

IVAN EDWARD SUTHERLAND

Affiliation: Visiting Scientist, Portland State University

ACADEMIC DEGREES:

1959 - B.S.	Electrical Engineering Carnegie-Mellon University Pittsburgh, Pennsylvania
1960 - M.S.	Electrical Engineering California Institute of Technology Pasadena, California
1963 - Ph.D.	Electrical Engineering Massachusetts Institute of Technology Cambridge, Massachusetts
1966 - M.A. (Hon.)	Harvard University Cambridge, Massachusetts
1986 - D.Sc. (Hon.)	University of North Carolina Chapel Hill, North Carolina
2000 - Ph.D. (Hon.)	University of Utah Salt Lake City, Utah
2003 - Ph.D. (Hon.)	Carnegie Mellon University Pittsburgh, Pennsylvania

MAJOR RESEARCH INTERESTS:

Asynchronous systems, computer graphics, architecture of high-performance computing machinery, algorithms for rapid execution of special functions, large-scale integrated circuit design, robots.

EXPERIENCE:

2009 - present Visiting Scientist in ECE Department,
Co-Founder of the Asynchronous Research Center,
Maseeh College of Engineering and Computer Science,
Portland State University

2012 - present Consultant to US Gov't, Part time
ForrestHunt, Inc.

2009 - present Consultant, Part time
Oracle Laboratory

2005 - 2007 Visiting Scientist in CSEE Department
University of California, Berkeley

1991 - 2009 Vice President and Fellow
Sun Microsystems Laboratories

1980 - 1991 Vice President and Technical Director
Sutherland, Sproull, and Associates, Inc.
Independent Consultants
Purchased by Sun Microsystems to form Sun Microsystems Laboratory

1980 - 2008 Founder and General Partner,
Chairman of Board of Advisors
Advanced Technology Ventures

1985 - 1987 Visiting Professor
Imperial College, London

1980 - 1984 Visiting Scientist, Robotics Institute
Carnegie-Mellon University

1976 - 1980 Fletcher Jones Professor of Computer Science and
Founding Head, Department of Computer Science
California Institute of Technology

1975 - 1976 Senior Technical Staff Member
The RAND Corporation
Santa Monica, California

1974 Vice President and co-founder
Picture Design Group
Santa Monica, California

1968 - 1974 Vice President and Chief Scientist
Evans and Sutherland Computer Corporation
Salt Lake City, Utah

1968 - 1973 Associate Professor and Professor
Electrical Engineering Department
University of Utah

1966 - 1968	Associate Professor (with tenure) Division of Engineering and Applied Physics Harvard University
1964 - 1966	Director Information Processing Techniques Defense Advanced Research Projects Agency
1964	Instructor, Electrical Engineering University of Maryland
1963 - 1964	Electrical Engineer National Security Agency Fort Meade, Maryland
1963	Technical Operations Officer U.S. Army Liaison Group, Project MICHIGAN University of Michigan, Ypsilanti, Michigan

BOARDS AND COMMITTEES:

Public Companies:

Former Member, Board of Directors, Evans & Sutherland Computer Corporation
 Former Member: Board of Directors, Quotron Systems, Inc.
 Former Member: Board of Directors, Newmarket Venture Capital Ltd. (London)
 Former Member: Board of Directors, National Aviation and Technology Fund

Private Companies:

Former Member, Board of Advisors, Advanced Technology Ventures, (was Chairman)
 Former Member, Board of Directors, Thunderbird Technologies
 Former Member, Board of Directors, Tartan Laboratories
 Former Member, Board of Directors, Digit Wireless
 Former Member, Board of Directors, Interactive Systems
 Former Member, Board of Directors, Austek Ltd.

Government Committees:

High Performance Computing and Communications: Status of a Major Initiative,
 National Research Council, 1995
 Computer Science and Technology Board, Assembly of Mathematics and Physical Sciences,
 National Research Council, 1977 - 1980 and 1988 - 1993
 U, S, Defense Science Board, 1977 - 1984
 Executive Committee, Assembly of Engineering,
 National Research Council, 1975 - 1978
 Naval Research Advisory Committee, U.S. Department of the Navy, 1968 - 1975

PROFESSIONAL AND SCIENTIFIC SOCIETIES:

Member, National Academy of Engineering (since 1973)
 Member, National Academy of Sciences (since 1978)
 American Academy of Arts and Sciences
 Institute of Electrical and Electronic Engineers
 Fellow, Association for Computing Machinery
 Sigma Xi

HONORS AND AWARDS:

BBVA Foundation Frontiers of Knowledge Award in the Information and Communication Technologies category, for "pioneering the move from text-based to graphical computer displays," 2018

