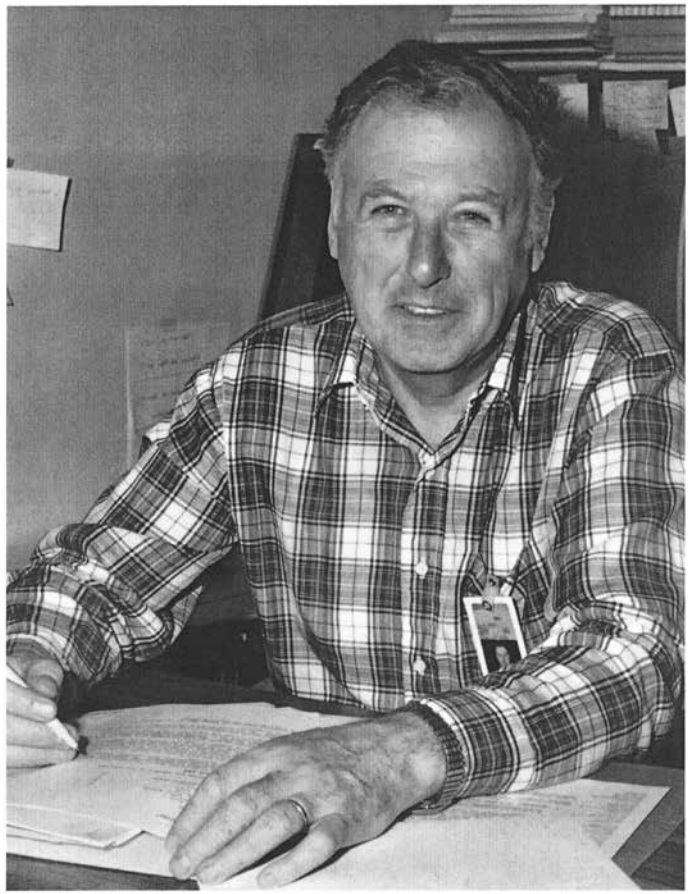

JAMES W. COOLEY

1926–2016

Elected in 2000

"For the creation and development of the fast Fourier transform (FFT) algorithm for time series analysis."

BY RONALD W. SCHAFER

JAMES WILLIAM COOLEY, a pioneer of the field of digital signal processing and long-time applied mathematician at the IBM Thomas J. Watson Research Center, died June 29, 2016, at the age of 89.

Jim was born in New York City on September 18, 1926, to Anna Fanning and William Francis Cooley. He graduated from Grover Cleveland High School, and then served in the US Army Air Corps (1944–45). Afterward, under the GI Bill, he attended Manhattan College, graduating with a BA degree in 1949 and an MA in mathematics in 1951. He received his PhD in applied mathematics from Columbia University in 1961.

From 1953 to 1956 he was a programmer for von Neumann's machine at the Institute for Advanced Study in Princeton, and then he did quantum mechanics computations at the Courant Institute at New York University. In 1962 he joined the research staff of IBM's Watson Center in Yorktown Heights, NY, where he remained until he retired in 1991. He then joined the University of Rhode Island as a professor of electrical engineering, teaching graduate courses and participating in signal processing research projects until he retired in 1993.

Jim Cooley will long be remembered for his central role in the disclosure, development, and dissemination of the fast Fourier transform computational algorithm (or FFT), a very

efficient method for calculating the Fourier transform of discrete data.

The 1965 publication in *Mathematics of Computation* of his paper "An Algorithm for the Machine Calculation of Complex Fourier Series," coauthored with John W. Tukey, is widely accepted as the beginning of the discipline now called digital signal processing (DSP). The paper initially sparked great interest among a handful of pioneers already working on digital filters, but it soon became clear that with the Cooley-Tukey algorithm, the Fourier transform had suddenly gone from being a powerful mathematical tool for representing signals and systems to an even more powerful computational tool for analyzing recorded signals and implementing a virtually unlimited variety of signal processing operations.

Jim's contribution was truly a milestone in the march toward today's digital world that began in the 1960s. His NAE election citation now seems too restrictive in describing the impact of his work. Time series analysis was an application that he recognized and contributed to early on, but the FFT has enabled countless other technical accomplishments that simply would not be possible without it.

Jim was a soft-spoken and modest gentleman who often expressed surprise at the highly acclaimed reception to his work. He was always quick to point out that Richard Garwin of IBM had conveyed the basic divide-and-conquer idea to him from John Tukey and, furthermore, that a long list of other mathematicians, starting with Gauss, had understood the basic principle.

But with the rapid evolution of digital computers, the time was ripe to exploit the many orders-of-magnitude speed-up that could be achieved for large datasets and images, and it was Jim Cooley who first worked out the intricate indexing and storage allocation required to make a widely applicable program. With the publication of the Cooley-Tukey paper, the FFT was placed in the public domain and made available to anyone who could see its enormous potential to transform signal processing–based technologies.

Although he once noted that he had not initially seen the significance of the FFT and hadn't even ordered reprints of the paper, Jim soon became a fervent advocate for widespread dissemination of the FFT and the variety of computer programs implementing it. He published valuable papers on properties and applications of the FFT along with several fascinating papers on the history of the idea. Through his efforts with others in the Audio and Electroacoustics Group of the Institute of Electrical and Electronics Engineers (IEEE), the FFT became central to both DSP research and the burgeoning applications of DSP.

Just three years after his landmark paper, Jim was the keynote speaker at the first Arden House Workshop (October 6–8, 1968, in New York), on the FFT. The event brought together researchers from diverse fields with a common interest in the FFT and its many applications. In his address, Jim observed that people were already saying things like, "some day radio tuners will operate with DSP units," and of course today we have software radios along with such DSP-enabled technologies as cell phones, digital audio, and HDTVs, to name but a few. The 1968 Arden House conference, and two more in 1972 and 1976 that he cochaired, were powerful forces in establishing digital signal processing as a key enabling technology in the paradigm shift from analog to digital systems.

Notwithstanding his modesty, Jim received much well-deserved recognition for his work, including several awards from the IEEE Signal Processing Society, the 2002 IEEE Jack S. Kilby Signal Processing Medal, and numerous corporate awards from IBM.

With Jim's passing, we have lost one of the pioneers of a field whose influence permeates all current technology.

At the time of his death, he was residing in Huntington Beach, California. He was preceded in death by his wife, Ingrid Uddholm Cooley, and is survived by sons William and Lars, daughter Anna-Carin, and eight grandchildren.