Dr. Harry L. Van Trees

EDUCATION

Sc.D.E.E., Massachusetts Institute of Technology (1961)

My doctoral thesis advisor was Professor Yuk Wing Lee, a protégé of Norbert Wiener, who led the Statistical Communications Group. Professor Amar Bose, whose acoustic research was in its early stages, was a member of my committee. I was fortunate to be able to take my Information Theory course from Professor Claude Shannon.

M.Sc.E.E., University of Maryland (1958)

B.Sc., U.S. Military Academy, West Point (1952)

I graduated first in a class of 525 students. I received nine academic prizes for ranking first in specific academic subjects, including all of the mathematical and technical subjects. This is the largest number of academic prizes awarded to an individual in the history of the Academy.

EXPERIENCE

The experience summary is divided into four sections: academic, government, industrial, and entrepreneurial. Within each section, the entries are chronological.

Academic

June 1961-June 1972: Professor of Electrical Engineering, Massachusetts Institute of Technology.

Dr. Van Trees joined the M.I.T. faculty after receiving his Sc.D. in 1961, received tenure in 1968, and was appointed a full Professor in 1969. His mentor during this period was Professor Wilbur Davenport. He was active in graduate course development, creating a sequence of three courses on detection and estimation theory and its applications.

He formed a new research group in the area of signal processing. He and his students made major contributions in detection and estimation theory, phase-locked loops, optimum array processing, the application of Kalman filtering to communications, adaptive equalization, and sonar signal processing.

One of his most important professional contributions during this period was a three-volume set of books on *Detection, Estimation, and Modulation Theory*. These books contained a number of new research results in addition to a unified approach to communications, radar, sonar, and seismic applications. The first volume is the classic in its field, is used in graduate schools throughout the world, and has been translated into

Russian and Chinese. Part I had thirty printings through 1998 and has been used to educate an entire generation of engineers and is one of the most widely-referenced books in the field. The second and third volumes are widely used as references in the communications and radar/sonar area. The three parts were reprinted in paperback in 2001.

During this period, he has also developed a two-semester video-taped course on "Probability and Random Processes" (100 lectures, 44 hours) and an extensive study guide (2600 pages in nine volumes) to accompany this course.

Sept. 1988-August 2005: George Mason Institute Professor of Electrical Engineering and Director, Center for Excellence in Command, Control, Communications, and Intelligence, George Mason University.

The focus of my activities at George Mason University can be divided into two time periods.

1988-1997

Dr. Van Trees joined the George Mason University faculty with an Endowed Chair and a joint appointment in the Electrical Engineering Department and Systems Engineering Department.

He founded the Center of Excellence in Command, Control, Communications, and Intelligence (C3I) in June 1989 with grants from the Virginia Center for Innovative Technology and several government agencies and private companies. The Center grew rapidly and, at its peak had 15 faculty members associated with it and an annual budget exceeding 5 million dollars. Research areas include remote sensing, data fusion, reasoning under uncertainty, decision support systems, telecommunications, high speed networks, mobile communications, satellite communications, speech enhancement for hearing aids, intelligent tutoring for high school students, distributed simulation, and architectures for complex systems, statistical signal and array processing.

During this period, he developed new graduate courses in Detection and Estimation Theory, Array Processing, and Advanced Signal Processing.

In addition, he led the development of a C3 curriculum as an option under the M.Sc. System Engineering program. This curriculum was the only quantitative program in this area in the world. As part of this curriculum, he developed and taught a two-semester course, "Principles of C3," laying the quantitative foundations for the area.

1997-2005

During this period, Dr. Van Trees continued to direct the C3I Center but de-emphasized further growth. He focused his attention on his own research and writing in the statistical signal and array processing area.

In collaboration with Professor Kristine Bell, he supervised a number of doctoral students and co-authored a large number of journal articles and conference papers.

His most important contribution during this period was his book, "Optimum Array Processing", Part IV of the Detection, Estimation, and Modulation Theory series which was published in 2002. It has received wide acceptance throughout the world and has been translated into Chinese.