National Inventor's Hall of Fame, 2016

Founders Award, Proto Awards 2015, Virtual Reality Society

Kyoto Prize in Information Science, 2012

Fellow, Computer History Museum, 2008

Prize named in honor of Ivan Sutherland
University of Newcastle, UK, 2002

CAD/CAM Hall of Fame
Machine Design, 1998

IEEE John von Neuman Award, 1998

Software Industry Achievement Award
Massachusetts Software Council, 1996

Price Waterhouse Information Technology Leadership Award for Lifetime Achievement
Smithsonian Institution, 1996

Certificate of Merit
The Franklin Institute, 1996

First Distinguished Alumni Award, Electrical Engineering
Carnegie-Mellon University, 1994

Pioneer Award
Electronic Frontier Foundation, 1994

Software System Award for the "Sketchpad" system
Association for Computing Machinery, 1994

A.M. Turing Award for Pioneering and Visionary Work in Computer Graphics
Association for Computing Machinery, 1988

Emanuel R. Piore Award for Pioneering Work in Computer Graphics
Institute of Electrical and Electronic Engineers, 1986

Distinguished Alumni Award
California Institute of Technology, 1985

First Steven Anson Coons Award for Achievements in Computer Graphics
Association for Computing Machinery, SIGGRAPH, 1983

Award for Outstanding Accomplishment
Systems, Man & Cybernetics Society, 1975

First Zworykin Award
National Academy of Engineering, 1972

Prize Paper
Fall Joint Computer Conference, 1968

National Science Foundation Graduate Fellowship
Caltech and MIT, 1959-1962

George Westinghouse Full-Tuition Scholarship
Carnegie-Mellon University, 1955-1959

PATENTS (75):

- Ebergen, J.C., Jamadagni, N.P., Sutherland, I.E., 9,281,157, "Performing a division operation using a split division circuit," December 22, 2015.
- Sutherland, I.E., 9,182,782, "Synchronizing timing of communication between integrated circuits", November 10, 2015.
- Sutherland, I.E., 9,076,663, "Determining spacing using a spatially varying charge distribution", July 7, 2015.
- Chow, A., Drost, R.J., Ho, R., Hopkins, R.D., & Sutherland, I.E., 8,918,752, "Determining alignment using a spatially varying charge distribution", December 23, 2014.
- Drost, R., & Sutherland, I., 7,994,501, "Method and apparatus for electronically aligning capacitively coupled mini-bars," August 9, 2011.
- Forrest, C., Drost, R., Ho, R., & Sutherland, I., 7,786,427, "Proximity optical memory module having an electrical-to-optical and optical-to-electrical converter," August 31, 2010.
- Ebergen, J., Cohen, D., & Sutherland, I., 7,660,842, "Method and apparatus for performing a carry-save division operation," February 9, 2010.
- Ebergen, J., Schauer, J., Hopkins, D., & Sutherland, I., 7,636,361, Apparatus and method for high-throughput asynchronous communication with flow control, December 22, 2009.
- Tourancheau, B., Gouraud, H., Cohen, D., & Sutherland, I., 7,561,584, "Implementation of a graph property in a switching fabric for fast networking," July 14, 2009.
- Ebergen, J., Sutherland, I., & Drost, R., 7,417,993, "Apparatus and method for high-throughput asynchronous communication," August 26, 2008.
- Drost, R., Sutherland, I. & Coates, W, 7,384,804, "Method and apparatus for electronically aligning capacitively coupled mini-bars," June 10, 2008.
- Drost, R., Sutherland, I. & Ho, R., 7,200,830, "Enhanced electrically-aligned proximity communication," April 3, 2007.
- Ebergen, J., Sutherland, I. & Tourancheau, B., 7,064,583, "Arbiters with preferential enables for asynchronous circuits," June 20, 2006.
- Drost, R., Ho, R., & Sutherland, I., 7,046,017, "Full-wave rectifier for capacitance measurements," May 16, 2006.
- Sutherland, I., 7,020,779, "Secure, distributed e-mail system," March 28, 2006.
- Sutherland, I., 7,012,459, "Method and apparatus for regulating heat in an asynchronous system," March 14, 2006.
- Drost, R., Ho, R., & Sutherland, I., 7,026,867, "Floating input amplifier for capacitively coupled communication," April 11, 2006.
- Harris, D., Drost, R., & Sutherland, I., 6,995,039, "Method and apparatus for electrostatically aligning integrated circuits," February 7, 2006.
- Sutherland, I., Bosnyak, R., & Drost, R., 6,987,412, "Sense amplifying latch with low swing feedback," January 17, 2006.
- Drost, R., Ho, R., & Sutherland, I., 6,987,394, "Full-wave rectifier for capacitance measurements," January 17, 2006.
- Drost, R. & Sutherland, I., 6,925,411, "Method and apparatus for aligning semiconductor chips using an actively driven vernier," August 2, 2005.
- Sutherland, I., Drost, R., Lauterbach, G., & Davidson, H., 6,870,271, "Integrated circuit assembly module that supports capacitive communication between semiconductor dies," March 22, 2005.

