



SPS Members, You Are All Heirs of Fourier!

My three years of service as the editor-in-chief (EIC) of *Signal Processing Magazine (SPM)* are now coming to a close. During the past three years, many of us were deeply affected by serious political, social, and environmental events such as the war in Ukraine; protests for freedom in Iran; coups d'état in Africa; the COVID-19 pandemic; seisms in Turkey, Syria, and Morocco; huge floods in Libya and India; gigantic fires in North America and Southern Europe; and an avalanche of stones in the Alps, to name a few. In such a context, I believe that the IEEE slogan, “Advancing Technology for Humanity,” is incredibly relevant and timely. It also must be viewed in a wider sense, including the preservation of Earth and sustainable development. In point of fact, what would become of humanity without Earth? I believe that we must always have this in mind when contemplating our future projects, asking for funding, and while teaching.

The year 2023 also marks the 75th anniversary of the IEEE Signal Processing Society (SPS), and this too offers us an opportunity to think about the signal processing domain and ponder its roots and its dazzling evolution. It is also interesting to think about the early contributions that are of the highest importance in our domain and became its pillars. During ICASSP 2023 in Rhodes, Alan Oppenheim, Ron Schafer, and Tony Constantinides recounted the adventure of digital signal processing in the 1970s.

Such ideas and the book *Digital Signal Processing* [1] were revolutionary at a time when computers were in their infancy. In fact, the concept of digital signal processing was met with mixed reviews and skepticism.

But long before this came the contributions of Jean-Baptiste Joseph Fourier who developed for our understanding the propagation of heat. His most famous book [2], published 201 years ago, in 1822, contains the basics of the Fourier series and transform and their ability to represent a large range of signals. Fourier's ideas were also “out of the box,” and they were also received with reservations from eminent scientists who could not understand how and why a sum of continuous functions could approximate noncontinuous functions. Later, in 1829, Dirichlet presented the theoretical results concerning the convergence of Fourier series [A1]. Fourier's life is a real novel, which the curious reader can discover in this well-documented and fun work (unfortunately, only in French) [3].

In this issue

During this year in which we celebrated the 75th anniversary of the SPS, it was mandatory to recall Fourier, and I warmly thank Patrick Flandrin for his article [A1], which gives many historical details on some of Fourier's contributions and their impact on sound analysis and recordings. The article also highlights tricks for implementing computation before the computer era with amazing machines. As obvious proof of the importance of Fourier in signal and image processing (SIP),

note that all the articles in this issue explicitly mention Fourier's legacy.

You all know what an eigenvalue decomposition (EVD) is and some of its uses, but do you know what a polynomial EVD (PEVD) is? In feature article [A2], you will learn about PEVD and its application in many problems involving multichannel broadband signals. Denoising is an essential task in SIP. Currently, many methods for image denoising use convolutional neural networks (CNNs). Feature article [A3] proposes an in-depth understanding of encoding-decoding CNN architectures (convolution, down/upsampling structures, activation functions, etc.) following signal processing principles.

This issue contains four “Tips and Tricks” columns. In [A4], the authors propose two tricks for approaching a perfect filter with reduced complexity. In [A5], the authors present a trick for robust estimation of the frequency of a single complex exponential using the magnitude of only two samples of its discrete-time Fourier transform. In [A6], the author shows that coding numbers as integers rather than as floating points can avoid rounding errors in the implementation of moving average filters. Note that a copy of the code for this trick can be obtained by sending an e-mail to the author. Finally, [A7] presents a trick for realizing sub-Nyquist coherent imaging based on an optimized multiplexing hologram scheme.

In SP Education column [A8], the authors reflect on education in data science (DS), including signal processing and machine learning, with the objective that

their ideas and guidelines can inspire educators to develop new teaching programs. I appreciated that in these new programs, the authors highlight the consideration of ethical aspects and the sustainability of our global environment. I believe that, in the evaluation of DS methods, educators must also propose metrics, including both performance and complexity terms.