Dr. Van Trees retired from George Mason University on September 1 , 2005 and is a University Professor Emeritus and a consultant in the areas of detection and estimation theory and array processing.

2005-2006

Dr. Van Trees is currently a Professor of Electrical Engineering at the University of Hawaii at Manoa in a half-time position He is also a Distinguished Research Professor at George Mason University in a part-time position. He serves as a consultant to DARPA and ONR on various array and signal processing problems.

Government

In June 1972, M.I.T. loaned Dr. Van Trees to the Defense Department. This led to a sequence of increasingly responsible government positions.

June 1972-Feb. 1975: Chief Scientist and Associate Director, Technology, Defense Communications Agency.

He was the senior civilian in the agency and the primary scientific and technical authority for the Director. He assumed responsibility for the DCA and DCS R&D program, established a centralized engineering center, organized the military satellite office, and acted as a major contributor to the WWMCCS efforts of the DCA. He was instrumental in moving defense communications from analog technology to digital technology.

He organized the first DCA Advisory Committee and used his contacts to get a group of senior communications experts to advise DCA. This group played a major role in many important policy decisions, including the evolution of ARPANET.

Nov. 1978-June 1979: Chief Scientist, United States Air Force.

Dr. Van Trees was the chief scientific advisor to the Chief of Staff, USAF, and to the Air Force in all areas of research, development, and acquisition. He played a key role on the Air Staff for many communications and C2 programs. In particular, he helped shape the

military satellite program and the evolution of JTIDS (joint tactical information distribution system).

June 1979-Jan. 1981: Principal Deputy Assistant Secretary of Defense C3I.

Dr. Van Trees served as the Assistant Secretary's alter ego and was involved in all major actions of the office. During this time, he instituted a mission-oriented management structure in the C3I staff, provided guidance to a number of important C3I programs, and provided direction to the Military Satellite Office, the WWMCCS (Worldwide Military Command and Control System) System Engineer, and the Defense Communication Agency. He was in charge of all U.S. C3I activities in the NATO area and was responsible for major accomplishments in the area of satellite communications, secure voice, and IFF in NATO.

There were several serious false alarms in the Missile Warning System at NORAD. Dr. Van Trees led the effort to find the failure mechanism and redesign the system.

Jan. 1981-Aug. 1981: Acting Assistant Secretary of Defense; Command, Control, Communications, and Intelligence C3I.

Dr. Van Trees was responsible for the research, development, and acquisition of C3I systems for the Department of Defense. The program consisted of nearly 400 program elements with annual expenditures of approximately $30 billion. He was responsible for providing leadership and direction to the DoD C3I efforts, coordinating service programs, and ensuring a proper balance of C3I capabilities. He played a major role in the development of the military satellite architecture and he initiated the MILSTAR program in April 1981.

Industrial

March 1975-Nov. 1978: Assistant Vice-President, Advanced Systems, Communication Satellite Corporation

He was head of the Advanced Systems Division, whose responsibilities included planning the future INTELSAT system, including the INTELSAT VI satellite. In addition, the division generated advanced satellite system concepts in the non-INTELSAT area including some of the initial work on the SBS system.

Aug. 1981-Oct. 1982: Executive Vice-President, M/A-COM and General Manager, Eastern Operations

Dr. Irwin Jacobs, who was a colleague at M.I.T. asked Dr. Van Trees to join M/A-COM and start an Eastern Operation. He and Dr. Andy Viterbi had started Linkabit in San Diego and had recently sold the company to M/A-COM.

Dr. Van Trees started the M/A-COM Government Systems operation in Washington and Boston. In three years, it grew to an organization of 200 (with 80 engineers, 40 with advanced degrees) and sales of $35M. Included in the group's achievements were the development and production of a portable SHF satellite communications terminal for the White House Communications Agency and other national users, development of a signal processing payload for a classified satellite, winning the system engineering contract for the Military Satellite Office at DCA, and acting as system engineer for the multiple satellite system.

The portable SHF terminal was an outstanding accomplishment. It was carried in a set of suitcases and could be deployed quickly. It was the only SHF connectivity General Schwarzkopf had when he first arrived in theater for the first Gulf War.