Jones, I., & Sutherland, I., 6,847,247, "Jittery polyphase clock," January 25, 2005.

Drost, R. & Sutherland, I., 6,825,708, "Apparatus and method for an offset-correcting sense amplifier," November 30, 2004.

Drost, R., Sutherland, I. & Papadopoulos, G., 6,812,046, "Method and apparatus for electronically aligning capacitively coupled chip pads," November 2, 2004.

Sutherland, I. & Harris, D., 6,769,007, "Adder circuit with a regular structure," July 27, 2004.

Drost, R. & Sutherland, I., 6,753,726, "Apparatus and method for an offset-correcting sense amplifier," June 22, 2004.

Sutherland, I., Coates, W. & Jones, I., 6,741,616, "Switch fabric for asynchronously transferring data within a circuit," May 25, 2004.

Harris, D., Drost, R. & Sutherland, I., 6,710,436, "Method and apparatus for electrostatically aligning integrated circuits," March 23, 2004.

Harris, D., Drost, R. & Sutherland, I., 6,995,039, "Method and apparatus for electrostatically aligning integrated circuits," February 7, 2006.

Ebergen, J., Sutherland, I., Lexau, J. & Gainsley, J., 6,707,317, "Method and apparatus for asynchronously controlling domino logic gates," March 16, 2004.

Molnar, C.E., Jones, I. & Sutherland, I., 6,675,246, "Sharing arbiter," January 6, 2004.

Sutherland, I., & Ebergen, J., 6,629,301, "Determining transistor widths using the theory of logical effort," September 30, 2003.

Coates, W., Bosnyak, R. & Sutherland, I., 6,600,325, "Method and apparatus for probing an integrated circuit through capacitive coupling," July 29, 2003.

Sutherland, I., 6,559,531, "Face to face chips," May 6, 2003.

Sutherland, I., 6,500,696, "Face to face chip," December 31, 2002.

Clark, W.A., & Sutherland, I.E., 6,496,359, "Tile Array Computers," December 17, 2002.

Sutherland, I.E., Fairbanks, S., & Ebergen, J., 6,486,709, "Distributing Data to Multiple Destinations within an Asynchronous Circuit," November 26, 2002.

Fairbanks, S., & Sutherland, I.E., 6,456,136, "Method & Apparatus for Latching Data within a Digital System," September 24, 2002.

Sutherland, I.E., Fairbanks, S., & Ebergen, J., 6,420,907, "Method and Apparatus for Asynchronously Controlling State Information within a Circuit," July 16, 2002.

Sutherland, I.E., Coates, W.S., Molnar, C.E., & Sproull, R.F., 6,360,288, "Method and modules for control of pipelines carrying data using pipelines carrying control signals", March 19, 2002.

Sutherland, I.E., Fairbanks, S., & Ebergen, J., 6,356,117, "Asynchronously Controlling State Information within a Circuit," March 12, 2002.

Sutherland, I.E., Coates, W.S., & Molnar, C.E., 6,360,288, "Method and modules for control of pipelines carrying data using pipelines carrying control signals", March 19, 2002.

Reichlen, B. & Sutherland, I.E., 6,351,261, "System and method for a virtual reality system having a frame buffer that stores a plurality of view points that can be selected and viewed by the user", February 26, 2002.

Sutherland, I.E., 6,304,125, "Method for Generation and Distribution of Polyphase Clock Signals," October 16, 2001.

Sutherland, I.E., 6,188,262, "Polyphase Synchronous Clock Distribution System," February 13, 2002.

Sutherland, I.E., Molnar, C.E., Jones, I.W., Coates, W.S., & Lexau, J., 6,085,316, "Layered Counterflow Pipeline Processor with Anticipatory Control," July 4, 2000.

Molnar, C. E., Jones, I. W., & Sutherland, I. E., 6,072,805, "Observing Arbiter," June 6, 2000.

Sutherland, I. E., Coates, W.S., & Lexau, J.K., 5,955,898, "Selector and Decision Wait Using Pass Gate XOR," September 21, 1999.

Sutherland, I. E., Sproull, R.F., & Coates, W.S., 5,943,491, "Control Circuit of Mutual Exclusion Elements," August 24, 1999.

Sutherland, I.E., 5,861,762, "Inverse Toggle XOR and XNOR Circuit," January 19, 1999.

