2010 Wiener Prize

DAVID L. DONOHO received the 2010 AMS-SIAM Norbert Wiener Prize in Applied Mathematics at the Joint Mathematics Meetings in San Francisco in January 2010.

Citation

The 2010 Norbert Wiener Prize is awarded to David L. Donoho for introducing novel fundamental and powerful mathematical tools in signal processing and image analysis. His many outstanding contributions include those to compressed sensing and the construction of multiscale analysis techniques that take advantage of the specific mathematical and physical properties of the problems under consideration. His methods are very deep mathematically and very efficient computationally. This explains their success with both theoreticians and practitioners, which causes him to be one of the most cited applied and computational mathematicians of our time.

Biographical Sketch

David Donoho received his A.B. in statistics (summa cum laude) from Princeton University, where his undergraduate thesis adviser was John W. Tukey. After working in seismic signal processing research at Western Geophysical under Ken Larner, he obtained the Ph.D. in statistics at Harvard, where his thesis adviser was Peter Huber. He held a postdoctoral fellowship at MSRI, then joined the faculty at the University of California, Berkeley, advancing to the rank of professor. He later moved to Stanford University, rising to the position of Anne T. and Robert M. Bass Professor in the Humanities and Sciences. He has also been a visiting professor at Université de Paris, University of Tel Aviv (Sackler Professor and Sackler Lecturer), National University of Singapore, Leiden University (Kloosterman Professor), and University of Cambridge (Rothschild Visiting Professor and Rothschild Lecturer). Donoho is proud of his more than twenty-five Ph.D. students and postdocs, many of whom have become very successful in academia and industry. Donoho is a member of the U.S. National Academy of Sciences and of the American Academy of Arts and Sciences, and he is a recipient of the honorary Doctor of Science degree from the University of Chicago. Donoho cofounded two companies while in Berkeley: D2 Software, makers of MacSpin for high-dimensional data visualization, and BigFix, makers of remote network management software. Donoho has served on the research staff of Renaissance Technologies, a prominent quantitative hedge fund.

David L. Donoho

Response

Norbert Wiener means a lot to me; I am a proud owner of his *Collected Works* [1] and have dived into them regularly for more than two decades. They allowed me to survey Wiener's career from close up: I became intimately familiar with many of Wiener's visionary achievements, including the generalized harmonic analysis, the work on Brownian motion and chaos, and the work on prediction and smoothing of signals, as well as his technical achievements, such as the algebra of absolutely convergent Fourier series and the space PW of bandlimited functions. From the nonmathematical fourth volume [2] of his *Collected Works*, I learned that Wiener had a "wild side" in his later career—a vision of the future; he aimed to be broader and to see farther than any other mathematician of comparable stature.

I am also the proud owner of a beaten-up old copy of a special issue of the *Bulletin of the AMS* dedicated to Norbert Wiener [3]. I have studied carefully what scholars of that time had to say about Wiener. Mathematicians were partially at a loss to assess Wiener's significance, for he was by then a public intellectual and, in some sense, a seer

of our future; mathematics simply was too narrow a forum for discussing and evaluating some of his insights. Has any other issue of the *Bulletin* ever had an article with a title like "From philosophy to mathematics to biology"? It seems unlikely to me.

When Wiener did his great work on prediction and filtering in the early 1940s, he realized that the coming convergence of mathematics and computers was going to have great impacts on society and human life. Others had related insights at the time, notably von Neumann. But Wiener saw farther. He saw three things coming together: mathematical insights, computational power, and the capture of signals sensing the world around us and our position in and effects on the world. Wiener communicated the feeling that the convergence of these three elements was a great adventure for humankind, with great potential benefit but also some complexity and even moral peril.

I am fortunate to have lived part of Wiener's adventure: I have the good fortune to be inspired by mathematical analysis; to have rendered some inspiring mathematics operational through computers, and to actually use the resulting computer codes for processing some of the massive bodies of signals data our civilization is now capturing. I have been fortunate to be part of research teams imaging the earth seismically, probing molecular structure by NMR spectroscopy, using magnetic resonance imaging in novel clinical applications, and processing financial signals in markets worldwide. I have been particularly fortunate to find collaborators willing to do new things in those areas, inspired by mathematical criteria. Wiener must have envisioned that mathematical scientists would someday be so fortunate, but he was able to experience only limited opportunities of this kind in his own lifetime.

Wiener's vision has "caught on"; while his enthusiasm for the convergence of mathematics, computing, and signals must have seemed odd to mathematicians sixty years ago, today there are many mathematicial scientists who implicitly assume this convergence as a central ingredient in their world view. The journals *Inverse Problems* and the *SIAM Journal of Imaging Science* are two venues where mathematical scientists are engaged actively in this convergence. I personally am very fortunate to have had students, coauthors, and postdocs who were as inspired as I was by this same convergence. I'd like to mention three mentors: John Tukey, who foresaw the data-drenched world of today and the importance of data analysis; Yves Meyer, who inspired me to work in multiscale analysis through his eloquent writings and broad scientific attitude; and Raphy Coifman, who foresaw so many of the interactions between harmonic analysis and signal processing that we see today.

We are still only at the beginning of Wiener's adventure. The full convergence of mathematics, computing, and ubiquitous signal capture is still in the future. Perhaps future Wiener awardees will, from time to time, contribute in their own way to Wiener's adventure.

References

[1] NORBERT WIENER, *Collected Works*, Vols. 1–3, The MIT Press, Cambridge, 1976, 1979, 1981.

[2] _____, *Collected Works,* Vol. 4: Cybernetics, Science, and Society; Ethics, Aesthetics, and Literary Criticism; Book Reviews and Obituaries. The MIT Press, Cambridge, 1985.

[3] Special issue on Norbert Wiener, 1894–1964, *Bull. Amer. Math. Soc.* **72** (1966) no. 1, part 2:1–125.

About the Prize

The Wiener Prize is awarded every three years to recognize outstanding contributions to applied mathematics in the highest and broadest sense (until 2001, the prize was awarded every five years). Established in 1967 in honor of Norbert Wiener (1894–1964), the prize was endowed by the Department of Mathematics of the Massachusetts Institute of Technology. The prize is given jointly by the AMS and the Society for Industrial and Applied Mathematics (SIAM). The recipient must be a member of one of these societies and a resident of the United States, Canada, or Mexico. The prize carries a cash award of US$5,000.

The recipient of the Wiener Prize is chosen by a joint AMS-SIAM selection committee. For the 2010 prize, the members of the selection committee were: James G. Glimm, Ronald Glowinski, and Nancy J. Kopell.

The previous recipients of the Wiener Prize are: Richard E. Bellman (1970), Peter D. Lax (1975), Tosio Kato (1980), Gerald B. Whitham (1980), Clifford S. Gardner (1985), Michael Aizenman (1990), Jerrold E. Marsden (1990), Hermann Flaschka (1995), Ciprian Foias (1995), Alexandre J. Chorin (2000), Arthur T. Winfree (2000), James Sethian (2004), and Craig Tracy and Harold Widom (2007).