April 1985-Sept. 1988: President, M/A-COM Government Systems Division.

In April 1985, Irwin Jacobs left M/A-COM. Shortly thereafter, he and Andy Viterbi started Qualcomm. I decided to stay with M/A-COM, partly out of loyalty to all of the people I had personally hired.

M/A-COM Government Systems was a high technology division in the defense electronics area. It was a world leader in the development and production of modems, decoders, and communications terminals for military satellite systems. Annual sales approached $90M. MGS had over 1600 employees (including 350 engineers) in San Diego, Boston, and Washington. The division had a reputation for innovative design, state-of-the-art solutions to complex communication systems problems, and excellent system engineering. Dr. Van Trees was responsible for running the division and reported to the CEO of M/A-COM. During this period, the division produced the Army MILSTAR Terminal (SCOTT) modem, the UHF satellite terminal for MAC, an advanced DAMA/CDMA model, a high performance UHF radio, an SHF-receive terminal for the nuclear forces, and a portable SHF terminal used for Presidential communications.

Dr. Van Trees had responsibility for the business management of the Government segment of the company as well as being General Manager of the Washington and Boston Operations.

In June 1988, M/A-COM sold the Washington operation to SAIC and Dr. Van Trees decided to return to academia.

ENTREPENURIAL ACTIVITIES

April 1982-June 2002: **AFCEA Professional Development Center**

In collaboration with Dr. Jon Boyes, the President of the Armed Forces Communication and Electronics Association (AFCEA), Dr. Van Trees founded the Professional Development Center. The mission was to teach short courses (classified at the secret level) to professionals in government and industry. Dr. Van Trees organized and was the

principal lecturer in the first two courses; “Military Satellite Communications” and “Principles of Command, Control, and Communications”. These two courses are still being offered and have been taken by several thousand professionals over the years.

February 1991-August 1999: **CommQuest Technologies Inc.**

In 1991, in collaboration with Dr. Hussein El-Ghoroury and Dale McNeill, former colleagues at M/A-COM, Dr. Van Trees co-founded CommQuest Technologies Inc. and was the first Chairman of the Board of Directors.

The company developed efficient satellite modems. However, its outstanding accomplishment was a low-cost, low-power consumption GSM chip-set for cellular telephones.

The company was very successful and was acquired by IBM in 1999.

PROFESSIONAL AWARDS

Fellow, Institute of Electrical and Electronic Engineers (1974)
Presidential Award for Meritorious Executive (1980)
Distinguished Civilian Service Award (1975)
Distinguished Civilian Service Award (1986)
Best Paper Award, Honorable Mention, Communications Society (1965)
National Science Foundation Fellow (1960, 1961)
AFCEA Gold Medal for Engineering (1988)
Virginia Cultural Laureate (1992)
AFCEA Education Medal (1993)

PUBLIC SERVICE

The following is a list of previous memberships. I am not currently active on any committees.

Member, U.S. Air Force Scientific Advisory Board
Member, U.S. Air Force Studies Board, National Academy of Sciences
Member, Space Division Advisory Group, U.S. Air Force
Member, National Security Agency Advisory Board
Member, U.S. Information Agency Television Telecommunications Advisory Committee
Member, U.S. Information Agency, Radio Engineering Advisory Committee
Member, Communications Society Board of Governors
Member, Army Science Board
Member, Rome (Air Force Base) Labs Advisory Group
Member, Defense Information Systems Agency Scientific Advisory Group
Member, Board of Directors, AFCEA Educational Foundation

MAJOR PUBLICATIONS: Academia I

Books and Video-courses

Detection, Estimation, and Modulation Theory, Part I. New York: John Wiley and Sons, 1968.

Detection, Estimation, and Modulation Theory, Part II. New York: John Wiley and Sons, 1971.

Detection, Estimation, and Modulation Theory, Part III. New York: John Wiley and Sons, 1971.

Synthesis of Optimum Nonlinear Control Systems. Cambridge, Massachusetts: Massachusetts Institute of Technology Press, 1962.