Sutherland, I.E., 5,838,939, "Multi-issue/Plural Counterflow Pipeline Processor," November 17, 1998.

Sutherland, I.E., & Tavrow, L.S., 5,805,838, "Fast Arbiter with Decision Storage," May 31, 1998.

Molnar, C.E., & Sutherland, I.E., 5,758,139, "Interlocked FIFO Control Circuits," May 26, 1998.

Sproull, R.F., & Sutherland, I.E., 5,748,539, "Recursive Multi-Channel Interface," May 5, 1998.

Sutherland, I.E., 5,742,182, "A Symmetric Selector Circuit for Events," April 21, 1998.

Molnar, C.E., Jones, I.A., & Sutherland, I.E., 5,713,025, "Asynchronous Arbiter Using Multiple Arbiter Elements to Enhance Speed," January 27, 1998.

Sutherland, I.E., 5,684,724, "Flashback Simulator," November 4, 1997.

Sutherland, I.E. & Molnar, C.E., 5,638,009, "Three Conductor Asynchronous Signaling," June 10, 1997.

Sproull, R.F. & Sutherland, I.E., 5,600,848, "Counterflow Pipeline Processor with Instructions Flowing in a First Direction and Instruction Results Flowing in the Reverse Direction," February 4, 1997.

Sutherland, I.E., 5,592,103, "System for Fast Switching of Time Critical Input Signals," January 7, 1997.

Molnar, C.M., Sutherland, I.E., Sproull, R.F. & Jones, I.W., 5,572,690, "Cascaded Multistage Counterflow Pipeline Processor for Carrying Distinct Data in Two Opposite Directions," November 5, 1996.

Sutherland, I.E., 5,567,110, "Robot Arm Structure," October 22, 1996.

Sutherland, I.E., 5,187,800, "Asynchronous Pipelined Data Processing System," February 16, 1993.

Sutherland, I.E., 4,900,218, "Robot Arm Structure," February 13, 1990.

Sutherland, I.E., 4,837,740, "Asynchronous First-In-First-Out Register Structure," June 6, 1989.

Sutherland, I.E., 4,679,213, "Asynchronous Queue System," July 7, 1987.

Sutherland, I.E., 4,622,992, "Reaction Control Valve," November 18, 1986.

Sutherland, I.E. & Seitz, C.L., 4,209,240, "Reticle Exposure Apparatus and Method," June 24, 1980.

Sutherland, I.E., 3,889,107, "System of Polygon Sorting by Dissection," June 10, 1975.

Sutherland, I.E. & Hodgman, G., 3,816,726, "A Computer Graphics Clipping System for Polygons," June 11, 1974.

Sutherland, I.E. & Evans, D., 3,732,557, "Incremental Position-Indicating System," May 8, 1973.

Sutherland, I.E., 3,684,876, "Vector Computing System as for Use in a Matrix Computer," August 15, 1972.

Sutherland, I.E., 3,639,736, "Display Windowing by Clipping," February 1, 1972.

Sutherland, I.E., 3,103,305, "Optical Systems for Retrieving Stored Information," April 21, 1964.

PUBLICATIONS (Asterisks identify more significant publications):

