminated by so-called great scientists. Without any solid arguments, some people have also suggested the COVID-19 virus may have been designed in a laboratory. Sure, to be able to reproduce research experiments and to do fair benchmarks, open and reproducible science is very useful for providing confidence in replicable scientific results and rejection of fakes. But, one can see the other side of the coin. Open and reproducible science, by offering data and codes to anyone, makes the task easier for people with bad intentions. Again, a dilemma for scientists!

Finally, one can ponder if some advances in sciences and technologies, like 5G or 6G in telecommunications or machine learning, etc., are actually mandatory for most uses and users, or mainly developed for the profit of private companies. But at the international level, it is clear that, there is a strong competition—not actually a war—but has it gone too far? It has had a significant impact on jobs and the economies of many countries. And in this international competition, some cooperation between scientists can be difficult or impossible since antinomic to the economical policy of our own countries, which can be concurrent. Always, a dilemma for scientists!

Finally, when we look back in history, and much further back than World War II, there is a very strong correlation between wars and scientific progress, although causality is not always clear.

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clear solution. In addition, scientists, except perhaps in the fields of medicine and biology, are generally not trained to think about these questions. But, would it change things? If we were aware of the ethical issues, do you think it possible to prevent or even to guess all the imaginable bad purposes?

In this issue

A large variety of topics are addressed in this issue and I am sure that everyone can find informative and enriching articles.

Most of us are familiar with classical data-driven methods in machine learning, especially supervised and unsupervised methods, and perhaps less so in reinforcement learning. But there are new approaches, which have been developed for overcoming some of the drawbacks associated with the aforementioned methods. In this issue, there

are two features articles presenting such recent learning approaches.

Federated learning is an interesting approach to preserving data privacy. The main idea is that each user will train on a local server different architectures on his/her own data, thus avoiding the sharing of data with the other users. The architectures resulting from local trainings are shared and trained locally by the other users, and merged in a central server but the data are never shared.

Self-supervised representation learning is another approach to dealing with weakly annotated data. This can be viewed as an alternative to both semi-supervised learning or transfer learning. The main idea is to first train a supplementary network for generating pseudo-labels for the unlabeled data.

These are interesting ideas for preserving privacy or using unlabeled data. Challenges include the reduction of high communication (for federated learning) and computational loads with large carbon footprints. Always, keep in mind the primary question: Is DL mandatory for the task?

Augmented and virtual reality applications and hearable devices are becoming more and more popular. In the feature article "Augmented/Mixed Reality Audio for Hearables: Sensing, Control, and Rendering," (page 63), you will discover the major developments in this area, and the three main SP blocks to delivering realistic, immersive audio content to the user: sound sensing, real sound control, and virtual sound rendering.

The year 2021 has been marked by gigantic fires and floods all over the world. In the "Special Reports" column (page 10), John Edwards presents two projects using signal and image processing for addressing the challenges posed by these two fundamental forces of our planet. But certainly, the true challenge is: What must we do to avoid such disasters?

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If you are eager to advance your knowledge on reconfigurable intelligent surfaces (RISs), that you perhaps first discovered in the feature article on RIS in *IEEE Signal Processing Magazine's (SPM's)* March issue [2] and the report on the 2021 SP Cup [3], the "Lecture Notes" column, that describe the three fundamental properties of RIS (page 97), is for you. In the other "Lecture Notes" column (page 90), you can discover how to design a simple but effective pitch-independent timbre feature, well adapted to musical data. You can also benefit from the ideas presented in the two new "Tips and Tricks" columns, which revisit classical SP tools: Kalman filters (page 105) and the Prony method (page 115).
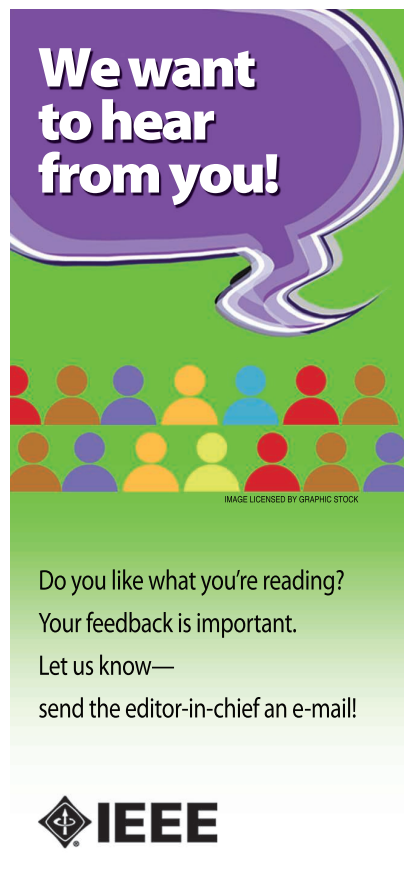
Finally, be sure to check out detailed reports on two SP competitions that took place in 2021. The assigned tasks, results, participants, and winners are discussed in "Automatic Medical Image Diagnosis" (page 130) and "Privacy-Preserving in-Bed Human Pose Estimation" (page 121).

In conclusion, I believe that we must pay constant attention to the ethical issues and dilemmas associated with our scientific activities. Albert Einstein once said: "Science is a powerful tool. The use we make of it depends on the man, not the tool."

References

[1] R. Magdane. "Les rois des fous (the kings of fools)—1981 in French." Facebook. https://fr-fr. facebook.com/rolandmagdane/videos/le-roi-des-fous/ 1015373150782718/

[2] E. Björnson, H. Wymeersch, B. Matthiesen, P. Popovski, L. Sanguinetti, and E. de Carvalho, "Reconfigurable intelligent surfaces: A signal processing perspective with wireless applications," *IEEE Signal Process. Mag.*, vol. 39, no. 2, pp. 135–158, Mar. 2022, doi: 10.1109/MSP.2021.3130549.

[3] E. Björnson and L. Marcenaro, "Configuring an intelligent reflecting surface for wireless communications: Highlights from the 2021 IEEE Signal Processing Cup Student Competition [SP Competitions]," *IEEE Signal Process. Mag.*, vol. 39, no. 1, pp. 126–131, Jan. 2022, doi: 10.1109/MSP. 2021.3123593.

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