Probability, Volumes I-IV, Massachusetts Institute of Technology, 1970, 1506 pages. This is a detailed study guide to accompany the *Probabilities* video-taped course.

Random Processes, Volumes I-V, Massachusetts Institute of Technology, 1971, 1100 pages. This is a detailed study guide to accompany the *Random Processes* video-taped course.

Probability (fifty video-taped lectures, 22 hours). This was a graduate-level video course produced by the Center for Advanced Engineering Study at M.I.T.

Random Processes (fifty video-taped lectures, 22 hours). This was a graduate-level video course produced by the Center for Advanced Engineering Study at M.I.T.

EDITED VOLUMES

Satellite Communications (Ed.), IEEE Press, 1979.

Proceedings of the IEEE, Special Issue on Packet Communication Networks, Volume 66, No. 11, pp. 1303-1576, November 1978. Kahn, R. (Guest Editor), Uncapher, K. and H. Van Trees (Associate Guest Editors).

JOURNAL ARTICLES

"Functional Techniques for the Analysis of the Nonlinear Behavior of Phase-Locked Loops," *Proceedings of the IEEE,* Vol. 32, No. 8 (Aug. 1964), pp. 894-911.

"Analog Communication over Randomly Time-Varying Channels," *IEEE Transactions on Information Theory,* Vol. IT-12, No. 1 (Jan. 1966), pp. 51-63.

"Optimum Signal Design and Processing for Reverberation-Limited Environments," *IEEE Transactions on Military Electronics,* Vol. MIL-9, Nos. 3-4 (July-Oct. 1965), pp. 212-229.

"Bounds on Accuracy Attainable in Estimating Continuous Random Processes," *IEEE Transactions on Information Theory,* Vol. IT-12, No. 3, July 1966.

"Optimum Angle Modulation," with C. J. Boardman, *IEEE Transactions on Communication Technology,* Vol. COM-13, No. 4 (Dec. 1965), pp. 452-467.

"A Comparison of Optimum Angle Modulation Systems and Rate-Distortion Bounds," *Proceedings of the IEEE*, Vol. 53, No. 12 (Dec. 1965), pp. 2123-2124.

"Applications of State-Variable Techniques in Detection Theory," *Proceedings of the IEEE*, Vol. 58, No. 5 (May 1970), pp. 610-623.

In addition, a number of my doctoral students published journal articles. I encouraged them to acknowledge rather than list me as a co-author.

Major Publications: Academia II

Books

Detection, Estimation, and Modulation Theory, Part IV. New York: Wiley Interscience, 2002.

Detection, Estimation, and Modulation Theory, Part I. New York: Wiley Interscience, 2001 (reprint).

Detection, Estimation, and Modulation Theory, Part II. New York: Wiley Interscience, 2001 (reprint).

Detection, Estimation, and Modulation Theory, Part III. New York: Wiley Interscience, 2001 (reprint).

Book Chapter

"Military Satellite Communication, From Concept to Realtity" in *THE LIMITLESS SKY - Air Force Science and Technology Contributions to the Nation*, A. Levis (ed.), 2004

Keynote Speeches

"Parameter Estimation in Arrays" Eighth IEEE Workshop on Statistical Signal and Array Processing (SSAP '96), Corfu, Greece, June 1996

"Optimum Array Processing". Second IEEE Sensor Array and Multichannel Processing Workshop, Rosslyn, Virginia, August, 2002

"Bayesian Bounds", Adaptive Sensor Array Processing Workshop, Lexington, Massachusetts, June, 2005

Journal Articles

1. K. L. Bell and H. L. Van Trees, "LCMV Beamforming with Quadratic Pattern Constraints for Adaptive and Non-Adaptive Pattern Control," submitted
2. R. E. Zarnich, K. L. Bell, and H. L. Van Trees, "A Unified Method for Measurement and Tracking of Multiple Contacts from Sensor Array Data," *IEEE Trans. Sig. Proc.*, vol. 49, no.12, pp. 2950 –2961, Dec. 2001.
3. Z. Tian, K. L. Bell, and H. L. Van Trees, "Robust Constrained Linear Receivers for CDMA Wireless Systems," *IEEE Trans. Sig. Proc.*, vol. 49, no. 7, pp. 1510-1522, July 2001.