- Roncken, M., Sutherland, I., Esimai, E., "Micropipelines United," *A. Brown and A. Yakovlev (Eds.), We're Going to Need a Bigger Computer: Essays dedicated to Steve Furber, on the Occasion of his Retirement – At Last*, University of Manchester Print Unit, pages 66-81, January 2024.
- Sutherland, I., Morgan, Q., Hunt Jr, W., Ramanathan, V., Roncken, M., "An IEEE-compatible JTAG Test-Access-Port Controller for RSFQ Logic and Systems," *IEEE Transactions on Applied Superconductivity (TAS)*, Vol. 33, No. 5. August 2023.
- Roncken, M., Esimai, E., Ramanathan, V., Hunt Jr, W., Sutherland, I., "State Access for RSFQ Test and Analysis," *IEEE Transactions on Applied Superconductivity (TAS)*, Vol. 33, No. 5. August 2023.
- *Roncken, M., and Sutherland, I., "Design and Test of High-Speed Asynchronous Circuits," *J. Di and S. Smith (Eds.), Asynchronous Circuit Applications, Chapter 7*, The Institute of Engineering and Technology (IET), London, UK, pp. 113–171, 2020.
- Mettala Gilla, S., Roncken, M., Sutherland, I., Song, X., "Mutual Exclusion Sizing for Hoi Polloi," *IEEE Transactions on Circuits and Systems II: Express Briefs (TCAS-II)*, Vol. 66, No. 6, pages 1038-1042, June 2019.
- Chau, C., Hunt Jr, W., Kaufmann, M., Roncken, M., Sutherland, I., "A Hierarchical Approach to Self-Timed Circuit Verification," *Proc. IEEE International Symposium on Asynchronous Circuits and Systems (ASYNC)*, pages 105-113, 2019.
- Roncken, M., Sutherland, I., Chen, C., Hei, Y., Hunt Jr, W., Chau, C., Mettala Gilla, S., Park, H., Song, X., He, A., and Chen, H., "How to Think about Self-Timed Systems," *Proc. Asilomar Conference on Signals, Systems, and Computers*, pages 1597-1604, 2017.
- Chau, C., Hunt Jr, W., Roncken, M., Sutherland, I., "A Framework for Asynchronous Circuit Modeling and Verification in ACL2," *O. Strichman and R. Tzoref-Brill (Eds.), Proc. Haifa Verification Conference (HVC), Springer International Publishing, LNCS 10629*, pages 3-18, 2017.
- Roncken, M., Cowan, C., Massey, B., Mettala Gilla, S., Park, H., Daasch, R., He, A., Hei, Y., Hunt Jr, W., Song, X., and Sutherland, I., "Beyond Carrying Coal to Newcastle: Dual Citizen Circuits," *A. Mokhov (Ed.), This Asynchronous World - Essays dedicated to Alex Yakovlev on the occasion of his 60th birthday*, Newcastle University, 2016.
- Park, H., He, A., Roncken, M., Song, X., and Sutherland, I., "Modular Timing Constraints for Delay-Insensitive Systems," *Journal of Computer Science and Technology (JCST)*, Volume 31, Number 1, pages 77-106, January 2016.
- *Roncken, M., Mettala Gilla, S., Park, H., Jamadagni, N., Cowan, C., Sutherland, I., "Naturalized Communication and Testing," In *Proc. Asynchronous Circuits and Systems (ASYNC) 2015*.
- *Sutherland, I., "The Tyranny of the Clock," *Communications of the ACM*, Vol 55, No. 10, October 2012, pp. 35-36.
- Sutherland, I., "The Sequential Prison," *Proceedings of the 2011 ACM international conference on Object oriented programming systems languages and applications*, OOPSLA 2011.
- Mettala Gilla, S., Roncken, M., Sutherland, I., "Long- Range GasP with Charge Relaxation." In *Proc. Asynchronous Circuits and Systems (ASYNC)*, pages 185–195, 2010.
- Joshi, P., Beerel, P., Roncken, M., Sutherland I., "Timing Verification of GasP Asynchronous Circuits: Predicted Delay Variations Observed by Experiment," *D. Dams, U. Hannemann, M. Steffen (Eds.), Willem-Paul de Roever Festschrift, LNCS 5930*, pp. 260–276, Springer-Verlag, 2010.
- *Drost, R., Hopkins, D., Ho, R., Sutherland, I.E., "Proximity Communication," *IEEE JSSC*, pp 1529-1535, Vol 39, No 9, September 2004.

