



James L. Hanegan

JAMES L. FLANAGAN

1925–2015

Elected in 1978

“Contributions to the acoustic theory of speech and hearing processes and engineering applications of this knowledge to voice communication.”

BY BISHNU S. ATAL AND LAWRENCE R. RABINER

JAMES LOTON FLANAGAN, an internationally recognized pioneer and a guiding force in digital voice processing, died August 25, 2015, just 4 hours short of his 90th birthday. He spent 33 years in research at AT&T Bell Laboratories, retiring as director of information principles research in 1990. He then served 15 years at Rutgers University in dual roles as a research center director and as university vice president for research.

Early Years

Jim was born August 26, 1925, to Hanks and Wilhelmina (née Barnes) Flanagan in Greenwood, Mississippi. He grew up with his younger brother, Marion, on a cotton farm owned by their father, in sparse country seven miles east of Greenwood. He rode the yellow bus to school over unpaved rural roads, and did his homework by kerosene lamp until government acts in the mid-1930s brought electrification and telephone communication to rural areas of the United States.

Encouraged by dedicated teachers, he was attracted to math and science. He believed the necessity of improvisation and alternate solutions in farm life amplified his interest in experimentation. He played on the football team and was first chair trumpet in the school band. He graduated from high school

in 1943 with moderately good grades and as president of his class of about 70 students.

By entering college (Mississippi State University) immediately in the summer term and taking an accelerated program in preengineering, he completed the first year of undergraduate education before joining the US Army at age 18. He returned home about three years later, picked up his studies with the help and support of the GI Bill, and graduated with good grades and a BS degree in electrical engineering.

His department head, Harry Simrall, urged him to continue his education and helped him apply to the Massachusetts Institute of Technology for a graduate assistantship. He was delighted when MIT offered a graduate assistant position in the Acoustics Laboratory under Richard Bolt and Leo Beranek (two of the founders of Bolt, Beranek, and Newman, BBN). This opportunity initiated a lifelong career in communications engineering, acoustics, and speech signal processing.

The MIT Years

Completing the SM degree had depleted Jim's financial resources, but Professor Simrall again stepped in and not only offered him a position as instructor but also helped him successfully apply for a Rockefeller scholarship for doctoral study. When the time came to commence his doctoral thesis research at MIT in 1952, it was natural for Jim to turn again to the Acoustics Laboratory and Professor Beranek, and to join a project aimed at efficient coding of speech signals for voice communication. His thesis result (1955) was a formant coding system that required only one-tenth the bandwidth of a conventional landline telephone channel.

His Years at Bell Telephone Labs

Because Jim had studied and been impressed by technical papers emanating from Bell Telephone Laboratories, it was an easy sell by Edward E. David (later science advisor to the White House) to recruit him to his research department

in Murray Hill, New Jersey. Jim was assigned a “two-bay, long side” laboratory, with newly hired technical assistant Bernie Watson. Jim enjoyed periodically mimicking the classic phrase of Alexander Graham Bell, “Mr. Watson, come here, I want you.”

Bell Labs had just acquired its first digital computer, an IBM 650. It had no compiler or assembler. Jim’s first program, written in binary, was a short-time Fourier transform for speech signals. It took a month to write!

In time, Jim’s work was favorably received and he was given responsibility to head the Speech and Auditory Research Department in 1961. Werner Meyer-Eppler, of the University of Bonn, invited him to contribute a book to a series he was organizing for Springer Verlag. Jim accepted on the basis that it be written as a spare-time effort outside of regular duties. The first edition of *Speech Analysis Synthesis and Perception* (1965) was well received, and soon translated and published in Russian. The publisher subsequently urged a second expanded edition (1972), and the book ultimately underwent five printings.

Organizational changes at Bell Labs nudged Jim toward engineering acoustics and he was given responsibility for the Acoustics Research Department, where, in addition to digital speech coding, he had the opportunity to work in the areas of acoustic transducers and room acoustics. The following years continued to be heavily devoted to efficient digital coding and the transmission of speech, with a number of patents on adaptive quantizing and adaptive differential coding, which later aided a useful product for increasing the capacity of private line service.

In 1984 Jim was promoted to director of Information Principles Research, with departments devoted to signal processing, speech research, acoustics, robotics, human perception, and linguistics. He managed to maintain some ancillary personal research on autodirective microphone arrays, digital transducers, and human/machine interaction. The latter was aimed at spatially realistic audio/video teleconferencing; the first system, called HuMaNet (for Human-to-Machine

Network), was the subject of a cover article in the *AT&T Technical Journal*.

Technological Achievements in the Bell Labs Years

Jim Flanagan's individual research included comprehensive modeling of basilar membrane motion in the inner ear, leading to useful engineering models of auditory signal processing. His research also provided the theoretical basis for experimental development of a physiological model of vocal excitation for speech production, which in turn provided a basis for advanced types of vocoders.

Jim was a pioneer in the field of speech and audio processing, with outstanding insights that changed both people-to-people and people-to-machine communications. He always had an eye on the long-term goals while working on current technologies that greased the wheels for his many technical contributions.

Another example of Jim's ability to see into the future was his long-range goal of inventing ways to give a computer a mouth to speak and an ear to listen and learn. Perhaps the best validation of his vision in this area was his 1976 paper in *IEEE Proceedings* 64(4):405–415, "Computers That Talk and Listen: Man-Machine Communication by Voice." This paper predicted user agents such as Siri and Cortana—39 years before their appearance in today's smartphones! Much of the research that led to today's working synthesis and recognition systems originated in Jim's lab, realizing his vision of customer service by machine-generated voice commands.

Jim had a clear vision of how a range of disparate multimedia technologies could work in unison to create something bigger and more useful as a whole. The HuMaNet system integrated voice and image processing technologies with advanced networking capability, leading to the concept of agent-based visual systems.

