

# Remembering James Spilker, Jr., Stanford Professor and Pioneer of GPS Technology

*The IEEE Life Fellow's contributions opened the door for more advanced navigation systems*

IEEE Life Fellow James J. Spilker, Jr., Global Positioning Systems (GPS) pioneer, philanthropist, and entrepreneur died on 24 September at the age of 86. Lives around the world are better every day thanks to Prof. Spilker's passion and dedication to his work.

**"I easily could have been homeless."**

Prof. Spilker's early childhood was marked by difficulties. He was raised solely by his mother, battled illnesses, and, as he noted in the IEEE Oral History recorded, became legally blind in one eye when he was young. But, adversity did not hinder Spilker's passion for learning, which continued throughout his life.

Concerned that his mother could not afford tuition at a four-year college, he enrolled in the College of Marin, a two-year community college, in Kentfield, California. His excellent performance, coupled with support from his teachers, led him to apply for a scholarship to Stanford. He passed the required entrance exam and had a perfect score in mathematics. In just five years, Spilker



James J. Spilker, Jr.

earned a bachelor's degree, a master's degree, and a Ph.D. in electrical engineering from the university.

**"It was a magical time."**

NOTE: An earlier version of this article appeared in October 2019 in *The Institute*. It is reprinted with permission from Krauser, Natalie R., "Remembering James Spilker, Jr., Stanford Professor and Pioneer of GPS Technology," *The Institute*, October 25, 2019.

Spilker's career began at Lockheed Research Labs, in Palo Alto, California, where he invented a variant of the well-known phase-locked loop called the delay-locked loop (DLL), as described in a 1961 paper in the *Proceedings of the IEEE*. Variants of the DLL are still widely used in GPS receivers.

He then joined Ford Aerospace, in Newport Beach, California, where he was the payload team leader for the first U.S. military communication satellites. He later led the Ford Aerospace Air Force 621B satellite navigation program, the predecessor to GPS.

In 1973, Spilker cofounded Stanford Telecommunications in Santa Clara County, California, with two colleagues from Ford Aerospace. When the company received the contract to design the signals for GPS, Spilker and GPS became intricately linked. He was the key architect of the unique GPS signal structure, and his company developed the global monitoring equipment that has enabled unprecedented worldwide accuracy.

In 1982, Spilker was elevated to IEEE Fellow "for contributions to the development of digital satellite communications and navigation systems."

**"If you are going to finish, finish fast."**

Over the next 27 years, Spilker grew Stanford Telecommunications into a company of 1,300 employees that operated in five states.

After he sold the company in 1999 to a consortium of buyers, Newbridge/Alcatel; Dii/Flextronics, Intel; and ITT Industries, Spilker helped develop the L5 civilian signal. This technology, which was launched in 2011, provides higher accuracy and more resistance to the effects of interference on navigation, such as from space weather.

Spilker also co-invented the split spectrum mode, now called binary offset carrier, for modern GPS ranging. This technology allows civilian and military signals to use separate areas of the spectrum. He also developed adaptive vector tracking for simultaneously tracking ranging signals from multiple satellites. This will be critical to handling GPS satellite navigation expansion as new satellites and signals are introduced by space agencies around the world.

Spilker joined Stanford in 2001 as a consulting professor of electrical engineering and aeronautical and astronautical engineering.

His highly cited book *Global Positioning System: Theory and Applications* is considered the standard

reference for GPS and it won the 1996 American Institute of Aeronautics and Astronautics Sommerfield Book Award. His popular textbook, *Digital Communications by Satellite* (Prentice Hall), went through 10 reprints.

**“I didn’t have to work, this was my hobby.”**

Prof. Spilker received an impressive number of awards throughout his life for his pioneering work and innovations. He was the recipient of the 2015 IEEE Edison Medal “for contributions to the development and implementation of the GPS civilian navigation system and a career of meritorious achievement.”

Prof. Spilker was also awarded the 1987 Arthur Young Entrepreneur of the Year Award, the 1999 Institute of Navigation Kepler Award, the 2000 U.S. Air Force Space Command Recognition Award, and the 2002 Institute of Navigation Burka Award.

Earlier this year, he, along with Hugo Freuhauf, Brad Parkinson and Richard Schwartz, were honored with the 2019 Queen Elizabeth Prize for Engineering for their collective work on GPS.

Prof. Spilker’s key contributions to the development—and subsequent

enhancement—of GPS, have a profound impact on more than 4 billion people using the technology around the world. Today, each of us benefits from his efforts and the myriad applications stemming from his work are intricately woven into the fabric of everyone’s daily lives. From mobile phones and commercial and private aviation to agriculture and disaster warning and recovery systems—all rely on GPS.

IEEE and its philanthropic partner, the IEEE Foundation, relished their relationship with Prof. Spilker and his wife Anna Marie.

“We will continue to honor his legacy through promoting his entrepreneurial spirit, facilitating the education of future engineers, and preserving his unparalleled contributions to technology, which betters lives daily,” IEEE Foundation President John Treichler says.

Spilker is survived by his wife, Anna Marie Spilker; two sisters; four children; 12 grandchildren; three great-grandchildren; as well as Merry, his German Shepherd, and two rescue cats, Siam and Tiger.

—Natalie Krauser is the development officer for the IEEE Foundation.

**SP**

## **SOCIETY NEWS** (continued from page 13)

and edited several special issues of *IEEE Journal of Selected Topics in Signal Processing* (2013, 2008), *IEEE Journal on Selected Areas in Communications* (2012), and *IEEE Signal Processing Magazine* (2007).

Her research interests include statistical inference, sequential decision

theory, stochastic optimization, machine learning, and algorithmic theory with applications in infrastructure, communications, and social-economic networks. Her lecture topics include active hypothesis testing for anomaly detection in large-scale complex networks; multiarmed bandits for online

learning; adversarial machine learning; label efficiency, prediction accuracy, and robustness; stochastic convex optimization and approximation; classical results and recent advances; and distributed no-regret learning in multiagent systems.

**SP**