- Drost, R., Ho, R., Hopkins, D., Sutherland, I., "Electronic Alignment for Proximity Communication", *IEEE ISSCC 2004*.
- Drost, R., Hopkins, D., Sutherland, I., "Proximity Communications", *IEEE 2003 Custom Integrated Circuits Conference*, p469-472.
- *Sutherland, I., & Ebergen, J., "Computers without Clocks," *Scientific American*, Vol. 287, No. 2, August 2002, pp. 62-69.
- *Sutherland, I., & Fairbanks, S., "GasP: A Minimal FIFO Control," *Proceedings of the Seventh International Symposium on Advanced Research in Asynchronous Circuits and Systems (ASYNC 2001)*, April 2001.
- Sutherland, I., & Lexau, J., "Designing Fast Asynchronous Circuits," *Proceedings of the Seventh International Symposium on Advanced Research in Asynchronous Circuits and Systems (ASYNC 2001)*, April 2001.
- Coates, W., Lexau, J., Jones, I., Fairbanks, S., & Sutherland, I., "*FLEETzero*: An Asynchronous Switching Experiment," *Proceedings of the Seventh International Symposium on Advanced Research in Asynchronous Circuits and Systems (ASYNC 2001)*, April 2001.
- *Sutherland, I., Sproull, R., Harris, D., Logical Effort, Morgan Kaufman, ISBN 1-55860-557-6, 1999.
- Molnar, C., Jones, I., Coates, W., Lexau, J., Fairbanks, S., & Sutherland, I., "Two FIFO Ring Performance Experiments," *Proceedings of the IEEE Special Issue on Asynchronous Circuits and Systems*, February 1999.
- Ebergen, J., Fairbanks, S., & Sutherland, I., "Predicting Performance of Micropipelines Using Charlie Diagrams," *Proceedings of the Fourth International Symposium on Advanced Research in Asynchronous Circuits and Systems (ASYNC98)*, March-April 1998.
- Coates, W., Lexau, J., Jones, I., Fairbanks, S., and Sutherland, I., "A FIFO Data Switch Experiment," *Proceedings of the Fourth International Symposium on Advanced Research in Asynchronous Circuits and Systems (ASYNC98)*, March-April 1998.
- Brooks, F. and Sutherland, I., Evolving the High Performance Computing and Communications Initiative to Support the Nation's Information Infrastructure, Computer Science and Telecommunications Board, National Research Council, 1995.
- Sutherland, I., A View of the Task You Face, Perspectives #2, Sun Microsystems Laboratories, 1997.
- *Sutherland, I., Technology and Courage, Perspectives #1, Sun Microsystems Laboratories. Reprinted in 1996 from *CMU Computer Science 25th Anniversary Commemorative*, 1991.
- Sproull, R.F., Sutherland, I., and Molnar, C.E., "The Counterflow Pipeline Architecture," Technical Report Series TR-25, Sun Microsystems, Fall 1994.
- Sproull, R.F., Sutherland, I., and Molnar, C.E., "The Counterflow Pipeline Architecture," *Design and Test of Computers*, IEEE, Fall 1994.
- Sproull, R.F., and Sutherland, I., "A Comparison of Codebook Generation Techniques for Vector Quantization," *Proceedings of the Data Compression Conference*, 1992.
- Sproull, R.F., and Sutherland, I.E., "Logical Effort: Designing for Speed on the Back of an Envelope," IEEE Advanced Research in VLSI, C. Sequin, ed., MIT Press, 1991.
- *Sutherland, I., "Technology and Courage," CMU Computer Science: A 25th Anniversary Commemorative, R.F. Rashid, ed., ACM Press, 1991. Reprinted as Perspectives #1 by Sun Microsystems Laboratories.
- Sproull, R., and Sutherland, I., Asynchronous Systems, Course Notes, 1990.
- Sutherland, I., and Sproull, R., A Theory of Logical Effort, Course Notes, 1990 (see 1999 book).
- *Sutherland, I., "Micropipelines," *Communications of the ACM*, June 1989.

- Sutherland, I., and Ullner, M.K., "Footprints in the Asphalt," *The International Journal of Robotics Research*, Vol. 3, No. 2, Summer 1984, MIT Press.
- *Raibert, M., and Sutherland, I., "Machines That Walk," *Scientific American*, January 1983, pp. 44-53.
- Sutherland, I., and Carlson, F., A Walking Robot. The Marcian Chronicles, Inc., Pittsburgh, PA, 1983.
- Sproull, R., Sutherland, I., Thompson, A., Gupta, S., and Minter, C. "The 8 by 8 Display," *ACM Transactions on Graphics*, Vol. 2, No. 1, January 1983, pp. 32-52.
- Feldman, J., Sutherland, W., Bell, G., Galler, B., Goldberg, P., Hamblen, J., Pinson, E., and Sutherland, I., "Rejuvenating Experimental Computer Science," *Communications of the ACM*, September 1979, Vol. 22, No. 9, pp. 497-502.
- *Sutherland, I., and Mead, C., "Microelectronics and Computer Science," *Scientific American*, September 1977, pp. 210-228.
- *Sutherland, I., and Mead, C., and Everhart, T.E., "Basic Limitations in Microcircuit Fabrication Technology," RAND Report R-1956-ARPA, November 1976.
- Sutherland, I., "Structure in Drawings," in Nicholas Negroponte (Ed.), Computer Aids to Design and Architecture, New York: Petrocelli/Charter, 1975.
- Sutherland, I., "Hidden-Surface Problem," In Nicholas Negroponte (Ed.), Computer Aids to Design and Architecture, New York: Petrocelli/Charter, 1975.
- *Sutherland, I.E., "Computerized Commerce," The RAND Corporation, P5515, September 1975, acceptance address for the 1975 Award for Outstanding Accomplishment of the Systems, Man, and Cybernetics Society, San Francisco, California, September 23, 1975.
- *Sutherland, I., Sproull, R.F., and Schumacker, R., "A Characterization of Ten Hidden-Surface Algorithms," *Computing Surveys: Journal of the ACM*, March 1974. Summarized in Naval Research Reviews, June 1975, pp. 21-23.
- Kajiya, J., Sutherland, I., and Cheadle, E., "A Random-Access Video Frame Buffer," *Proceedings of the Conference on Computer Graphics, Pattern Recognition, and Data Structure*, UCLA Extension, Los Angeles, California, May 14-16, 1975.
- Burton, R., and Sutherland, I., "Twinkle Box: Three-Dimensional Computer-Input Devices," *Proceedings of the National Computer Conference*, Chicago, Illinois, May 1974.
- Sutherland, I., "Three-Dimensional Data Input by Tablet," *Special Issue of the Proceedings of the IEEE on Computer Graphics*, April 1974.
- Sutherland, I., and Hodgman, G., "Reentrant Polygon Clipping," *Communications of the ACM*, January 1974.
- *Sutherland, I., and Oestreicher, D., "How Big Should a Printed Circuit Board Be?," *IEEE Transactions of Computers*, Vol. C-22, May 1973, pp. 537-542.
- Sutherland, I., and Gouraud, H., "Les Images Electroniques," *La Recherche*, December 1972, Vol. 3, pp. 1055-1061.
- Greenfield, H., Vickers, D., Sutherland, I., Kolff, W., and Reemtsa, K., "Moving Computer Graphics Images Seen from Inside the Vascular System," *Transactions of the American Society Artificial Internal Organs*, Vol. 17, 1971, pp. 381-385.
- Sutherland, I., "Windows into Alice's Wonderland," *IEEE Student Journal*, September 1970, pp. 36-41.
- *Sutherland, I., "Computer Displays," *Scientific American*, Vol. 222, No. 6, June 1970, pp. 56-81.
- Sutherland, I., "Terminal Aspects," *Proceedings of the Interdisciplinary Conference on Multiple Access Computer Networks*, University of Texas at Austin and the Mitre Corporation, April 1970, pp. 511-514.