Jim was the author or coauthor of more than 200 publications and more than 50 patents, including the design patent on the artificial larynx (providing speaking capability to people

who had tracheotomies) and a patent on handling voice in a data network, a forerunner to VoIP services.

In addition to his numerous technological contributions, Jim was widely recognized as an insightful technical speaker and writer. He had a knack for getting to the essence of complex concepts and making them clear to an audience with a wide range of experience and technical expertise.

The Rutgers Years

AT&T Bell Labs corporate policy at the time required officers and directors to leave their jobs at age 65. Jim elected to retire (1990), and a number of opportunities emerged around the country. Discussions with his wife, Mildred, and three sons, Stephen, James, and Aubrey—all married with families and living within a one-hour radius in northern New Jersey—favored remaining in Warren, NJ.

He accepted an offer at Rutgers University, commuting 20 minutes south rather than 10 minutes east. He was appointed Board of Governors Professor of Electrical Engineering and, jointly, director of the Computer Aids to Industrial Productivity (CAIP) research center of about 85 people. The center was supported in part by 20–25 corporate partners, representatives of which formed the CAIP Center board of directors and provided a wealth of interesting research targets (such as automatic computer imaging to maintain quality in pharmaceutical manufacture).

After three years of running the center, Jim was asked by Rutgers University president Francis Lawrence to take the position of university vice president for research (for 50,000 students). Initially Jim demurred, saying he could not separate himself from close contact with technical work to become a university administrator. The president said, “That’s OK, you can do both jobs.” Thus began frequent trips across the Raritan River to the central campus in New Brunswick, and less frequent trips to the urban campuses at Newark and Camden. These duties, which included the center research as well as a great variety of administrative functions, yielded extensive

insight into management techniques for a major state university—the opposite of those in industry.

After 15 years, Jim retired from Rutgers at age 80. Still attracted to technology, he took on consulting for Avaya Communication Research, reporting to the research president. This period also encompassed a three-month visit to Mississippi State University to assist in formulating and teaching a new option in the Electrical Engineering Department on multimedia communication.

Managerial Skills

Jim spent most of his technical career managing other individuals as a department head and then as a lab director. He guided the careers of more than two generations of individuals who grew to positions of prominence in their own right. An outstanding judge of technical talent, he attracted and hired the best and the brightest individuals, and continually thought of ways to bring them to Bell Labs to work alongside the members of his department.

A hallmark of Jim's managerial skills was the general feeling of the broad research community that every time one research challenge was solved by members of Jim's team, he was ready with a new set of challenges, thus illustrating his out-of-the-box thinking skills.

He inspired individuals to be the best they could be and took an interest in all aspects of their technical growth. He guided them with basic principles such as "you never get a second chance to make a great first impression," generally followed by the sage advice to "do it right the first time."

Service to the Technical Community and to the Nation

Jim Flanagan was a model in providing outstanding service to the technical community and to the nation. While at Bell Labs, he served the nation at critical times by being part of a blue ribbon committee that analyzed the infamous 18-minute gap in the Watergate tapes and by his analysis of the final spoken

words in the Challenger explosion. He also served on committees of the National Academy of Sciences and National Academy of Engineering: the Academic Advisory Board (1996–1998), Commission on Engineering and Technical Systems (1984–1986), Board on Telecommunications/Computer Applications (1988–1990), and Board on Army Science and Technology (1992–1995).

Jim believed strongly in service as a way of paying back the debt accumulated by taking advantage of all that the various technical societies offered. He volunteered and assumed leadership positions in both the Institute of Electrical and Electronics Engineers (IEEE; as president of the Group on Audio and Electroacoustics) and the Acoustical Society of America (as president). And he had a way of making sure that everyone he mentored also assumed positions of leadership at the appropriate times in their technical careers.

Recognition of a Lifetime of Achievements

Jim's work was blessed by widespread professional recognition. He received both national and international honors, such as the National Medal of Science, the IEEE Medal of Honor, election to both the NAE and the National Academy of Sciences, the LM Ericsson International Prize for notable contributions to telecommunications, the Marconi International Fellowship, and honorary doctorates from the University of Paris-Sud and the Polytechnic University of Madrid.

Jim is survived by his wife of 57 years, Mildred Bell Flanagan; his brother Thomas Marion of Greenwood; sons Stephen (Deborah), Jim, and Aubrey (Ann Marie); and grandchildren Aubrey, James, Bryan, Antonia, and Hanks.

Thoughts Offered by Son Jim

Professionally for Jim it was all about the science, and for leisure it was all about the outdoors. Deriving from a Southern agrarian heritage, it's not surprising that he acquired and developed an early and lifelong participation in hunting,

fishing, and high school/collegiate (amateur) football. These were accompanied by an ear for music (no doubt enhanced by his acoustic interest) and he studied and played the coronet.

He did not pilot aircraft while serving in the US Army Air Forces, but he was passionate about the “wild blue yonder” and obtained an advanced private pilot’s license with an instrument rating. Later he engaged in tennis and jogging, and maintained his interest in football as an avid spectator, particularly Southeastern Conference competition.

These leisure endeavors were not practiced in isolation. All family members shared in them. Naturally with three sons, he refined and cultivated our interests. Many hours afield included copious training in marksmanship, safety, and the demanding responsibilities of personal conduct. And my brothers and I had many occasions to ride “copilot” and wiggle the aircraft control yoke under his supervision. Jim’s and Mildred’s musical combinations of coronet and piano produced some “dueling duos.” Traveling together both domestically and internationally was a mainstay for all of the family.

Between his leisure and professional states was his awareness of and penchant for encouraging educational attainment. He fostered interest and inspiration in scientific education, particularly in children and young women.