Finally, [A9] reports on the 2022 VIP Cup, which took place in October 2022 at ICIP. The aim of the competition was the detection of synthetic images, i.e., telling the difference between real and fake images, which is a very important task in combating fraudulent design and the use and diffusion of fake images.

Many thanks...

These three years as the EIC of *SPM* were a very enriching experience, requiring a lot of work but giving me great pleasure. Of course, the EIC is just a link in the chain.

It has been my great luck and pleasure to work with a very nice and efficient Editorial Board. In the first circle, I warmly thank the area editors: Laure Blanc-Féraud for FAs, Xiaoxiang Zhu

for special issues (SIs), Rodrigo Guido and Vicky Zhao for columns and forums (C&Fs), Emil Björnson for social media and outreach, and Behnaz Ghoraani and Hamid Palangi for the e-newsletter. I appreciated their friendly interactions and their hard work during these three years. They were always involved in promoting high-quality articles with the specific tutorial nature that is the signature of *SPM*, and whose target audience covers all SPS members and beyond.

I also thank the great team of associate editors of the C&F articles and the e-newsletter. Their role is essential for managing the different categories of articles but is not limited to handling reviews, as in the transactions, since they are also in charge of developing content.

The team of senior members is of the highest importance. In fact, since *SPM* fully covers SIP, and due to the tutorial style of *SPM* articles, the expertise of the team of senior members must be very large. Each proposal for a Special Issue or a Feature Article white paper must be reviewed by a large set of scientists, not all experts in the domain, to represent the *SPM* target au-

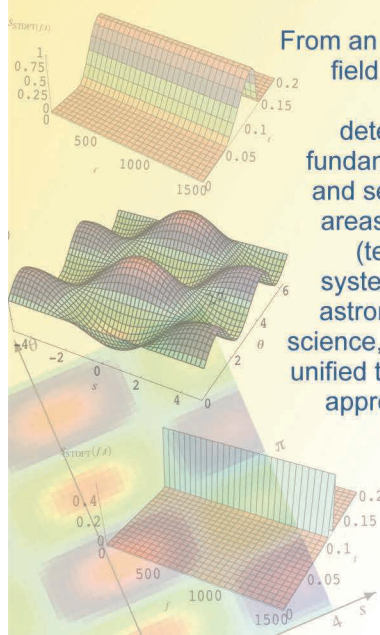
dience. Usually, the decision on proposals is based on at least 10 reviews, which are required in less than three weeks. I thank you all for your service to *SPM*.

All the members of the Editorial Board are ambassadors of *SPM*, and in addition to their reviewing tasks, their roles include the detection, stimulation, and invitation of potential scientists to submit articles or Special Issues to *SPM*. This everyday task is essential for providing compelling and attractive content.

SPM is a fully edited journal. This means that all the articles, after acceptance, are edited, laid out, and illustrated by the IEEE editorial team. For each issue, the cover is also created by the design team after exchanges between the EIC and the journal production managers, Jessica Welsh (up to the end of 2021) and Sharon Turk. I warmly thank the IEEE editorial team, who contributed to the quality and the attractiveness of *SPM*, and especially Sharon and Jessica for their leadership and the quality of our interactions, both friendly and professional.

The reviewing process is based in ScholarOne, and I warmly thank Rebecca

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FIGURE 1. A montage of the 19 *SPM* issues published while Christian Jutten served as EIC.

Wollman for the valuable, efficient, and timely help she provided to the authors, teams of guest editors (GEs), and members of the Editorial Board. I won't forget Rupal Blatt, webpage manager, for her reactivity in updating the *SPM* webpages, adding templates, adding calls for articles for Special Issues etc.

I would like to thank all of the authors who contributed feature articles and columns and forums. And finally, I warmly thank the guest editors who proposed exciting Special Issues and thank them for their efforts in managing the reviews from white papers to full articles and for providing the final manuscripts in due time. *SPM* needs high-level tutorial-like contributions covering SIP methods and applications, following trends in DS and machine learning but always under the SIP umbrella. Keynote speakers and organizers of tutorials and special sessions in conferences and workshops—you are all potential candidates for *SPM* articles. Don't hesitate to contact the area editors to refine and concretize your draft article or idea for a Special Issue. Following the ideas of previous EICs, I added the covers of the 19 *SPM* issues published during the last three years (Figure 1), illustrating the

diversity of articles and Special Issues and also the quality of the work done by the design and editorial teams.