- Sutherland, I., "Future Trends in Computer-Aided Design," *Proceedings of the Society for Information Display*, Vol. 11-2 Second Quarter, 1970, pp. 49-51.
- Sutherland, I., "A Method of Solving Arbitrary Wall Mazes by Computers," *IEEE Transactions on Computers*, Vol. C-18, No. 12, December 1969, pp. 1092-1097.
- Land, R., Sutherland, I., "Real-Time Color, Stereo Computer Display," *Applied Optics*, Vol. 8, No. 3, March 1969, pp. 721-723.
- Sutherland, I., "Perspective Views that Change in Real Time," *Proceedings of the 8th Meeting — UAIDE*, 1969, Coronado, California, pp. 299-310.
- Myer, T., Sutherland, I., Vosbury, M.K., and Watson, R.W., "A Display Processor Design," *Proceedings of the AFIPS Conference*, Vol. 35, 1969, pp. 209-217.
- Sutherland, I.E., "Pictures [sic] Languages," *Estratto da Linguaggi Nella Societa e Nella Technica*, Milano, 1968, pp. 423-431.
- *Sutherland, I.E., "A Head-Mounted Three-Dimensional Display," *AFIPS Conference Proceedings*, Vol. 33, Part I, 1968, pp. 757-764.
- Sproull, R.F., and Sutherland, I.E., "A Clipping Divider," *AFIPS Conference Proceedings*, Vol. 33, Part I, 1968, p. 765-776.
- Sutherland, I., "Facilitating the Man-Machine Interface," *Purposive Systems: Proceedings of the First Annual Symposium of the American Society for Cybernetics*, Heinz Von Foester, J. White, L. Peterson, and J. Russell, eds., Spartan Books, 1968, pp. 127-140.
- Sutherland, I., "A Futures Market in Computer Time," *Communications of the ACM*, June 1968, Vol. 11, No. 6, pp. 449-451.
- *Myer, T., and Sutherland, I., "On the Design of Display Processors," *Communications of the ACM*, June 1968, Vol. 11, No. 6, pp. 410-414.
- Ball, N., Foster, H.Q., Long, W., Sutherland, I., and Wigington, P., "A Shared Memory Computer Display System," *IEEE Transactions on Electronic Computers*, October 1966.
- Sutherland, I., "Computer Inputs and Outputs," *Scientific American*, September 1966.
- *Sutherland, I., "Ten Unsolved Problems in Computer Graphics," *Datamation*, May 1966, Vol. 12, No. 5, pp. 22-27.
- Sutherland, I., "The Ultimate Display," *Proceedings of IFIPS Congress 1965*, New York, New York, May 1965, Vol. 2, pp. 506-508.
- Sutherland, I., "The Future of On-Line Systems," *Proceedings of the Symposium Sponsored by the University of California at Los Angeles and Informatics, Inc.*, Los Angeles, California, February 1965.
- *Sutherland, I., "Sketchpad — A Man-Machine Graphical Communication System," *Proceedings of the Spring Joint Computer Conference*, Detroit, Michigan, May 1963, and MIT Lincoln Laboratory Technical Report #296, January 1963.)
- Sutherland, I., "Stability in Steering Control," *Electrical Engineering*, April 1960.
- Sutherland, I., "Parallels — Men and Machines," *American Institute of Electrical Engineers*, Prize Paper, March 1959.
- Sutherland, W., Mugglin, M., and Sutherland, I., "An Electro-Mechanical Model of Simple Animals," *Computers and Automation*, February 1958.
- Feigenbaum, E., and Sutherland, I., "Age of the Great Brains," *Carnegie Technical*, December 1956.