4. Z. Tian, K. L. Bell, and H. L. Van Trees, "A Recursive Least Squares Implementation for LCMP Beamforming Under Quadratic Constraint," *IEEE Trans. Sig. Proc.*, vol. 49, no. 6, pp. 1138-1145, June 2001.
5. K. L. Bell, Y. Ephraim, and H. L. Van Trees, "A Bayesian Approach to Robust Adaptive Beamforming," *IEEE Trans. Sig. Proc.*, vol. 48, no. 2, pp. 386-398, Feb. 2000.
6. K. L. Bell, Y. Steinberg, Y. Ephraim, and H. L. Van Trees, "Extended Ziv-Zakai Lower Bound for Vector Parameter Estimation," *IEEE Trans. Info. Theory*, vol. 43, no. 2, pp. 624-637, March 1997.
7. K. L. Bell, Y. Ephraim, and H. L. Van Trees, "Explicit Ziv-Zakai Lower Bound for Bearing Estimation," *IEEE Trans. Sig. Proc.*, vol. 44, no. 11, pp. 2810-2824, Nov. 1996.

Conference Proceedings Papers

1. R. Jeffers, K. L. Bell, and H. L. Van Trees, "Broadband Passive Range Estimation using MUSIC," *2002 IEEE Intl. Conf. on Acoust., Speech, Sig. Proc. (ICASSP `02)*, vol. III, pp. 2921-2924, Orlando, FL, May 2002.
2. Z. Tian, K. L. Bell, and H. L. Van Trees, "Robust Measures for Decision Feedback Equalization in CDMA Systems," *IEEE GLOBECOM 2001*, vol. II, pp. 1361-1365, San Antonio, TX, Nov. 2001.
3. Z. Tian, H. L. Van Trees, "Beamspace MODE," *Proceedings of the 35th IEEE Asilomar Conference on Signals, Systems, and Computers*, Pacific Grove, CA, vol. 2, pp. 926-930, November 2001.
4. Z. Tian and K. L. Bell, "An Adaptive RLS Solution to the Optimal Minimum Power Filtering Problem With a Max/Min Formulation," *2001 IEEE Intl. Conf. on Acoust., Speech, Sig. Proc. (ICASSP `01)*, Salt Lake City, UT, vol. VI, pp. 3781-3784, May 2001.
5. Z. Tian, K. L. Bell, and H. L. Van Trees, "Space-Time Blind MOE Detection for DS-CDMA Wireless Systems," *34th Asilomar Conf. on Signals, Syst., and Computers*, Pacific Grove, CA, pp. 526-531, Oct. 2000.
6. R. E. Zarnich, K. L. Bell, and H. L. Van Trees, "A Sequential Extension of the Unified MAP Track Estimation Method," *First IEEE Sensor Array and Multichannel Signal Processing Workshop (SAM 2000)*, Cambridge, MA, pp. 97-101, March 2000.
7. Z. Tian, H. L. Van Trees, "Beamspace IQML," *Proceedings of the 1st IEEE Sensor Array and Multichannel Signal Processing Workshop* (*SAM'*2000), Cambridge, MA, pp. 361-364, March 2000.
8. K. L. Bell, H. L. Van Trees, and L. J. Griffiths, "Adaptive Beampattern Control Using Quadratic Constraints for Circular Array STAP," *8th Annual Workshop on Adaptive Sensor Array Processing (ASAP 2000)*, MIT Lincoln Lab, Lexington, MA, pp. 43-48, March 2000.
9. R. E. Zarnich, K. L. Bell, and H. L. Van Trees, "A Unified Method for Passive Measurement and Tracking of Contacts from an Array of Sensors," *8th Annual Workshop on Adaptive Sensor Array Processing (ASAP 2000)*, MIT Lincoln Lab, Lexington, MA, pp. 115-120, March 2000.
10. K. L. Bell and H. L. Van Trees, "Adaptive and Non-Adaptive Beampattern Control Using Quadratic Beampattern Constraints," *33rd Asilomar Conf. on Signals, Syst., and Computers*, Pacific Grove, CA, pp. 486-490, Oct. 1999.