Professor Tulay Adali, from the University of Maryland, Baltimore County, will be taking over as EIC on 1 January 2024. You will be able to read about her vision for the magazine in her editorial in the January 2024 issue. I know her very well; she is a great scientist, and she has also served the SPS in different positions for many years. She is now inviting scientists to join her as area editors, and she will present herself and her team in more detail in her first editorials. With her as EIC, I know that *SPM* is in good hands.

Appendix: Related Articles

- [A1] P. Flandrin, "Fourier and the early days of sound analysis," *IEEE Signal Process. Mag.*, vol. 40, no. 7, pp. 11–16, Nov. 2023, doi: 10.1109/MSP.2023.3297313.
- [A2] V. W. Neo, S. Redif, J. G. McWhirter, J. Pestana, I. K. Proudler, S. Weiss, and P. A. Naylor, "Polynomial eigenvalue decomposition for multichannel broadband signal processing," *IEEE Signal Process. Mag.*, vol. 40, no. 7, pp. 18–37, Nov. 2023, doi: 10.1109/MSP.2023.3269200.
- [A3] L. A. Zavala-Mondragón, P. H. N. de With, and F. van der Sommen, "A signal processing interpretation of noise-reduction convolutional neural networks," *IEEE Signal Process. Mag.*, vol. 40, no. 7, pp. 38–63, Nov. 2023, doi: 10.1109/MSP.2023.3300100.
- [A4] D. Shiung, J.-J. Huang, and Y.-Y. Yang, "Tricks for designing a cascade of infinite impulse response filters with an almost linear phase response," *IEEE Signal*

Process. Mag., vol. 40, no. 7, pp. 64–73, Nov. 2023, doi: 10.1109/MSP.2023.3290772.

[A5] R. Guo and T. Blu, "Super-resolving a frequency band," *IEEE Signal Process. Mag.*, vol. 40, no. 7, pp. 73–77, Nov. 2023, doi: 10.1109/MSP.2023.3311592.

[A6] S. Engelberg, "Implementing moving average filters using recursion," *IEEE Signal Process. Mag.*, vol. 40, no. 7, pp. 78–80, Nov. 2023, doi: 10.1109/MSP.2023.3294721.

[A7] Y. Jeong, B. Tayebi, and J.-H. Han, "Sub-Nyquist coherent imaging using an optimizing multiplexed sampling scheme," *IEEE Signal Process. Mag.*, vol. 40, no. 7, pp. 81–88, Nov. 2023, doi: 10.1109/MSP.2023.3310710.

[A8] S. Gannot, Z.-H. Tan, M. Haardt, N. F. Chen, H.-T. Wai, I. Tashev, W. Kellermann, and J. Dauwels, "Data science education: The signal processing perspective," *IEEE Signal Process. Mag.*, vol. 40, no. 7, pp. 89–93, Nov. 2023, doi: 10.1109/MSP.2023.3294709.

[A9] D. Cozzolino, K. Nagano, L. Thomaz, A. Majumdar, and L. Verdoliva, "Synthetic image detection: Highlights from the IEEE video and image processing cup 2022 student competition," *IEEE Signal Process. Mag.*, vol. 40, no. 7, pp. 94–100, Nov. 2023, doi: 10.1109/MSP.2023.3294720.

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- [1] A. V. Oppenheim and R. W. Schaffer, *Digital Signal Processing*. Englewood Cliffs, NJ, USA: Prentice-Hall, 1975.
- [2] J. Fourier, *Théorie Analytique de la Chaleur*. Paris, France: Firmin Didot, 1822. [Online]. Available: <https://gallica.bnf.fr/ark:/12148/bpt6k1045508v.texteImage>
- [3] E. Marie and E. Cerisier, *Les Oscillations de Joseph Fourier*. Nantes, France: Editions Petit à Petit, 2018.