BIOGRAPHY

Dr. Ivan E. Sutherland carries the title Visiting Scientist at Portland State University where he and his wife, Marly Roncken, established the Asynchronous Research Center (ARC) in 2008. Both Ivan and Marly now devote full time to research and teaching at the ARC, working with a few graduate students. Before moving to Portland, Ivan spent over 20 years working at Sun Microsystems as a Vice President and Fellow, Sun's highest technical grade.

In 1980 Dr. Sutherland incorporated, with Bob Sproull, a small consulting company called Sutherland, Sproull, and Associates (SSA). Sun acquired SSA in 1990 to form the nucleus of its new research laboratory. Also in 1980, with different partners, Dr. Sutherland started the venture capital partnership called Advanced Technology Ventures (ATV). ATV continues an active investment program although Ivan has now retired from active participation.

From 1976 to 1980, Dr. Sutherland was the Fletcher Jones Professor of Computer Science at Caltech serving as head of Computer Science. The pioneering work of the Caltech group helped fuel the silicon revolution by giving academia worldwide the confidence and the tools to teach integrated circuit design.

In 1968, Dr. Sutherland founded the Evans and Sutherland Computer Corporation (E&S) with Dr. David Evans in Salt Lake City. E&S grew to be a \$200 million per year firm manufacturing high performance computer graphics equipment. Dr. Sutherland served as Vice President and Chief Scientist for E&S for six years but remained as a member of its Board of Directors for 35 years until he reached age 65. Both Drs. Sutherland and Evans also taught at the University of Utah, and between the company and the University, made Salt Lake City the premier center for computer graphics. A key publication of the period, "A Characterization of Ten Hidden Surface Algorithms," by Sutherland, Sproull, and Schumacker, offered a taxonomy of the then current research in computer graphics.

Dr. Sutherland had been an Associate Professor (with tenure) of Computer Science on the Gordon McKay endowment at Harvard prior to founding Evans and Sutherland. His head-mounted display research at Harvard led to early use of dynamic three-dimensional computer graphics, demonstrating what is now known as "virtual reality." Bob Sproull, later co-founder of SSA, participated in the Harvard work as young student. Bob and Ivan formed a friendship and association during that period that carries on today.

Dr. Sutherland went to Harvard from the Defense Advanced Research Projects Agency (DARPA), where he had spent two years as Director of the Information Processing Techniques Office. In that capacity Dr. Sutherland was responsible for funding much of the US academic research in advanced computing. His contracts included Project MAC at MIT, the Illiac IV project, and major programs led by AI Perlis at Carnegie-Mellon University and David Evans at the University of California at Berkeley and Wesley Clark at Washington University, Saint Louis.

Dr. Sutherland has always maintained an active research program of his own. In the early 80's he built a six-legged hydraulic walking machine featured on the cover of the January 1983 issue of Scientific American. His research program at Sun, which he continues at the ARC, involves design techniques for asynchronous digital systems. His book, "A Theory of Logical Effort" resulted from this work. The asynchronous design style was the subject of Dr. Sutherland's influential 1988 ACM Turing Award Lecture, "Micropipelines," published in the June 1989 issue of *Communications of the ACM*. It was also the subject of his remarks at the 2012 Turing Centenary celebration of the ACM.

Dr. Sutherland received a Ph.D. degree from MIT in 1963, following an MS from Caltech and a BS degree from Carnegie Tech, all in Electrical Engineering. He holds honorary degrees from Harvard, Caltech, the University of North Carolina, the University of Utah, and Carnegie Mellon University. Dr. Sutherland is a member of both the National Academy of Sciences and the National Academy of Engineering. Dr. Sutherland is the 1988 recipient of the Turing award, the highest award given by the Association of Computing Machinery. In 1998 he received the John Von Neumann Medal from the IEEE. Dr. Sutherland is the 2012 recipient of the Kyoto Prize in Advanced Technology. Dr. Sutherland is author of two books, over 70 patents, as well as numerous publications and lectures. Ivan and his wife, Marly Roncken, make their home in Portland, Oregon. Ivan says, "I'm planning not to retire."