11. Z. Tian, K. L. Bell, and H. L. Van Trees, "A Quadratically Constrained Decision Feedback Equalizer for DS-CDMA Communication Systems," *2nd IEEE Workshop on Signal Processing Advances in Wireless Communications (SPAWC `99)*, Annapolis, MD, pp. 190-193, May 1999.
12. Z. Tian, K. L. Bell, and H. L. Van Trees, "Quadratically Constrained RLS Filtering for Adaptive Beamforming and DS-CDMA Multi-User Detection," *7th Annual Workshop on Adaptive Sensor Array Processing (ASAP `99)*, MIT Lincoln Lab, Lexington, MA, pp. 51-56, March 1999.
13. Z. Tian, K. L. Bell, and H. L. Van Trees, "A Recursive Least Squares Implementation for Adaptive Beamforming Under Quadratic Constraint," *9th IEEE Workshop on Stat. Sig. and Array Processing (SSAP `98)*, Portland, OR, pp. 9-12, Sept. 1998.
14. K. L. Bell and H. L. Van Trees, "Robust Adaptive Beamforming for Spatially Spread Sources," *9th IEEE Workshop on Stat. Sig. and Array Processing (SSAP `98)*, Portland, OR, pp. 1-4, Sept. 1998.
15. Z. Tian and H. L. Van Trees, ``DOA Estimation with Hexagonal Arrays," *Proceedings of IEEE Intl. Conf. on Acoustics, Speech and Signal Processing* (*ICASSP'98*), Seattle, WA, vol. IV, pp. 2053-2056, May, 1998.
16. K. L. Bell, Y. Ephraim, and H. L. Van Trees, "Robust Adaptive Beamforming Using Data Dependent Constraints," *1997 IEEE Intl. Conf. on Acoust., Speech, Sig. Proc. (ICASSP `97)*, Munich, Germany, vol. V, pp. 3513-3516, April 1997.
17. K. L. Bell, Y. Ephraim, and H. L. Van Trees, "Robust Adaptive Beamforming Under Uncertainty in Source Direction-of-Arrival," *8th IEEE Workshop on Stat. Sig. and Array Processing (SSAP `96)*, Corfu, Greece, pp. 546-549, June 1996.
18. K. L. Bell, Y. Ephraim, and H. L. Van Trees, "Explicit Ziv-Zakai Lower Bound for Bearing Estimation," *1996 IEEE Intl. Conf. on Acoust., Speech, Sig. Proc. (ICASSP `96)*, Atlanta, GA, vol. V, pp. 2852-2855, May 1996.
19. K. L. Bell, Y. Ephraim, and H. L. Van Trees, "Ziv-Zakai Lower Bounds in Bearing Estimation," *1995 IEEE Intl. Conf. on Acoust., Speech, Sig. Proc. (ICASSP `95)*, Detroit, MI, vol. III, pp. 1649-1652, May 1995.
20. K. L. Bell, Y. Steinberg, Y. Ephraim, and H. L. Van Trees, "Improved Ziv-Zakai Lower Bound for Vector Parameter Estimation," *1994 IEEE-IMS Workshop on Info. Theory and Statistics*, Alexandria, VA, p. 75, October 1994.
21. K. L. Bell, Y. Ephraim, Y. Steinberg, and H. L. Van Trees, "Improved Bellini-Tartara Lower Bound for Parameter Estimation," *1994 Intl. Symp. on Info. Theory (ISIT `94)*, Trondheim, Norway, p. 117, June 1994.
22. K. L. Bell, Y. Ephraim, and H. L. Van Trees, "Comparison of the Chazan-Zakai-Ziv, Weiss-Weinstein, and Cramer-Rao Bounds for Bearing Estimation," *Conf. on Info. Sciences and Systems (CISS `93)*, Baltimore, MD, p. 675, March 1993.

Personal

Married to Diane Enright. Seven children and seventeen grandchildren.

Runner since 1969. Completed five Boston marathons.

Contact information

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